Energy Impact Evaluation of the Personalized Energy Report® Program in the Carolinas

Final Report

Prepared for
Duke Energy

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Executive Summary

Key Findings and Recommendations

This section presents the key findings and recommendations identified through this evaluation. Table 1 presents the estimated overall impacts of both the Personalized Energy Report (PER) and the online version (OHEC).

Table 1: Estimated Overall Impacts from Billing Analysis

	Gross Savings	Net Savings
Per Participant Annual Savings		
kW	0.041	0.035
kWh	378	321
Therms	0.152	0.129

The kWh impacts in this table are from the statistical analysis of participants' monthly electricity billing data. Since the billing data cannot provide estimates of either demand (kW) or gas (therms) savings as well as the net to gross ratio, these impact estimates were based upon the engineering analysis impacts, adjusted by the ratio of the overall kWh savings between the billing analysis and the engineering analysis (0.85%). The engineering analysis also provides insight into impacts by measures (the billing analysis only produces an overall number). Therefore, while the overall result is driven by the billing analysis, an engineering analysis is required as well, so both approaches will be discussed in the report.

Significant Impact Evaluation Findings

- Both the written and online aspects of the program result in statistically significant savings.
- The online survey results in significantly higher savings than the paper version, confirming that online survey takers have higher installation rates than participants who filled out the paper survey.
- The billing data results for the both the paper and online components are larger than the engineering estimate, which may be due to differences between the survey sample and the population on recommended measure uptake. However, for PER®, the confidence interval about the estimate from the billing analysis contains the engineering estimate, so the observed difference between them is not statistically significant.
- CFLs make up 94% of total program savings.
- On average, the 13-watt CFL replaced a 59-watt load; the 20-watt CFL replaced a 73-watt load.

Free Ridership and Spillover

Free ridership was calculated for CFLs distributed to customers who filled out a Personalized Energy Report® survey. The level of free ridership was determined by using the responses to two questions in the survey (found in Appendix B: Participant Survey Instrument). Respondents were asked if they had any CFLs installed in their home prior to completing the Personalized Energy Report® survey, and, if so, how many. The amount of pre-installed CFLs determined the level of free ridership applied to energy savings according to Table 2 below.

Table 2. Free Ridership Factors for Energy Efficiency Kit CFLs

Did you have any CFLs installed before you completed your PER® survey?	If yes, how many?	% Free Ridership
No	n/a	0%
Yes	1 to 3	0%
	4 to 6	25%
	7 to 9	50%
	10 to 12	75%
	More than 12	100%

The percentages of survey respondents in each range of free ridership for pre-installed CFLs are presented in Figure 1 below. These percentages multiplied by the free ridership levels are then presented in Table 3 to arrive at the unadjusted free ridership for CFLs in the Personalized Energy Report® programs. These numbers amount to an unadjusted free ridership of 17.0% in North Carolina and 13.4% percent in South Carolina. There are total of 113 responses in North Carolina and 52 responses in South Carolina for these questions, therefore the weighted average of these percentages gives an unadjusted system freeridership of 15.9% for the Carolinas.

Level of Discounting for Biases

The self-selection bias discount factor for all measures for PER is 29.9%. This is also the full discount for all recommendations. The false response bias discount factor, applied only to CFLs, is 17%. The total discount to CFLs, including freeridership, is then 50.7%. The combined program-wide freeridership and bias adjustment for the engineering estimates is 44.5%. The billing analysis is free of these biases and uses only the 15.9% freeridership adjustment applied only to CFLs. The program-wide adjustment for the billing analysis is 15%. Detailed tables can be seen in Appendix F: DSMore Table.

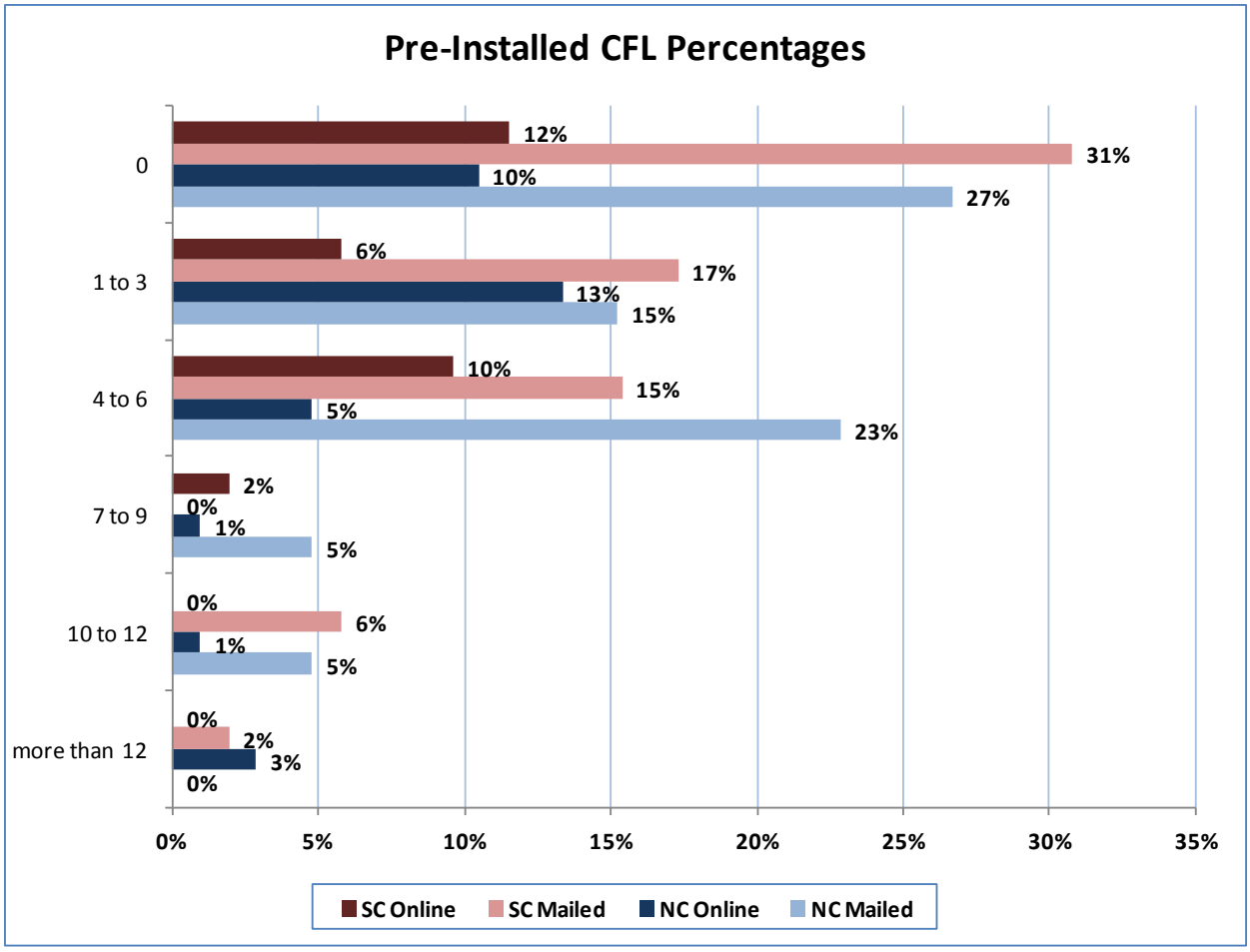

Figure 1. Percentage of Respondents by number of CFLs pre-installed

Table 3. Free Ridership in North and South Carolina

State	Type	Pre-installed CFL range	Percentage in range	Free ridership Level	Free ridership
NC	Mailed	0 to 3	41.9%	0	0%
		4 to 6	22.9%	25	5.7%
		7 to 9	4.8%	50	2.4%
		10 to 12	4.8%	75	3.6%
		More than 12	0%	100	0%
	Online	0 to 3	23.8%	0	0%
		4 to 6	4.8%	25	1.2%
		7 to 9	1.0%	50	0.5%
		10 to 12	1.0%	75	0.7%
		More than 12	2.9%	100	2.9%
Sum of NC Free Ridership					**17.0%**
SC	Mailed	0 to 3	48.1%	0	0%
		4 to 6	15.4%	25	3.8%
		7 to 9	0%	50	0%
		10 to 12	5.8%	75	4.3%
		More than 12	1.9%	100	1.9%
	Online	0 to 3	17.3%	0	0%
		4 to 6	9.6%	25	2.4%

		7 to 9	1.9%	50	1.0%
		10 to 12	0%	75	0%
		More than 12	0%	100	0%
Sum of SC Free Ridership					**13.4%**

Impact Estimates for Personalized Energy Report® Recommendations

The participants of the Personalized Energy Report® Program each received a customized report with specific recommendations for improvements to their home that would increase their home's energy efficiency. In this report, we present the recommendations as they were reported to us by the random sample of 157 participants contacted during the telephone survey. We first asked them what, if any, improvements they had made to their home. We then ask if this was a recommendation that was in the Personalized Energy Report® (PER®). If they said yes (it was in the Personalized Energy Report®), we ask how influential the recommendation in the report was to their decision to install the item on a scale of 1 to 10.

Savings were calculated using engineering algorithms that can be found in Appendix C: Impact Algorithms. Self-selection bias and false response bias are then factored in to calculate the final estimated net impact for engineering estimates only.

Recommendations

- As part of ongoing research related to program marketing effectiveness, Duke Energy has been exploring whether some programs are gateways that potentiate other offers. Research on follow on offer uptake for PER® indicates that customers that first participate in PER® are approximately twice as likely to respond to an offer to participate in Power Manager® as compared to those that did not first participate in PER®. The reverse correlation does appear strong. This suggests that customers participating in PER® should be offered additional opportunities to participate. Perhaps especially in simple offers like Power Manager®. Duke Energy's research on this type of offer progression focuses on the 2009 period, as eventually the universe of participants that *first* received PER® and *then* a Power Manager® offer is reduced, as the total number of Power Manager® offers mailed increases over time. It may be that the ability to migrate customers through programming experiences, e.g. PER® to Power Manager® could drive additional value for Duke Energy, by keeping customers engaged and continuing to offer relevant programming. It may be that engagement programming like PER® drives additional dividends beyond the measurement year. Here for example follow on Demand Response program offer uptake was described. In light of the need to find new ways to get more participation to meet ramping goals, Duke Energy should consider exploring whether this gateway effect exists for other programming types.

Introduction and Purpose of Study

Summary Overview

This document presents the evaluation report for Duke Energy's Personalized Energy Report® (PER®) Program as it was administered in the Carolinas.

Summary of the Evaluation

This document presents the evaluation report for Duke Energy's PER® Program as it was administered in the Carolinas. The evaluation was conducted by TecMarket Works, Integral Analytics, and BuildingMetrics.

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This document presents the evaluation report for Duke Energy's PER® and OHEC programs as they were administered in North and South Carolina. These customers received the PER® offer by mail, and either returned the paper PER® survey, or completed the OHEC survey online as directed in the cover letter. See Appendix E for PER Channel Process. An impact analysis was performed for 6 packs of CFLs and for the measures that were installed as a result of the PER® and OHEC's recommendations. The impacts are based on engineering analysis of the impacts associated with the self-reported measure installs identified through a participant survey. To increase the reliability of the study findings, additional confirmative analysis was performed using a billing analysis comparing the pre and post program energy consumption levels of program participants.

This report is structured to provide program energy savings impact estimations per measure via the engineering analysis, and program savings based on the billing analysis results. The impact tables reporting total savings are based on the savings identified from 157 surveyed participants extrapolated to the program's total participants. The study includes participants from August 2009 through August of 2010.

	NC	SC
Completed Online Survey	35	15
Completed Mail Survey	70	37

This impact evaluation of the 6-pack of CFLs is based on surveys conducted with customers who participated in the Personalized Energy Report® program and who have received the kits mailed by the program. The impact of the Personalized Energy Report® recommendations that were implemented is based on survey responses of the actions they have taken that, according to the customer, were at least in part caused by the PER® report. The impact analysis conducted for this study was systematically adjusted downward to account for self-selection bias and potential false response bias sometimes associated with survey research of socially acceptable behaviors documented via telephone surveys. As a result, the evaluation consultants consider this study a reasonable estimate of program-induced savings.

Description of Program

The Personalized Energy Report® (PER®) (referred to from here forward as the Personalized Energy Report® or PER®) is a customized energy report offered to Duke Energy's residential customers to help them identify ways to save energy in their homes. The Personalized Energy Report® is offered both via mail and via Duke Energy's website. (The online version of the program will be referred to from here forward as the Online Audit.) The online version is identical in content to the mailed Personalized Energy Report® and has the benefit of being accessible to Duke Energy's customer service representatives. The mailed Personalized Energy Report® includes a cover letter that informs customers of the availability of the OHEC if they wish to respond online. Customers channeled from the Personalized Energy Report® to OHEC are given a tracking code to use if they wish to respond online.

Through both the mailed version and online versions of the program, customers complete a survey about their home and energy use, and in return receive the customized energy report. As an incentive for participating in the PER® and OHEC programs, customers are also offered a free package of 6 CFLs. The PER®/OHEC participation survey can be found in Appendix A: Personalized Energy Report® Paper Survey.

Program Participation

Engineering Estimates

The results from 157 surveyed participants are extrapolated to a total of 54,492 program Participants from August 2009 through August of 2010.

Billing Analysis

The results from the billing analysis are the result of the entire population of participants with usable billing data in Ohio, North and South Carolina, and Kentucky.[1]

[1] Including all the data from all the states into a regression equation increases the number of data points, which in turn makes increases the efficiency of the estimated savings as well as the statistical precision of all estimated coefficients.

Methodology

Overview of the Evaluation Approach

This impact evaluation has two components: billing analysis and engineering estimates.

Study Methodology

Engineering Estimates

A combination of engineering algorithms and building energy simulations were used. The engineering algorithms were used to estimate savings from lighting measures. Building energy simulations models of prototypical residential buildings were used to develop unit energy and demand savings estimates for building shell and HVAC measures. These unit energy savings values were applied to customers in the engineering analysis sample.

Billing Analysis

Program tracking data was used to pull billing data from all participants in Ohio, North and South Carolina, and Kentucky. The billing data was combined with information on participation date and whether the customer completed the mail or online version. This was in turn linked to weather data (temperature) to form the dataset used in the regression analysis.

Data collection methods, sample sizes, and sampling methodology

Engineering Estimates

TecMarket Works and Building Metrics developed a customer survey for the Personalized Energy Report® (PER®) Program participants to be implemented after they have had time to install at least some of the CFLs in the kit and to follow the recommendations offered.

A telephone survey was conducted with a random sample of 157 Personalized Energy Report® program participants. These participants were surveyed by phone by TecMarket Works. To help focus the survey, the questions asked were based on key results of an earlier study employing an identical approach for similar measures. The experience from the previous study for the Personalized Energy Report® program allowed this study to use those questions that were most informative to the energy impact estimation process and eliminate those questions that were found to have little impact on the results of the energy savings calculations. This allowed the Personalized Energy Report® survey to be shorter and more focused, yet still provide the information needed to estimate savings. The survey can be found in Appendix B: Participant Survey Instrument.

	North Carolina	South Carolina
Participants		
Mail	32,370	10,042
Online	9,430	2,650
Surveyed		
Mail	70	37
Online	35	15

Billing Analysis

The results from the billing analysis represent the entire population of participants with usable billing data, so no sample design was necessary.

Number of completes and sample disposition for each data collection effort

Engineering Estimates

Phone surveys were conducted with a random sample of participants. Data were collected from a total of 157 program participants. Energy savings achieved as a result of self-installations were attributed to the program if it was indicated that the improvement was suggested by the home energy report provided to the customer through the program.

Billing Analysis

Program tracking data was used to pull billing data from all participants in all states. The billing data was combined with information on participation date and whether the customer completed the mail or online version. This was in turn linked to weather data (temperature) to form the dataset used in the regression analysis.

Expected and achieved precision

Engineering Estimates

Engineering Estimates rely on participant survey responses. Sampling procedures for the participant survey had an expected and achieved precision of 90% ± 10%.

Billing Analysis

All savings estimates from the billing analysis were statistically significant at the 95% confidence level.

Description of baseline assumptions, methods and data sources

Engineering Estimates

Baseline assumptions for CFLs were taken from the draft Ohio TRM. Impact analysis for the recommendations is based on DOE-2.2 simulations of a set of prototypical residential buildings. Building shell measure baselines were selected based on typical construction practices by building vintage, using data from the US EIA Residential Energy Consumption Survey (RECS). HVAC baselines assumed normal end-of life replacement of the HVAC system, and used Federal appliance standards (NAECA) to establish the baseline efficiency.

Description of measures and selection of methods by measure(s) or market(s)

Engineering Estimates

The measures and methods are shown below. All customers are in the residential market.

Measure	Method
CFLs	Draft Ohio TRM
Double Pane Windows	DOE-2.2 simulation
14 SEER Central AC	DOE-2.2 simulation
Energy Star Doors	DOE-2.2 simulation

Billing Analysis

The billing analysis computed the overall savings associated with the program. There was no measure-level investigation.

Threats to validity, sources of bias and how those were addressed

Engineering Estimates

Customers were sampled at random for the survey and subsequent engineering analysis. Measure adoptions were self-reported by the customer. There is a potential for self response bias, but the customer has no vested interest in the reported measure adoptions, so this bias is expected to be minimal. There is a potential for bias in the engineering algorithms, which was minimized through the use of building energy simulation models, which are considered to be state of the art for building shell and HVAC system analysis.

Billing Analysis

The specification of the model used in the billing analysis was designed specifically to avoid the potential of omitted variable bias by including monthly variables that capture any non-program effects that affect energy usage. The model did not correct for self-selection bias because there is no reason to as long as the program remains voluntary.

Spillover & Persistence

Both persistence and technical degradation are included in the calculation of each measure's effective useful life shown in Appendix F: DSMore Table. For this evaluation, over this evaluation period, spillover, if it has occurred, is not expected to make enough of an impact to be a measureable component. For that reason, it was not assessed and the estimated savings is not adjusted to account for spillover.

Engineering Estimates

The Personalized Energy Report® provides a six pack of CFLs and a list of energy-saving recommendations, when applicable, to each participant. A phone survey, which can be found in Appendix B: Participant Survey Instrument, were conducted with a random sample of participants that completed the PER® survey either online or through the mail and received the six pack of CFLs. The results of this survey with the associated energy impact estimations and recommendations are presented below. Survey responses were received from 157 of the 54,492 participants from August 2009 to August 2010, 105 participants from North Carolina, and 52 from South Carolina. The responses and estimated energy savings of these 157 respondents have been extrapolated to the full population of 54,492 participants for the purpose of calculating overall savings estimates. All algorithms used in the calculation of the savings estimates herein can be found in Appendix C: Impact Algorithms. A summary can be seen in Table 4.

Energy Savings: Engineering Estimates

Savings estimates for the Personalized Energy Report program are driven by the billing analysis. The role of the engineering estimates is purely complementary. They are presented in this section for support and comparison purposes only and not as program savings records.

The CFLs provided through the program, when installed and used, provide energy savings to the participants and to Duke Energy. For the North and South Carolina participants, the installation of the CFLs supplied in the kit to the 54,492 participants provides an estimated net annual energy savings of -7,595 therms, 7,611,954 kWh and reduces peak load by 617.6 kW. On a per-participant basis, this equals first year annual gross energy savings of 283 kWh and .023 kW, with a net savings of 140 kWh and .011 kW per participant for the CFLs. The total first year net energy savings for the CFLs and the recommendations are 990 kW, 8,280,765 kWh and 7,807 therms. The total net lifetime savings for the Personalized Energy Report is 919 kWh and 5.06 therms per participant. Table 4 shows a summary.

Table 4. Engineering Impact Summary

	Gross Savings	Net Savings
ANNUAL SAVINGS FOR CFL INSTALLATIONS		
kW	1251.7	617.6
kWh	15,427,247	7,611,954
Therms	-15,401	-7,595
ANNUAL SAVINGS FOR RECOMMENDATION INSTALLATIONS		
kW	531.0	372.2
kWh	954,082	668,812
Therms	21,971	15,402
TOTAL ANNUAL SAVINGS FOR CFLs AND RECOMMENDATIONS		
kW	1782.6	989.8
kWh	16,381,329	8,280,765
Therms	6,570	7,807

LIFECYCLE SAVINGS FOR CFL INSTALLATIONS		
kWh		38,059,768
Therms		-37,975
LIFECYCLE SAVINGS FOR RECOMMENDATION INSTALLATIONS		
kWh		12,025,887
Therms		313,878
TOTAL LIFECYCLE SAVINGS FOR CFLs AND RECOMMENDATIONS		
kWh		50,085,655
Therms		275,903

The impact estimates are based on 157 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 for the recommended actions taken 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. Program savings broken down by measure can be seen in Table 5.

Table 5. Total Program Savings by Measure

Measure	kW	kWh	therms
CFLs	1251.65	15,427,247	-15,401
Double Pane Windows	159.59	470,249	18,639
14 SEER Central AC	339.45	385,262	-1,666
Energy Star Doors	31.93	98,572	4,998
TOTALS	**1,783**	**16,381,329**	**6,570**

Energy Savings Distributions: Engineering Estimates

The tables below present a summary of the total CFL savings from the program participants. Table 6 presents the gross energy savings based on the randomly sampled participant survey responses extrapolated to the program population of 54,492. Table 7 presents the expected savings after the false-response and self-selection biases are factored into the calculations. Table 8 presents the net savings, which includes the estimated program free ridership.

Table 6. First Year Gross Energy Savings of CFLs, All Program Participants (n=54,492)

Lamp Wattage	kW	kWh	Therms
13-Watt CFL	**596.9**	**7,176,979**	**-7,356**
20-Watt CFL	**654.8**	**8,250,268**	**-8,045**
Total	**1,251.7**	**15,427,247**	**-15,401**

Table 7. First Year Energy Savings of CFLs, Net of False-Response and Self-Reporting Bias, All Program Participants (n=54,492)

Lamp Wattage	kW	kWh	Therms

13-Watt CFL	347.3	4,175,781	-4,280
20-Watt CFL	381.0	4,800,253	-4,681
Total	728.2	8,976,035	-8,961

Table 8. First Year Net Energy Savings of CFLs, Net of False-Response, Self-Reporting Bias and Free ridership, All Program Participants (n=54,492)

Lamp Wattage	kW	kWh	Therms
13-Watt CFL	294.4	3,540,192	-3,629
20-Watt CFL	323.1	4,071,762	-3,966
Total	617.6	7,611,954	-7,595

The tables below present a summary of the total recommendation savings from the program participants. Table 9 presents the gross energy savings based on the randomly sampled participant survey responses extrapolated to the program population of 54,492. Table 10 presents the net savings, which factors in the estimated program self-reporting bias.

Table 9. First Year Gross Energy Savings of Recommendations, All Program Participants (n=54,492)

Recommendation	Total Times Recommended	ΔkW	ΔkWh	Δtherms
Double Pane Windows	1041	159.59	470,249	18,639
14 SEER Central AC	694	339.45	385,262	-1,666
Energy Star Doors	694	31.93	98,572	4,998
TOTAL	**2430**	**530.97**	**954,082**	**21,971**

Table 10. First Year Net Energy Savings of Recommendations, Net of Self-Reporting Bias, All Program Participants (n=54,492)

Recommendation	Total Times Recommended	ΔkW	ΔkWh	Δtherms
Double Pane Windows	1041	111.87	329,644	13,066
14 SEER Central AC	694	237.95	270,069	(1,168)
Energy Star Doors	694	22.38	69,099	3,504
TOTAL	**2430**	**372.21**	**668,812**	**15,402**

PER® CFL Impacts

The phone surveys asked the respondents to state whether or not they used each CFL in the six pack and, if not, whether or not they plan to use them in the future. Those that indicated that they plan to use them are reported separately and should be interpreted as future potential savings rather than achieved savings. A summary of both achieved and potential savings from the CFLs can be seen in Table 11. A total of 15,427,247 kWh was achieved along with an

additional 5,254,103 kWh in potential savings. The savings from CFL installations is responsible for 94% of the total program kWh savings.

Table 11. Total Achieved and Potential Savings from CFLs by State

	North Carolina			South Carolina		
	ΔkW	ΔkWh	Δtherms	ΔkW	ΔkWh	Δtherms
Installed 13-Watt	466.89	5,613,894	-5,754	130.00	1,563,085	-1,602
Installed 20-Watt	498.84	6,285,598	-6,443	155.92	1,964,670	-1,602
Total Achieved	**965.73**	**11,899,492**	**-12,197**	**285.92**	**3,527,755**	**-3,204**
Potential 13-Watt	169.19	2,034,393	-2,085	19.70	236,831	-243
Potential 20-Watt	212.74	2,680,623	-2,748	23.99	302,257	-310
Total Potential	**381.94**	**4,715,015**	**-4,833**	**43.68**	**539,088**	**-553**

The CFL six packs included three 13-Watt CFLs and three 20-Watt CFLs. As presented in Table 12, the survey revealed that in North Carolina, a total of 218 13-Watt and 204 20-Watt CFLs were installed, which equates to 86,785 13-Watt and 81,211 20-Watt CFLs total, or about 67% of the amount distributed. Survey participants indicated that they plan to install an additional 79 13-Watt and 87 20-Watt CFLs, which equates to 31,450 13-Watt and 34,634 20-Watt CFLs total. If all of these potential installs are actualized, 93% of the total amount distributed would be in use.

In South Carolina, the survey showed that a total of 99 13-Watt and 104 20-Watt CFLs were installed, which equates to 24,164 13-Watt and 25,384 20-Watt CFLs total, or about 65% of the amount distributed. Survey participants indicated that they plan to install an additional 15 13-Watt and 16 20-Watt CFLs, which equates to 3,661 13-Watt and 3,905 20-Watt CFLs total. If all of these potential installs are actualized, 75% of the total amount distributed would be in use.

Table 12. Total number of CFLs installed by State

	North Carolina			South Carolina		
	Survey	**%**	**Total**	**Survey**	**%**	**Total**
Installed 13-Watt	218	69%	**86,785**	99	63%	**24,164**
Installed 20-Watt	204	65%	**81,211**	104	67%	**25,384**
Potential 13-Watt	79	25%	**31,450**	15	10%	**3,661**
Potential 20-Watt	87	28%	**34,634**	16	10%	**3,905**

In the calculation of the installation rates from the surveys, the responses from the online and by-mail participants were grouped together. However, there were some notable behavior differences between the two survey groups (online/mail). Figure 2 shows the differences in installation rates between the two survey populations in both North and South Carolina. On average, participants responding online tended to report higher and more consistent installation rates.

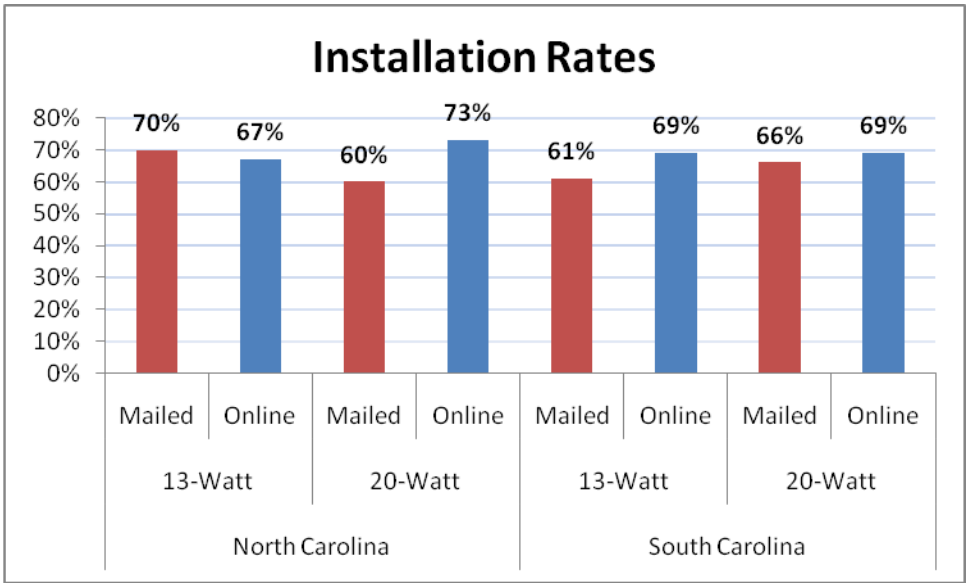


Figure 2. CFL Installation Rates Survey Group and State

From the survey, it was determined that, on average, participants use the 13-Watt CFL to replace a 59-Watt incandescent bulb and the 20-Watt CFL to replace a 73-Watt incandescent bulb. The savings from installing the CFLs are presented in Table 11**.** Using only the savings estimates based on those that said that they took the action, and extrapolating these estimates to the full population of program participants, PER® participants reduced their annual kWh consumption by 15,427,247 kWh, or 358 kWh per person per year. Of the total savings, 7,176,979 kWh (47%) is from 13-Watt CFLs and the other 8,250,268 kWh (53%) comes from 20-Watt CFLs. This results in per-installation savings achievements of 64.69 kWh and 77.40 kWh respectively. Mean values are shown in Table 13. The slight increase in therm consumption occurs because incandescent bulbs burn much hotter than CFLs and, consequently, homeowners must use a little bit more gas heating their homes in the winter.

Table 13. Mean Estimates per Install from Participants Installing CFLs

	kW	kWh	therms
Installed 13-Watt	0.0054	64.69	-0.0663
Installed 20-Watt	0.0061	77.40	-0.0793

Just as with the installation rate calculations, the replaced Wattage and operating hour calculations were carried out on aggregate data across both North and South Carolina. State dependent calculations were not performed. Figure 3 and Figure 4 show that survey participants that submit their survey by mail tend to use CFLs to replace higher Wattage incandescent bulbs and also that they have their lights turned on more often.

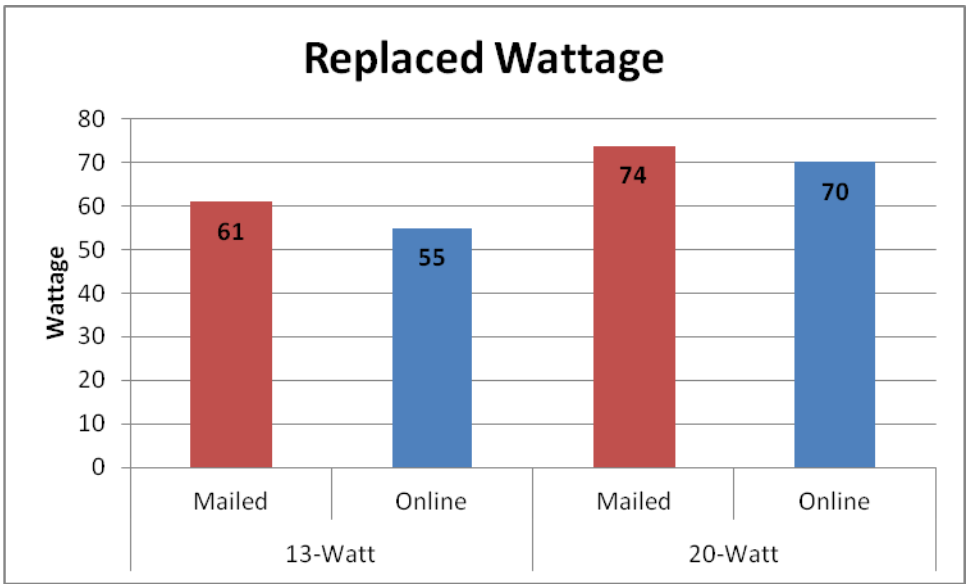


Figure 3. CFL Replaced Wattages by Survey Group

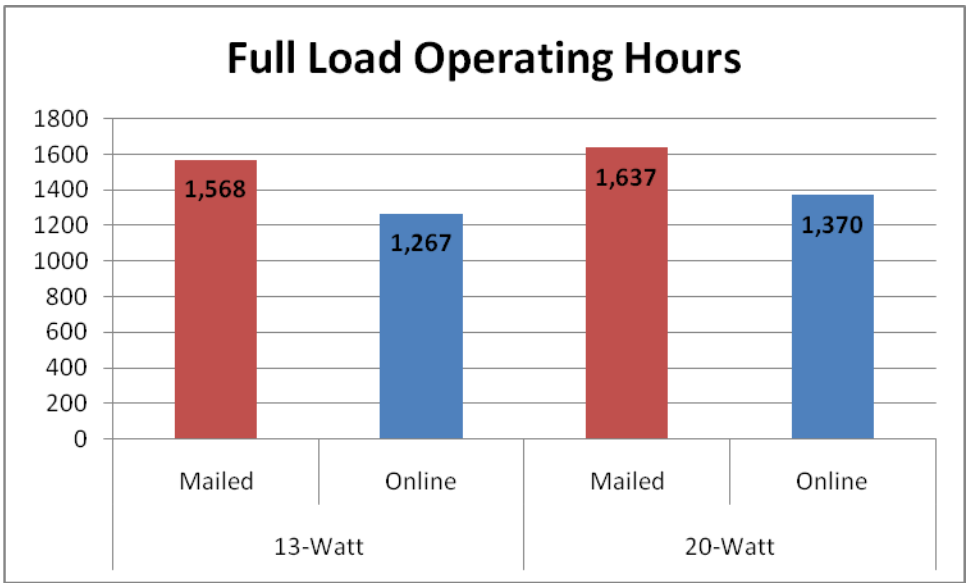


Figure 4. Stated CFL Operating Hours by Survey Group

PER Recommendation Impacts

There were a total of three different recommendations that were taken by program participants. Table 14 lists each recommendation along with how many times the recommendation was followed and the total estimated savings acquired from the measure taken. The phone survey did not allow participants to indicate whether or not they plan to take recommendations they have not yet taken as it did for the CFLs, so there are no planned or potential future savings presented for the recommendations provided by the Personalized Energy Report.

Table 14. All Recommendations with Savings Estimates

Recommendation	Times Recommendation Taken In Phone Survey	Percent of Total	Total Times Recommendation Taken	kW	kWh	therms
Double Pane Windows	3	1.91%	1041	159.59	470,249	18,639
14 SEER Central AC	2	1.27%	694	339.45	385,262	-1,666
Energy Star Doors	2	1.27%	694	31.93	98,572	4,998
TOTAL	**7**	**4.46%**	**2430**	**530.97**	**954,082**	**21,971**

There were a total of seven recommendations taken by survey participants. Double pane windows have an implementation rate of 1.91% and were hence employed by an estimated 1,041 participants out of the entire population of 54,492. Central air conditioners and Energy Star doors have an implementation rate of 1.27% and were thus employed by an estimated 694 participants. Due to this low implementation rate, the energy savings from the recommendations is quite low when compared to the savings from the CFLs, accounting for just 6% of the total program kWh savings. Mean savings estimates are shown in Table 15.

Table 15. Mean Savings Estimates for All Recommendations

	kW	kWh	therms
Double Pane Windows	0.1533	452	17.90
14 SEER Central AC	0.4890	555	-2.40
Energy Star Doors	0.0460	142	7.20

TecMarket Works and Duke Energy cross-checked the two customers that installed the AC units because of the PER recommendation, and neither of these PER participants received a rebate for these AC units by participating in the Residential Smart $aver® Program.

Billing Analysis

This section of the report presents the results of a billing analysis conducted over the participants in the North and South Carolina PER® program. Since the customer has a choice of either the mail or online version (OHEC), separate billing analyses were conducted for the mail version (referred below as PER®) and the online version (referred to as OHEC). For both analyses, billing data was obtained for all participants in the program between August, 2009 and March, 2011. For PER®, there were a total of 39,851 usable accounts after processing[2], of which 30,374 were from North Carolina, and 9,477 were from South Carolina, and for OHEC there were a total of 12,962 (9,781 from North Carolina and 2,838 from South Carolina).[3] For each program, a panel model was used to determine program impacts, where the dependent variable was monthly electricity consumption from January 2009 to March 2011. The results of the billing analysis are presented in Table 16.

Energy Savings: Billing Analysis

The estimated PER® and the online version (OHEC) program savings obtained from the billing data analysis are presented below.

Table 16. Estimated Carolina PER Impacts: Billing Analysis

	95% Confidence Interval		
	Lower Bound	Estimate	Upper Bound
Per Participant Annual Savings (Gross) - PER®	66.7	157.6	248.3
Per Participant Annual Savings (Gross) - OHEC	319.3	598.3	695.7

This table shows that both the written and online aspects of the PER® program produced statistically significant savings for participants in the Carolinas. The online version produced significantly higher savings, which may be due to several factors such as the customer is more involved or is more comfortable with newer technology (increasing the chance they will adopt newer, energy efficient appliances). These annual savings estimates are larger than the savings found from the engineering analysis, which may be due to differences in uptake of the recommended measures in the survey sample relative to the entire population of participants.

Note that the billing data analysis did not include variables to capture effect of participation in other Duke Programs after participation in PER. This *does not* imply that the savings from PER captures the effects of participation in other programs. The extent to which the PER estimate may capture the effect of participation in other programs depends upon the correlation between these variables. This correlation is quite low because 1) there is not a sizable number of

[2] Useable accounts are those accounts which have billing data for both a portion of the pre- and post-participation period. It was not required that the data covers the complete evaluation period, only that there is at least one observation in each period.

[3] In order to maximize the use of the data, a single model for PER® and OHEC were estimated that included households from across all states (Ohio, North Carolina, South Carolina and Kentucky). Therefore, the actual sample size in the PER® model included 8,638 houses in Ohio and 8,451 in Kentucky, for a total sample size of 56,940 households, and the OHEC model included 6,081 from Ohio and 1,021 from Kentucky, for a total sample of 19,821.

customers who first participation in PER and later participated in other programs, and 2) even for those customers who participate in other programs, there is generally a time lag between the participation dates (thus decreasing the correlation). These two effects imply that the correlation between PER participation and participation is low, and thus there is no need to capture participation in other programs in the billing data analysis.

For PER® the engineering analysis is within the 95% CI of the estimate from the bill data, so there is no statistically significant difference between the two estimates. However, that is not the case for OHEC, where the savings from the billing analysis are significantly larger (probably due to behavioral effects). The appropriate impact estimate for both PER® and OHEC is assumed to be the one based on the billing analysis because:

- The billing analysis is more likely to capture adoption of recommended measures as well as behavioral responses.
- The billing analysis was estimated over nearly all 2009-2011 participants (over 60,000 customers) while the engineering analysis relied upon the surveyed sample (157 customers).

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*
ß = vector of coefficients
x = vector of variables that represent factors causing changes in energy consumption for home *i* during month *t* (i.e., weather, time, 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 written and online aspects of the PER® program are captured by including a variable which is equal to one for all months after the household participated in the program. The coefficient on this variable is the savings associated with the program. In order to account for differences in billing days, the usage was normalized by days in the billing cycle. The estimated electric model for the written aspect of PER® and OHEC are presented in Table 17 and Table 18, respectively.[4]

Table 17. Estimated Savings Model for PER® – dependent variable is daily kWh usage, January 2009 through March 2011 (savings are negative).

Independent Variable	Coefficient (kWh Savings/day)	t-value
PER® participation – Carolina	-0.432	-3.41
Sample Size	1,490,567 observations (56,940 homes)	
R-Squared	79%	

Table 18. Estimated Savings Model for OHEC – dependent variable is daily kwh usage, January 2009 through March 2011 (savings are negative).

Independent Variable	Coefficient (kWh Savings/day)	t-value
OHEC participation – Carolina	-1.639	-12.04
Sample Size	457,836 observations (19,821 homes)	
R-Squared	78%	

[4] As stated previously, for each aspect of PER®, a single model was estimated over participants in all states. The table however only presents the results for the Carolinas.

The complete estimate model, showing the weather and time factors, is presented in Appendix D: Estimated Statistical Model.

Appendix A: Personalized Energy Report® Paper Survey

U142045

RECEIVE YOUR FREE, PERSONALIZED ENERGY REPORT (PER)™

[redacted]

FOR THE ADDRESS SHOWN ABOVE, PLEASE ANSWER THE FOLLOWING QUESTIONS RELATED TO YOUR HOME AND ENERGY USAGE. FILL IN THE CIRCLES COMPLETELY USING BLUE OR BLACK INK.

PROPERTY DETAILS

1. What type of home best describes your primary residence? *(check only one)*
   - Detached single family
   - Duplex / 2 family
   - Townhouse
   - Apartment / Multi – Family / (3 or more units)
   - Condominium
   - Manufactured home

2. How many levels does your home have, excluding the basement and unfinished attic?
   - 1
   - 2
   - 3

3. In what year was your home built?
   - Before 1959
   - 1960 – 1979
   - 1980 – 1989
   - 1990 – 1997
   - 1998 – 2000
   - 2001 – 2007
   - 2008

4. Does your home have an attic?
   - Yes
   - No

5. Does your home have a basement?
   - Yes, heated
   - Yes, unheated
   - No

6. Excluding bathrooms and hallways, how many rooms are in your home? *(include finished basement)*
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7
   - 8
   - 9
   - More than 9

7. How would you describe the size of the rooms in your home?
   - Above average
   - Average
   - Below average

8. Approximate size (heated area) of your home? Your answers to questions 6 & 7 above will allow us to estimate the size of your home in square feet. Or, if you know the square footage of your home, you may choose it here and we will use your input.
   - < 500
   - 500-999
   - 1000-1499
   - 1500-1999
   - 2000-2499
   - 2500-2999
   - 3000-3499
   - 3500-3999
   - 4000 or more
   - Don't know

MAIN HEATING SYSTEM

9. What is the fuel used in your primary heating system?
   - Electric
   - Natural Gas
   - Oil
   - Propane
   - Other (solar, wood, etc)
   - No heat system

10. Which of the following bests describes your home's primary heating system?
    - Electric Baseboard or ceiling cable
    - Forced air furnace
    - Standard heat pump
    - Ground source heat pump
    - Water boiler
    - Steam boiler
    - Wood heating system
    - Heat pump with gas backup
    - Heat pump with propane backup
    - Heat pump with oil backup
    - No heat system

11. How old is your heating system?
    - 0 – 4 years
    - 5 – 9 years
    - 10 – 14 years
    - 15 – 19 years
    - 20 years or greater

COOLING SYSTEM

12. Do you have a central cooling system? (If you use window or room air conditioners, you will note this in question 14)
    - No central cooling system
    - Central air conditioning
    - Heat Pump

13. If you have any cooling system, how old is it?
    - 0 – 4 years
    - 5 – 9 years
    - 10 – 14 years
    - 15 – 19 years
    - 20 years or greater

14. Do you use room or window air conditioners?
    - Yes
    - No

15. How many room or window A/Cs?
    - 1
    - 2
    - 3

16. If you have a central heating and cooling system with air ducts, are any of these ducts located in the attic?
    - Yes
    - No
    - Not applicable

Duke Energy®

17. What is your thermostat setting for a typical heating day and a typical cooling day in the afternoon?

Heating

- <67 °
- 67 – 70 °F
- 71 – 73 °F
- 74 – 77 °F
- > 77 °F
- Thermostat off/ No thermostat

Cooling

- <69 °
- 69 – 72 °F
- 73 – 76 °F
- 77 – 78 °F
- > 78 °F
- Thermostat off/ No thermostat

18. Do you have any of the following comfort issues in your home?

a. *Cold drafts in the winter*
- Yes
- No

b. *Sweaty windows in the winter*
- Yes
- No

c. *Cooling system will not keep the home comfortable*
- Yes
- No

d. *Heating system will not keep the home comfortable*
- Yes
- No

e. *Uneven temperatures between rooms*
- Yes
- No

19. How many people live in your home?
- 1
- 2
- 3
- 4
- 5
- 6
- 7 or more

20. Do you own or rent this home?
- Own
- Rent

21. What fuel is used by your water heater?
- Electric
- Natural Gas
- Propane
- Other
- None

22. What is the age of your water heater?
- 0 – 4 years
- 5 – 9 years
- 10 – 14 years
- 15 – 19 years
- 20 years or greater

23. What type of fuel do you use for clothes drying?
- Electric
- Natural Gas
- Other
- None

24. What type of fuel do you use for your cook top?
- Electric
- Natural Gas
- Other
- None

25. What type of fuel do you use for your oven?
- Electric
- Natural Gas
- Other
- None

26. a. Do you have a swimming pool?
- Yes
- No

b. *Do you have a pool heater?*
- Yes
- No

c. *What type of fuel do you use to heat your pool?*
- Electric
- Natural Gas
- Oil
- Propane
- Not applicable

27. a. Do you have a hot tub?
- Yes
- No

b. *What type of fuel do you use to heat your hot tub?*
- Electric
- Natural Gas
- Oil
- Propane

28. Would a two degree increase in your home's indoor temperature during summer weekday afternoons affect your family's comfort?
- Not at all
- A small impact
- A moderate impact
- A large impact

29. Are you planning to make any large purchases to improve the energy efficiency of your home within the next three years?
- Yes
- No
- Not sure

30. How many CFLs* do you have installed in your home?

* 0 1 4 2 0 4 5 *

31. Please print your email address in the boxes below:

*compact fluorescent light bulbs

Appendix B: Participant Survey Instrument

The questions below require mostly short, scaled replies from the interviewee, and not all questions will be asked of all participants. This interview should take approximately 10 to 15 minutes.

Personalized Energy Report® (PER®) Program

Participant Survey

SURVEY INTRODUCTION

If PER® participant, then contact for survey. Use five attempts at different times of the day and different days before dropping from contact list. Call times are from 10:00 a.m. to 8:00 p.m. EST or 9-7 CST Monday through Saturday. No calls on Sunday. (Sample size N =150)

SURVEY

Introduction

Note: Only read words in bold type.

Hello, my name is _____. I am calling on behalf of Duke Energy to conduct a customer survey about the Personalized Energy Report® Program. This was a survey someone in your home completed and you received a report and compact fluorescent light bulbs for your participation. May I speak with _____ please?

If person talking, proceed. If person is called to the phone reintroduce.
If not home, ask when would be a good time to call and schedule the call-back:

Call back 1:	Date: _____,	Time: _____	❑AM or ❑PM
Call back 2:	Date: _____,	Time: _____	❑AM or ❑PM
Call back 3:	Date: _____,	Time: _____	❑AM or ❑PM
Call back 4:	Date: _____,	Time: _____	❑AM or ❑PM
Call back 5:	Date: _____,	Time: _____	❑AM or ❑PM

❑ Contact dropped after fifth attempt.

We are conducting this survey to obtain your opinions about the Personalized Energy Report® Program. Duke Energy's records indicate that you participated in the Personalized Energy Report® Program by completing and mailing a paper survey or an online survey. We are not selling anything. The survey will take about 5 or 10 minutes and your answers will be confidential, and will help us to make improvements to the program to better serve others. May we begin the survey?

Note: If this is not a good time, ask if there is a better time to schedule a callback.

1. **Do you recall participating in the Personalized Energy Report® Program?**

1. ❑ Yes, *begin* → *Skip to Q3.*
2. ❑ No,
99. ❑ DK/NS

This program was provided through Duke Energy. In this program, you completed a short survey about your home in <*month year*>, and then Duke Energy provided you with energy-saving recommendations for you and your home, and you were also provided with a free six-pack of CFLs.

Do you remember participating in this program?

1. ❑ Yes, *begin* → *Go to Q2.*
2. ❑ No,
99. ❑ DK/NS

If No or DK/NS terminate interview and go to next participant.

2. **How did you learn of the PER® Program?**

a. ____ I visited Duke Energy's website (pop-up survey)
b. ____ I got the survey in the mail -- *Did you fill out the mailed PER® survey or did you complete the survey online?*
   i. Paper ____
   ii. Online _____
c. ____ Other: _____

3. Please think back to the time when you were deciding to participate in the Personalized Energy Report® program. What factors motivated you to participate? ***(do not read list, place a "1" next to the response that matches best)***

1. ____ Six pack of CFL bulbs
2. ____ Recommendation of someone else (*Probe*: **Who?**_____)
3. ____ Wanted to reduce energy costs
4. ____ The information provided by the program
5. ____ Past experience with this program
6. ____ Because of past experience with another Duke Energy program
7. ____ Recommendation from other utility program

i. (*Probe*: **What program? _____**)

8. ____ Recommendation of family/friend/neighbor
9. ____ Other (SPECIFY) _____
10. ____ Don't know/don't remember/not sure (DK/NS)

If multiple responses: 3.a. **Were there any other reasons?** *(number responses above in the order they are provided - Repeat until 'no' response.)*

4. Did you have any CFLs installed in your home before you completed your PER® survey?

❑ Yes ❑ No ❑ DK

If yes, 4a. **How many did you have installed before you completed the PER® survey?**

Enter response: _____

Please answer the following set of questions with a yes or no response.

5. Do you have any cold drafts in your house during the winter?

❑ Yes ❑ No ❑ DK

6. Do your windows have water on them or look "sweaty" in the winter?

❑ Yes ❑ No ❑ DK

7. Does your cooling system keep your home comfortable?

❑ Yes ❑ No ❑ DK ❑ Don't have a cooling system

8. **Does your heating system keep your home comfortable?**

❑ Yes ❑ No ❑ DK ❑ Don't have a heating system

9. Does the temperature in your house stay even from room to room?

❑ Yes ❑ No ❑ DK

10. I'd like to talk about the CFLs that you received for participating in the PER® program. The kit came with 3 13-watt CFLs and 3 20-watt CFLs. How many of the 13-watt CFLs are you using?

a. None of them
b. 1 of the CFLs
c. 2 of the CFLs
d. 3 of the CFLs
e. Don't know

11. **For the** <first, second, third> **How many watts was the old bulb that you took out?** (repeat for all installed out of the 3 provided)

❑<=44 ❑45-70 ❑71-99 ❑100+

4**. On average, approximately how many hours per day is this light used?** (repeat for all installed out of the 3 provided)

❑<=1 ❑1-2 ❑3-4 ❑5-10 ❑11-12 ❑13-24

If less than 3:

Do you plan on using the remaining 13-watt CFLs?
❑ Yes
❑ No **Why Not?** _____
❑ Maybe/DK

12. How many of the 20-watt CFLs are you using?

f. None of them
g. 1 of the CFLs
h. 2 of the CFLs
i. 3 of the CFLs
j. Don't know

13. **For the** <first, second, third> **How many watts was the old bulb that you took out?** (repeat for all installed out of the 3 provided)

❑<=44 ❑45-70 ❑71-99 ❑100+

4**. On average, approximately how many hours per day is this light used?** (repeat for all installed out of the 3 provided)

❑<=1 ❑1-2 ❑3-4 ❑5-10 ❑11-12 ❑13-24

If less than 3:

14. **Do you plan on using the remaining 20-watt CFLs?**
    i. ❑ Yes
    ii. ❑ No **Why Not?** _____
    iii. ❑ Maybe/DK

15. **On a scale from 1-10, with 1 indicating that you were very dissatisfied, and 10 indicating that you were very satisfied, please rate your satisfaction with the kit's 13-watt CFL(s).**

very dissatisfied very satisfied
1 2 3 4 5 6 7 8 9 10

If 7 or less, 10a. **Why were you dissatisfied with the 13-watt CFLs**?
_____
_____

16. On a scale from 1-10, with 1 indicating that you were very dissatisfied, and 10 indicating that you were very satisfied, please rate your satisfaction with the kit's 20-watt CFL.

very dissatisfied very satisfied
1 2 3 4 5 6 7 8 9 10

If 7 or less, 11a. **Why were you dissatisfied with the 20-watt CFL**?
_____
_____

17. Have you purchased any CFLs since receiving the kit from Personalized Energy Report?

❑ Yes ❑ No ❑ DK

If yes, 12a. **How many?** _____

18. **Since you participated in the Personalized Energy Report® Program**,

a. have you purchased and installed any energy efficiency equipment?

1. ❑ Yes
2. ❑ No
3. ❑ Don't Know

b. have you made energy efficiency improvements in your home?

a. ❑ Yes
b. ❑ No
c. ❑ Don't Know

c. Have you changed any of your habits related to energy use that were recommended by the PER® report?

a. ❑ Yes
b. ❑ No
c. ❑ Don't Know

If any of the responses to questions 18a - 18c are "yes", continue. If all responses are "no" or "Don't Know", skip to question #23.

19. **What type and quantity of high efficiency equipment did you install on your own?**
PROBE TO GET EXACT TYPE AND QUANTITY AND LOCATION

Type 1: _____ Quantity 1: _____ Location 1:_____
Type 2: _____ Quantity 2: _____ Location 2:_____
Type 3: _____ Quantity 3: _____ Location 3:_____
Type 4: _____ Quantity 4: _____ Location 4:_____

20. **Was this improvement suggested by the home energy report provided to you through the Personalized Energy Report® program?**

Type 1: _____ ❑ Yes ❑ No ❑ DK
Type 1: _____ ❑ Yes ❑ No ❑ DK
Type 1: _____ ❑ Yes ❑ No ❑ DK
Type 1: _____ ❑ Yes ❑ No ❑ DK

21. **Was this improvement suggested through a different energy efficiency program?**

Type 1: _____ ❑ Yes ❑ No ❑ DK
If yes: **Which program?**:_____
Type 1: _____ ❑ Yes ❑ No ❑ DK
If yes: **Which program?**:_____
Type 1: _____ ❑ Yes ❑ No ❑ DK
If yes: **Which program?**:_____
Type 1: _____ ❑ Yes ❑ No ❑ DK

If yes: **Which program?**:_____

22. *For each type listed in 14 above,* **How do you know that this equipment is high efficiency? For example, was it Energy Star rated?**

Type 1: _____
Type 2: _____
Type 3: _____
Type 4: _____

I'm going to read a statement about this equipment that you purchased on your own. On a scale from 1-10, with 1 indicating that you strongly disagree, and 10 indicating that you strongly agree, please rate the following statement.

23. **My experience with the Personalized Energy Report® Program in** <2009, 2010> **influenced my decision to install** <Type 1/Type 2/Type 3/Type 4> **on my own.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

24. **What other actions, if any, have you taken in your home to save energy and reduce utility bills at least in part as a result of what you learned in this program?**

Response:1 _____

Response:2 _____

Response:3 _____

Response:4 _____

Now I am going to ask you some general satisfaction statements. On a scale from 1-10, with 1 indicating that you strongly disagree, and 10 indicating that you strongly agree, please rate the following statements.

25. **The mailed survey was easy to understand. (**If an online participant**: The web site's survey was easy to understand**.)

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?_____

_____

26. **The energy report was easy to read and understand.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?_____

_____

27. **The recommendations in the PER® report provided new ideas that I was not previously considering.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?_____

_____

28. **The recommendations in the report increased the likelihood that I would take recommended actions.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?_____

_____

29. The kit I received met my expectations.

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?_____

_____

30. I am satisfied with the amount of time it took to receive the kit and report after completing the PER® survey.

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?_____

_____

31. **Overall I am satisfied with the program**.

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?_____

_____

32. What additional services would you like the program to provide that it does not now provide?

Response: _____

_____

33. Are there any other things that you would like to see changed about the program?

Response: _____

34. **What do you think can be done to increase people's interest in participating in the Personalized Energy Report® Program?**

Response:1 _____
Response:2 _____
Response:3 _____
Response:4 _____

35. **Have you recommended this program to others?**

If yes, **How many people did you recommend this program to?**

36. What did you like most about this program?

Response: _____

37. What did you like least about this program?

Response: _____

38. What other services could Duke Energy provide to help improve home energy efficiency?

Response: _____

That completes our survey, thank you for your time and feedback today! (*politely end call*)

Appendix C: Impact Algorithms

CFLs

General Algorithm

Gross Summer Coincident Demand Savings

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

Gross Annual Energy Savings

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

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

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 = -0.04353
$HVAC_d$	= HVAC system interaction factor for demand = -0.00102
$HVAC_g$	= HVAC system interaction factor for annual gas consumption = -0.0017

13 W CFL Measure

$Watts_{ee}$ = 13, which is the input power of program supplied CFL

$Watts_{base}$ - calculated from survey responses as shown below = 58.98181818

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: = 1470.830189 for 13-watt, 1541.339 For the 20-watt bulb.

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.

Charlotte, NC

Heating Fuel	Heating System	Cooling System	HVACc	HVACg
Other	Any except Heat Pump	Any except Heat Pump	0	0
Any	Heat Pump	Heat Pump	-0.10	0
Gas Propane Oil	Central Furnace	None	0	-0.0021
		Room/Window	0.069	-0.0021
		Central AC	0.069	-0.0021
	Other	None	0	-0.0021
		Room/Window	0.079	-0.0021
		Central AC	0.079	-0.0021
Electricity	Central furnace	None	-0.43	0
		Room/Window	-0.31	0
		Central AC	-0.31	0
	Electric baseboard	None	-0.43	0
		Room/Window	-0.31	0
		Central AC	-0.31	0
	Other	None	-0.43	0
		Room/Window	-0.31	0
		Central AC	-0.31	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: = 72.5

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

Recommendations

	kW	kWh	therms	Units
Double Pane Windows	.101	317	26.4	100 SF of Window
Energy Star Doors	.02	84	9.4	Door
Energy Star Dishwasher	0	35.4	2.26	Unit
Energy Star Clothes Washer	0	97.35	6.02	Unit
Energy Star Freezer	0	70.8	0	Unit
14 SEER Central AC	.168	141	-2.3	Ton of AC

Appendix D: Estimated Statistical Model

This appendix show the complete model estimated for the billing analysis of PER® and OHEC. The model includes indicators for each month (the yearmonth variable), temperature, the state the participant resides, and the participation variables.

PER®

Variable	Coefficient	Std. Err.	t-value	P>|t|	[95% Conf.	Interval]
Ohio PER®	-1.061723	.2275592	-4.67	0.000	-1.507731	-.6157145
Carolina PER®	-.4318153	.1267935	-3.41	0.001	-.6803262	-.1833044
Kentucky PER®	-.5153296	.4109788	-1.25	0.210	-1.320834	.2901747
yearmonth- monthly indicators						
200902	.4266216	1.010806	0.42	0.673	-1.554524	2.407767
200903	1.214701	1.240542	0.98	0.327	-1.21672	3.646121
200904	-9.274887	1.621965	-5.72	0.000	-12.45388	-6.095892
200905	-46.04743	1.530528	-30.09	0.000	-49.04722	-43.04765
200906	-152.9098	2.173861	-70.34	0.000	-157.1705	-148.6491
200907	-165.0771	2.978928	-55.41	0.000	-170.9157	-159.2385
200908	-174.267	2.831219	-61.55	0.000	-179.8161	-168.7179
200909	-161.846	2.172825	-74.49	0.000	-166.1046	-157.5873
200910	-70.86816	1.265211	-56.01	0.000	-73.34794	-68.38839
200911	-19.43655	1.912648	-10.16	0.000	-23.18528	-15.68783
200912	10.43675	.9859776	10.59	0.000	8.504268	12.36923
201001	13.31447	1.187308	11.21	0.000	10.98738	15.64155
201002	6.056467	1.24992	4.85	0.000	3.606667	8.506268
201003	21.50042	1.162243	18.50	0.000	19.22247	23.77838
201004	-7.110179	1.365137	-5.21	0.000	-9.7858	-4.434557
201005	-94.58579	2.174196	-43.50	0.000	-98.84714	-90.32444
201006	-167.8692	2.085284	-80.50	0.000	-171.9563	-163.7821
201007	-209.1718	3.371102	-62.05	0.000	-215.7791	-202.5646
201008	-200.396	3.466054	-57.82	0.000	-207.1894	-193.6027
201009	-159.8892	2.277926	-70.19	0.000	-164.3538	-155.4245
201010	-104.0399	1.334106	-77.98	0.000	-106.6547	-101.4251
201011	-15.56738	1.256639	-12.39	0.000	-18.03035	-13.10441
201012	13.01914	.9093942	14.32	0.000	11.23676	14.80152
201101	2.593355	1.406553	1.84	0.065	-.1634416	5.350151
201102	17.50172	1.237131	14.15	0.000	15.07698	19.92645
201103	9.087197	1.358838	6.69	0.000	6.423922	11.75047
temperature interacted with monthly indicator						
200901	-.8448921	.0231028	-36.57	0.000	-.8901728	-.7996115
200902	-.8684181	.0217809	-39.87	0.000	-.9111078	-.8257284
200903	-.8756204	.0225642	-38.81	0.000	-.9198455	-.8313953
200904	-.6823165	.028334	-24.08	0.000	-.7378501	-.6267829
200905	-.0299153	.0215229	-1.39	0.165	-.0720994	.0122688
200906	1.610204	.0280663	57.37	0.000	1.555195	1.665213
200907	1.846985	.0413431	44.67	0.000	1.765954	1.928016
200908	1.910927	.0380102	50.27	0.000	1.836429	1.985426
200909	1.867457	.0310438	60.16	0.000	1.806612	1.928302
200910	.4744001	.0200308	23.68	0.000	.4351403	.5136598
200911	-.5401151	.037813	-14.28	0.000	-.6142272	-.4660029
200912	-1.270706	.019183	-66.24	0.000	-1.308304	-1.233108
201001	-1.288228	.033432	-38.53	0.000	-1.353754	-1.222702
201002	-1.134498	.03636	-31.20	0.000	-1.205762	-1.063234
201003	-1.295564	.0186343	-69.53	0.000	-1.332087	-1.259042
201004	-.6484281	.0191337	-33.89	0.000	-.6859294	-.6109267
201005	.7130788	.0307386	23.20	0.000	.6528322	.7733253
201006	1.7906	.0256551	69.79	0.000	1.740317	1.840884
201007	2.373414	.0427584	55.51	0.000	2.289609	2.457219
201008	2.288716	.044393	51.56	0.000	2.201707	2.375725
201009	1.837347	.0311476	58.99	0.000	1.776299	1.898395
201010	1.028331	.0193759	53.07	0.000	.9903547	1.066307
201011	-.6584072	.0228751	-28.78	0.000	-.7032416	-.6135729
201012	-1.499983	.0167263	-89.68	0.000	-1.532766	-1.4672
201101	-.9255145	.0431786	-21.43	0.000	-1.010143	-.8408859
201102	-1.228139	.0262677	-46.75	0.000	-1.279623	-1.176655
201103	-1.092089	.0248396	-43.97	0.000	-1.140774	-1.043405

state interacted with monthly indicator

2	200901	-14.24384	.5474325	-26.02	0.000	-15.31679	-13.17089
2	200902	-13.54088	.518331	-26.12	0.000	-14.55679	-12.52497
2	200903	-16.25062	.4647394	-34.97	0.000	-17.16149	-15.33975
2	200904	-18.76405	.4715211	-39.79	0.000	-19.68822	-17.83989
2	200905	-19.30963	.4632841	-41.68	0.000	-20.21765	-18.40161
2	200906	-21.57624	.4973071	-43.39	0.000	-22.55095	-20.60154
2	200907	-25.5147	.5224062	-48.84	0.000	-26.5386	-24.4908
2	200908	-22.15775	.5028924	-44.06	0.000	-23.1434	-21.1721
2	200909	-32.42633	.5261241	-61.63	0.000	-33.45752	-31.39515
2	200910	-26.44687	.5309348	-49.81	0.000	-27.48749	-25.40626
2	200911	-17.17487	.5821393	-29.50	0.000	-18.31584	-16.0339
2	200912	-6.724921	.4933693	-13.63	0.000	-7.691907	-5.757934
2	201001	-6.855386	.4941245	-13.87	0.000	-7.823853	-5.886919
2	201002	-6.499494	.5447694	-11.93	0.000	-7.567223	-5.431765
2	201003	-17.73031	.3889161	-45.59	0.000	-18.49257	-16.96805
2	201004	-21.94704	.3813565	-57.55	0.000	-22.69448	-21.19959
2	201005	-18.90678	.3822114	-49.47	0.000	-19.6559	-18.15766
2	201006	-20.29665	.3830755	-52.98	0.000	-21.04746	-19.54583
2	201007	-23.06292	.4012778	-57.47	0.000	-23.84941	-22.27643
2	201008	-26.30591	.4283165	-61.42	0.000	-27.1454	-25.46643
2	201009	-32.79776	.4488772	-73.07	0.000	-33.67755	-31.91798
2	201010	-30.52598	.4351305	-70.15	0.000	-31.37882	-29.67314
2	201011	-14.44264	.4843888	-29.82	0.000	-15.39203	-13.49325
2	201101	-10.16058	.5146035	-19.74	0.000	-11.16919	-9.151975
2	201102	-16.37198	.3964678	-41.29	0.000	-17.14905	-15.59492
2	201103	-16.2204	.4099473	-39.57	0.000	-17.02389	-15.41692
3	200901	-2.719421	.4557286	-5.97	0.000	-3.612634	-1.826209
3	200902	-4.833738	.4596333	-10.52	0.000	-5.734604	-3.932873
3	200903	-2.1202	.4586602	-4.62	0.000	-3.019158	-1.221242
3	200904	-2.482411	.4517629	-5.49	0.000	-3.367851	-1.596971
3	200905	-1.926375	.4544875	-4.24	0.000	-2.817155	-1.035595
3	200907	-.766061	.4529398	-1.69	0.091	-1.653807	.1216853
3	200908	-1.251723	.4512852	-2.77	0.006	-2.136226	-.3672193
3	200909	-1.952124	.4520576	-4.32	0.000	-2.838141	-1.066106
3	200910	-1.832651	.4513288	-4.06	0.000	-2.71724	-.9480621
3	200911	-2.673984	.451699	-5.92	0.000	-3.559298	-1.78867
3	200912	-3.951661	.4600417	-8.59	0.000	-4.853326	-3.049995
3	201001	-3.513307	.475893	-7.38	0.000	-4.446041	-2.580573
3	201002	-2.760464	.5071023	-5.44	0.000	-3.754367	-1.766561
3	201003	-1.240512	.5077624	-2.44	0.015	-2.235709	-.2453155
3	201004	-2.562118	.5029819	-5.09	0.000	-3.547946	-1.576291
3	201005	-2.735408	.5035323	-5.43	0.000	-3.722314	-1.748502
3	201006	-1.480987	.5035467	-2.94	0.003	-2.467921	-.4940523
3	201007	-1.120872	.6074386	-1.85	0.065	-2.311431	.0696869
3	201008	-1.706594	.6428559	-2.65	0.008	-2.966569	-.4466181
3	201009	-1.13282	.6485791	-1.75	0.081	-2.404013	.1383728
3	201010	-1.975442	.6502539	-3.04	0.002	-3.249918	-.7009671
3	201011	-2.949383	.6507419	-4.53	0.000	-4.224815	-1.673952
3	201012	-4.499843	.6508389	-6.91	0.000	-5.775465	-3.224221
3	201101	-2.329826	.6518026	-3.57	0.000	-3.607337	-1.052316
3	201102	-1.289736	.653429	-1.97	0.048	-2.570434	-.0090371
3	201103	-1.724363	.6534582	-2.64	0.008	-3.005119	-.4436076

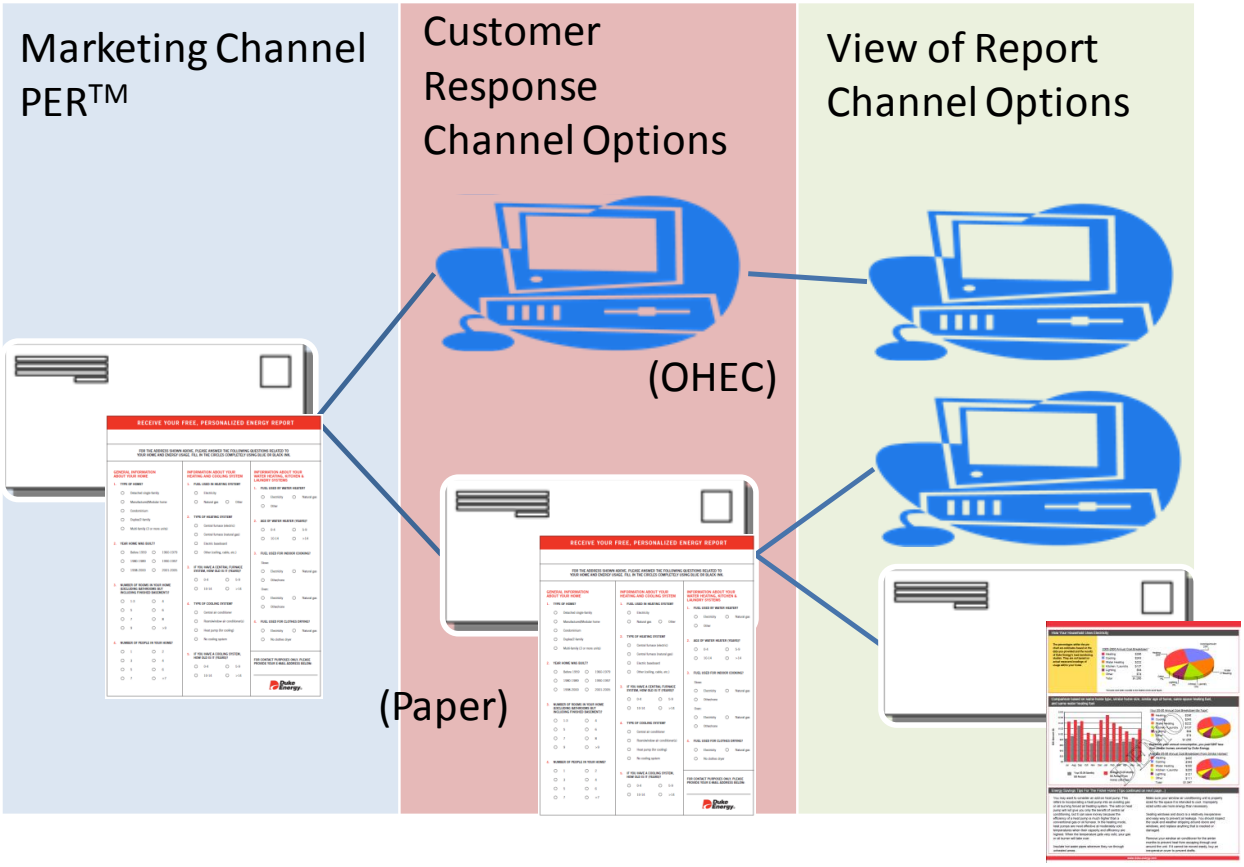
OHEC

Variable	Coefficient	Std. Err.	t-value	P>|t|	[95% Conf.	Interval]
Ohio OHEC	-.4752078	.1598156	-2.97	0.003	-.7884415	-.161974
Carolina OHEC	-1.639313	.1361068	-12.04	0.000	-1.906078	-1.372548
Kentucky OHEC	-1.156848	.4252654	-2.72	0.007	-1.990355	-.3233405
yearmonth- monthly indicators						
200902	6.1028	2.63925	2.31	0.021	.9299511	11.27565
200903	-2.973926	2.777778	-1.07	0.284	-8.418285	2.470433
200904	-28.67183	3.50644	-8.18	0.000	-35.54434	-21.79931
200905	-63.87458	3.371306	-18.95	0.000	-70.48224	-57.26693
200906	-178.4931	4.596679	-38.83	0.000	-187.5024	-169.4837
200907	-209.5281	7.25564	-28.88	0.000	-223.749	-195.3073
200908	-204.5421	6.464157	-31.64	0.000	-217.2117	-191.8726
200909	-174.9807	5.025815	-34.82	0.000	-184.8312	-165.1303
200910	-84.71277	3.19882	-26.48	0.000	-90.98236	-78.44318
200911	-45.71389	4.606562	-9.92	0.000	-54.74261	-36.68517
200912	16.12113	2.6609	6.06	0.000	10.90585	21.33641
201001	41.3951	3.073435	13.47	0.000	35.37126	47.41894
201002	27.33586	3.155435	8.66	0.000	21.15131	33.52042
201003	29.78945	2.51837	11.83	0.000	24.85352	34.72538
201004	-18.48318	2.952863	-6.26	0.000	-24.2707	-12.69566
201005	-136.32	4.33229	-31.47	0.000	-144.8111	-127.8288
201006	-194.0864	4.130382	-46.99	0.000	-202.1818	-185.9909
201007	-236.1339	7.18788	-32.85	0.000	-250.2219	-222.0458
201008	-211.5787	7.275538	-29.08	0.000	-225.8386	-197.3189
201009	-164.2715	5.105585	-32.17	0.000	-174.2783	-154.2647
201010	-120.3567	3.197601	-37.64	0.000	-126.6239	-114.0895
201011	-22.80084	3.209117	-7.11	0.000	-29.09062	-16.51107
201012	25.30604	2.464515	10.27	0.000	20.47567	30.13642
201101	66.20788	3.775215	17.54	0.000	58.80857	73.60718
201102	36.66786	2.833697	12.94	0.000	31.1139	42.22182
201103	9.462914	3.180452	2.98	0.003	3.229326	15.6965
temperature interacted with monthly indicator						
200901	-.7920264	.0458513	-17.27	0.000	-.8818935	-.7021594
200902	-.9218201	.0403026	-22.87	0.000	-1.000812	-.8428284
200903	-.760226	.0405027	-18.77	0.000	-.8396102	-.6808419
200904	-.338051	.0521215	-6.49	0.000	-.4402076	-.2358944
200905	.2580965	.0411678	6.27	0.000	.1774089	.3387841
200906	1.960164	.0577431	33.95	0.000	1.84699	2.073339
200907	2.356975	.0917796	25.68	0.000	2.17709	2.53686
200908	2.271226	.0791544	28.69	0.000	2.116085	2.426366
200909	1.881162	.0619722	30.35	0.000	1.759698	2.002625
200910	.5869888	.0384341	15.27	0.000	.5116592	.6623184
200911	-.0439493	.0737773	-0.60	0.551	-.1885505	.1006519
200912	-1.150471	.0367928	-31.27	0.000	-1.222583	-1.078358
201001	-1.783806	.0638012	-27.96	0.000	-1.908854	-1.658757
201002	-1.41811	.0645008	-21.99	0.000	-1.544529	-1.29169
201003	-1.490099	.0347189	-42.92	0.000	-1.558147	-1.422051
201004	-.4821425	.0367939	-13.10	0.000	-.5542573	-.4100276
201005	1.399267	.0585345	23.91	0.000	1.284541	1.513993
201006	2.172885	.0485893	44.72	0.000	2.077651	2.268118
201007	2.68543	.0865505	31.03	0.000	2.515793	2.855066
201008	2.35579	.0868163	27.14	0.000	2.185633	2.525947
201009	1.754277	.0611546	28.69	0.000	1.634416	1.874138
201010	1.134476	.0368492	30.79	0.000	1.062252	1.206699
201011	-.4310716	.0441303	-9.77	0.000	-.5175655	-.3445776
201012	-1.370989	.0326091	-42.04	0.000	-1.434902	-1.307076
201101	-2.537856	.0913773	-27.77	0.000	-2.716953	-2.358759
201102	-1.684399	.0496296	-33.94	0.000	-1.781671	-1.587126
201103	-1.039596	.0489464	-21.24	0.000	-1.135529	-.9436622
state interacted with monthly indicator						
2 200902	.7458418	.557853	1.34	0.181	-.3475329	1.839217
2 200903	-.8121234	.5531857	-1.47	0.142	-1.89635	.2721036
2 200904	-2.801436	.5491054	-5.10	0.000	-3.877666	-1.725206
2 200905	-3.36511	.546365	-6.16	0.000	-4.435969	-2.294251
2 200906	-4.325335	.5482618	-7.89	0.000	-5.399911	-3.250759
2 200907	-3.913752	.5729119	-6.83	0.000	-5.036641	-2.790862

2	200908	-3.161915	.5460493	-5.79	0.000	-4.232155	-2.091675
2	200909	-3.237897	.5430086	-5.96	0.000	-4.302177	-2.173616
2	200910	-2.628921	.5400286	-4.87	0.000	-3.687361	-1.570482
2	200911	-3.476591	.5446731	-6.38	0.000	-4.544134	-2.409049
2	200912	.024264	.5376477	0.05	0.964	-1.029509	1.078037
2	201001	4.398478	.5457061	8.06	0.000	3.328911	5.468045
2	201002	3.588498	.5471063	6.56	0.000	2.516187	4.66081
2	201003	2.051405	.5331268	3.85	0.000	1.006493	3.096318
2	201004	-1.954602	.5313711	-3.68	0.000	-2.996073	-.9131306
2	201005	-5.299274	.5384854	-9.84	0.000	-6.354689	-4.24386
2	201006	-4.655693	.5372707	-8.67	0.000	-5.708727	-3.602658
2	201007	-3.277058	.5478108	-5.98	0.000	-4.35075	-2.203366
2	201008	-1.67269	.5542155	-3.02	0.003	-2.758936	-.5864449
2	201009	-2.576074	.5475517	-4.70	0.000	-3.649259	-1.50289
2	201010	-3.263574	.5436797	-6.00	0.000	-4.32917	-2.197979
2	201011	-2.284696	.5407137	-4.23	0.000	-3.344478	-1.224913
2	201012	1.47561	.5432829	2.72	0.007	.4107921	2.540428
2	201101	6.170112	.5845433	10.56	0.000	5.024425	7.315799
2	201102	2.751435	.5495114	5.01	0.000	1.674409	3.82846
2	201103	-.9954718	.5540261	-1.80	0.072	-2.081346	.0904025
3	200901	-4.800005	.7892656	-6.08	0.000	-6.346941	-3.253068
3	200902	-8.255436	.6843585	-12.06	0.000	-9.596758	-6.914114
3	200903	-3.943258	.5398597	-7.30	0.000	-5.001367	-2.88515
3	200904	-.4013229	.5583763	-0.72	0.472	-1.495723	.6930776
3	200905	-.4390306	.5442348	-0.81	0.420	-1.505714	.6276529
3	200907	9.189895	.7675322	11.97	0.000	7.685555	10.69423
3	200908	4.292691	.6842789	6.27	0.000	2.951525	5.633857
3	200909	13.25935	.7441734	17.82	0.000	11.80079	14.71791
3	200910	7.464784	.7450409	10.02	0.000	6.004527	8.925041
3	200911	1.000552	.8762154	1.14	0.253	-.716803	2.717908
3	200912	-14.33377	.7421614	-19.31	0.000	-15.78838	-12.87915
3	201001	-18.37087	.7794767	-23.57	0.000	-19.89862	-16.84312
3	201002	-18.46548	.8850422	-20.86	0.000	-20.20014	-16.73083
3	201003	-2.171681	.5440646	-3.99	0.000	-3.238031	-1.105331
3	201004	-.1378551	.5283282	-0.26	0.794	-1.173362	.897652
3	201005	-5.336617	.532192	-10.03	0.000	-6.379697	-4.293537
3	201006	-3.836876	.538338	-7.13	0.000	-4.892002	-2.78175
3	201007	3.055561	.591153	5.17	0.000	1.89692	4.214203
3	201008	6.893369	.6588577	10.46	0.000	5.602028	8.184709
3	201009	11.38975	.7299049	15.60	0.000	9.959162	12.82034
3	201010	9.956821	.6898606	14.43	0.000	8.604716	11.30893
3	201011	-5.695116	.8066483	-7.06	0.000	-7.276122	-4.11411
3	201012	-21.35183	.7486924	-28.52	0.000	-22.81925	-19.88442
3	201101	-23.79701	.8934698	-26.63	0.000	-25.54819	-22.04584
3	201102	-6.114855	.5659414	-10.80	0.000	-7.224083	-5.005627
3	201103	-5.505351	.6004264	-9.17	0.000	-6.682168	-4.328533
4	200901	-5.861322	1.231562	-4.76	0.000	-8.275146	-3.447499
4	200902	-10.38068	1.172296	-8.86	0.000	-12.67834	-8.083015
4	200903	-3.243827	1.101798	-2.94	0.003	-5.403318	-1.084337
4	200904	-2.183546	1.08875	-2.01	0.045	-4.317463	-.0496286
4	200905	-2.393892	1.095938	-2.18	0.029	-4.541897	-.2458867
4	200907	6.828609	1.208247	5.65	0.000	4.460481	9.196737
4	200908	2.304797	1.158839	1.99	0.047	.0335076	4.576086
4	200909	9.570243	1.180024	8.11	0.000	7.257431	11.88305
4	200910	5.484633	1.198249	4.58	0.000	3.136101	7.833164
4	200911	-1.093537	1.264058	-0.87	0.387	-3.571052	1.383977
4	200912	-15.95889	1.191173	-13.40	0.000	-18.29355	-13.62423
4	201001	-19.01027	1.212553	-15.68	0.000	-21.38684	-16.6337
4	201002	-17.01281	1.278598	-13.31	0.000	-19.51882	-14.5068
4	201003	-1.210361	1.092289	-1.11	0.268	-3.351214	.9304931
4	201004	-1.443451	1.074951	-1.34	0.179	-3.550321	.6634191
4	201005	-7.14515	1.080256	-6.61	0.000	-9.262419	-5.02788
4	201006	-5.166153	1.085197	-4.76	0.000	-7.293106	-3.0392
4	201007	.5834876	1.106336	0.53	0.598	-1.584898	2.751873
4	201008	3.672043	1.124906	3.26	0.001	1.467262	5.876824
4	201009	9.13512	1.172299	7.79	0.000	6.837449	11.43279
4	201010	7.968857	1.160437	6.87	0.000	5.694436	10.24328
4	201011	-6.880328	1.225462	-5.61	0.000	-9.282195	-4.478461
4	201012	-22.25081	1.216083	-18.30	0.000	-24.6343	-19.86733
4	201101	-21.61695	1.289504	-16.76	0.000	-24.14434	-19.08957
4	201102	-3.931399	1.114829	-3.53	0.000	-6.11643	-1.746368

4 201103	-5.299288	1.130323	-4.69	0.000	-7.514686	-3.08389

Appendix E: PER Channel Process



Appendix F: DSMore Table

SAE

Per Measure Impacts Summary for PER Carolinas

Impacts ⇨ / Technology ⇩	Product code	State	EM&V gross savings (kWh/unit)	EM&V gross kW (customer peak/unit)	EM&V gross kW (coincident peak/unit)	Unit of measure	Combined spillover less freeridership	EM&V net savings (kWh/unit)	EM&V net kW (customer peak/unit)	EM&V net kW (coincident peak/unit)	EM&V load shape (yes/no)	EUL (whole number)
CFLs		Carolinas	356.0	0.2888	0.0289	customer	15.9%	299.4	0.2429	0.0243	no	5
Double Pane Windows		Carolinas	10.9	0.0037	0.0037	customer	0.0%	10.9	0.0037	0.0037	no	20
14 SEER Central AC		Carolinas	8.9	0.0078	0.0078	customer	0.0%	8.9	0.0078	0.0078	no	15
Energy Star Doors		Carolinas	2.3	0.0007	0.0007	customer	0.0%	2.3	0.0007	0.0007	no	20
Program wide			**378**	**0.3011**	**0.0411**		**15.0%**	**321**	**0.2552**	**0.0365**		**6**

Notes:
1. Technology names should match the DSMore naming convention.
2. Energy impacts are average per installed unit for each DSMore technology and unit description (measure/ton/sq.ft., etc.)
3. Any analysis using a control group (such as billing analysis with a control group) does not need a freeridership adjustment
(it is already in the analysis via the control group adjustment)
4. EM&V load shape: “no” if using standard DSMore load shape for technology units, “yes” if an evaluation-provided load shape should be used for DSMore.

Process Evaluation of the Personalized Energy Report Program in the Carolinas

Final Report

Prepared for
Duke Energy

139 East Fourth Street
Cincinnati, OH 45201

Drafted: December 31, 2010
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Summary of Findings

Significant Process Evaluation Findings

- The overall participant satisfaction with the program is high at 9.4 on a one-to-ten scale.

- The kit mean satisfaction rating is the lowest of all the satisfaction ratings in the program at 8.4. Respondents stating problems with the kit all referenced the quality of the CFLs. Several respondents said the kit CFLs were too dim, too easily broken, or took too long to warm up.

- The free six pack of CFLs is the most referenced (38% and 40%) primary motivator for participation in the program in North and South Carolina while the desire to save energy was the second-most often referenced primary motivating factor at 35% in North Carolina and 21% in South Carolina.

- Sixty-six participants in North Carolina (63%) and thirty participants in South Carolina (58%) indicated they had at least one pre-installed CFL in their home prior to taking part in the Personalized Energy Report® program. In addition, 15% of respondents in North Carolina and 10% of respondents in South Carolina indicated that they had more than six CFLs installed prior to taking part in the program.

- As part of ongoing research related to program marketing effectiveness, Duke Energy has been exploring whether some programs are gateways that potentiate other offers. Research on follow on offer uptake for PER® indicates that customers that first participate in PER® are approximately twice as likely to respond to an offer to participate in Power Manager® as compared to those that did not first participate in PER®. The reverse correlation does appear strong. This suggests that customers participating in PER® should be offered additional opportunities to participate, especially in simple offers like Power Manager®. Duke Energy's research on this type of offer progression focuses on the 2009 period. Eventually the universe of participants that *first* received PER® and *then* a Power Manager® offer will decline, as the total number of Power Manager® offers mailed increases over time. It may be that the ability to migrate customers through programming experiences, e.g. PER® to Power Manager®, could drive additional value for Duke Energy, by keeping customers engaged and continuing to offer relevant programming.

Recommendations

- Consider increasing the Personalized Energy Report's® ability to provide reports that are more customized to Duke Energy's customers. While the current energy efficiency tips in the Personalized Energy Report® are accurate, they border on being generic and are not focused on the specific needs of the customer receiving them. Tips that are directly tied to customer responses and tuned to local climates and trends are likely to be better heeded.
- Streamline program delivery by consolidating operations within the same vendor whenever possible. This allows easier management for Duke Energy and greater accountability from the vendor for program operations.
- Review areas of overlap between Duke Energy's residential energy report programs: PER®/OHEC (Online Home Energy Calculator) vs. HEHC (Home Energy House Call) vs. HECR (Home Energy Comparison Report). The current number of slightly different residential energy report offerings risk confusing customers who may participate in one residential program and then not know whether they could or should participate in another. Duke Energy needs to make clear if there are different benefits of each program to the customer. It is also critical for Duke Energy to provide consistent messaging and energy tips, in order for Duke Energy to retain its role as the trusted source for energy efficiency information.
- Verify CFL installations and track cross-program participation. Consider increasing the variety of specialty CFLs included in the program offer and tracking the ratio of CFLs to lighting fixtures in residential homes. The two types of CFLs being offered through Duke Energy residential programs are the 13w and 20w medium screw base lamps. These CFLs typically only fit into a few fixtures within a residence, leaving many fixtures that use inefficient bulbs. If more specialty CFLs are offered, the proportion of CFLs to lighting fixtures will increase. This can help maintain high installation rates, and decrease the risk that CFLs will be stockpiled or stored by customers.

Introduction

The Personalized Energy Report® (PER®) (referred to from here forward as the Personalized Energy Report® or PER®) is a customized energy report offered to Duke Energy's residential customers to help them identify ways to save energy in their homes. The Personalized Energy Report® is offered both via mail and via Duke Energy's website. (The online version of the program will be referred to from here forward as the Online Audit.) The online version is identical in content to the mailed Personalized Energy Report® and has the benefit of being accessible to Duke Energy's customer service representatives. The mailed Personalized Energy Report® includes a cover letter that informs customers of the availability of the OHEC if they wish to respond online. Customers channeled from the Personalized Energy Report® to OHEC are given a tracking code to use if they wish to respond online.

Through both the mailed version and online versions of the program, customers complete a survey about their home and energy use, and in return receive the customized energy report. As an incentive for participating in the PER® and OHEC programs, customers are also offered a free package of 6 CFLs. The PER®/OHEC participation survey can be found in Appendix C: Personalized Energy Report® Paper Survey.

This document presents the evaluation report for Duke Energy's PER® and OHEC programs as they were administered in North and South Carolina. These customers received the PER® offer by mail, and either returned the paper PER® survey, or completed the OHEC survey online as directed in the cover letter. A separate impact analysis was performed for the 6 pack of CFLs and for the measures that were installed as a result of the PER® and OHEC's recommendations.

The study includes participants from August 2009 through August of 2010.

	NC	SC
Completed Online Survey	35	15
Completed Mail Survey	70	37

The evaluation was conducted by TecMarket Works and BuildingMetrics with assistance from Yinsight. The survey instruments were developed by TecMarket Works and BuildingMetrics. The survey was administered by TecMarket Works. Yinsight (a TecMarket Works subcontractor) conducted the in-depth interviews with program management.

Methodology

This section presents the approach for conducting this assessment.

Development of the Surveys

TecMarket Works and Building Metrics developed a customer survey for the Personalized Energy Report® (PER®) Program participants to be implemented after they have had time to install at least some of the CFLs in the kit and to follow the recommendations offered.

The survey was conducted with a random sample of 157 Personalized Energy Report® program participants. These participants were surveyed by TecMarket Works. To help focus the survey, the questions asked were based on key results of an earlier study employing an identical approach for similar measures. The experience from the previous study for the Personalized Energy Report® program allowed this study to use those questions that were most informative to the energy impact estimation process and eliminate those questions that were found to have little impact on the results of the energy savings calculations. This allowed the Personalized Energy Report® survey to be shorter and more focused, yet still provide the information needed to estimate savings. The survey can be found in Appendix A: Participant Survey Instrument.

	North Carolina	South Carolina
Participants		
Mail	32,370	10,042
Online	9,430	2,650
Surveyed		
Mail	70	37
Online	35	15

Installation Rates of Kit Items

Participants were asked if they installed the CFLs in the Personalized Energy Report® kit. The results are summarized in Table 1 below. A more in-depth look at installation rates and energy savings can be found in the impact section.

Table 1. Respondent Installation Rates

	North Carolina			South Carolina		
	Survey	%	Total	Survey	%	Total
Installed 13-Watt	218	69%	**86,785**	99	63%	**24,164**
Installed 20-Watt	204	65%	**81,211**	104	67%	**25,384**
Potential 13-Watt	79	25%	**31,450**	15	10%	**3,661**
Potential 20-Watt	87	28%	**34,634**	16	10%	**3,905**

Free Ridership and Spillover

Free ridership was calculated for CFLs distributed to customers who filled out a Personalized Energy Report® survey. The level of free ridership was determined by using the responses to two questions in the survey (found in Appendix A: Participant Survey Instrument). Respondents were asked if they had any CFLs installed in their home prior to completing the Personalized Energy Report® survey, and, if so, how many. The

amount of pre-installed CFLs determined the level of free ridership applied to energy savings according to Table 2 below.

Table 2. Free Ridership Factors for Energy Efficiency Kit CFLs

Did you have any CFLs installed before you completed your PER® survey?	If yes, how many?	% Free Ridership
No	n/a	0%
Yes	1 to 3	0%
	4 to 6	25%
	7 to 9	50%
	10 to 12	75%
	More than 12	100%

The percentages of survey respondents in each range of free ridership for pre-installed CFLs are presented in Figure 1 below. These percentages multiplied by the free ridership levels are then presented in Table 3 to arrive at the unadjusted free ridership for CFLs in the Personalized Energy Report® programs. These numbers amount to an unadjusted free ridership of 17.0% in North Carolina and 13.4% percent in South Carolina. There are total of 113 responses in North Carolina and 52 responses in South Carolina for these questions, therefore the weighted average of these percentages gives an unadjusted system freeridership of 15. 9% for the Carolinas.

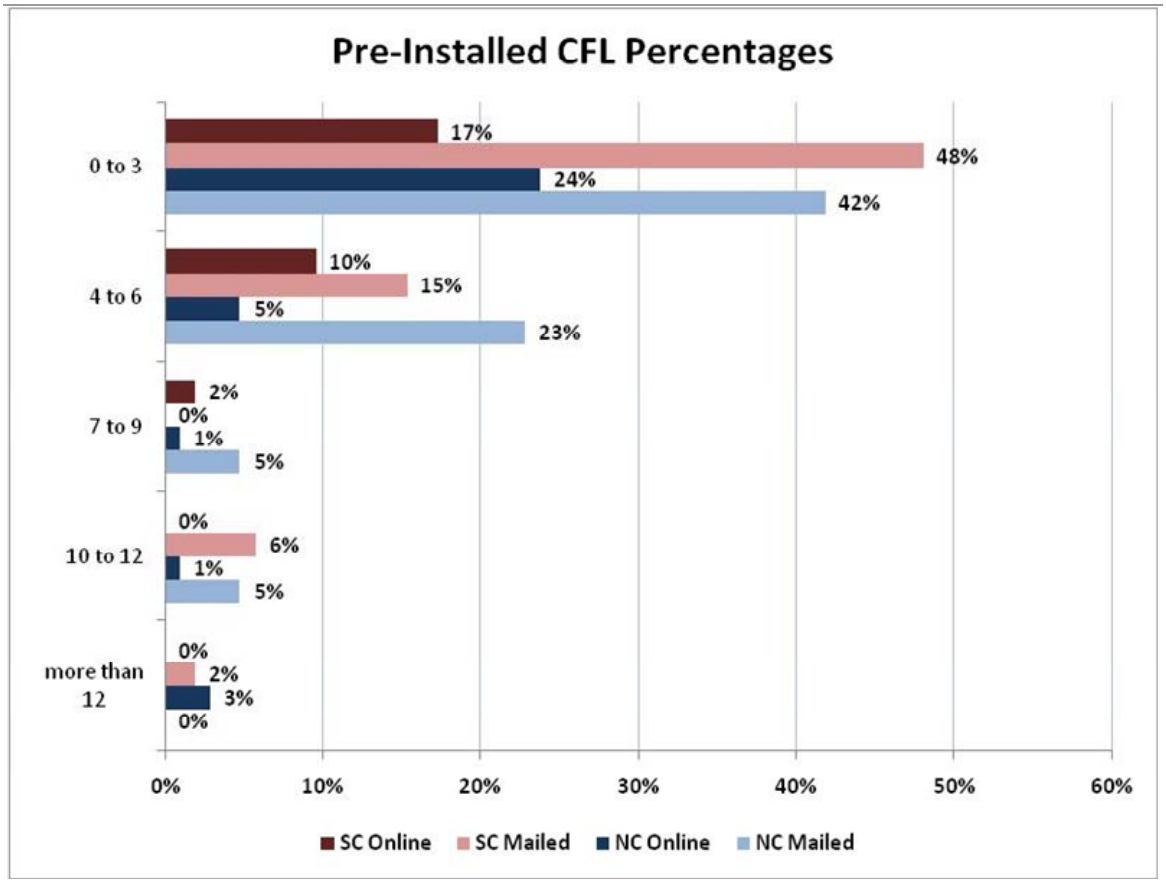


Figure 1. Percentage of Respondents by number of CFLs pre-installed

Table 3. Free Ridership in North and South Carolina

State	Type	Pre-installed CFL range	Percentage in range	Free ridership Level	Free ridership
NC	Mailed	0 to 3	41.9%	0	0%
		4 to 6	22.9%	25	5.7%
		7 to 9	4.8%	50	2.4%
		10 to 12	4.8%	75	3.6%
		More than 12	0%	100	0%
	Online	0 to 3	23.8%	0	0%
		4 to 6	4.8%	25	1.2%
		7 to 9	1.0%	50	0.5%
		10 to 12	1.0%	75	0.7%
		More than 12	2.9%	100	2.9%
Sum of NC Free Ridership					**17.0%**
SC	Mailed	0 to 3	48.1%	0	0%
		4 to 6	15.4%	25	3.8%
		7 to 9	0%	50	0%
		10 to 12	5.8%	75	4.3%
		More than 12	1.9%	100	1.9%
	Online	0 to 3	17.3%	0	0%
		4 to 6	9.6%	25	2.4%
		7 to 9	1.9%	50	1.0%

		10 to 12	0%	75	0%
		More than 12	0%	100	0%
Sum of SC Free Ridership					**13.4%**

Section 1: Program Operations

Interviewees

In-depth interviews were conducted with four program and account managers: the Personalized Energy Report® Program Manager at Duke Energy, the Personalized Energy Report® Project Manager at Aclara, the Personalized Energy Report® Account Manager at Niagara Conservation, and the project manager at McKay Press.

Program Background

The Personalized Energy Report® (PER®) is a customized energy report offered to Duke Energy's residential customers to help them identify ways to save energy in their homes. The Personalized Energy Report® is offered both via mail and via Duke Energy's website. (The online version of the program will be referred to from here forward as the Online Audit.) The Online Audit is identical in content to the mailed Personalized Energy Report® and has the benefit of being accessible to Duke Energy's customer service representatives. The mailed Personalized Energy Report® includes a cover letter that informs customers of the availability of the OHEC if they wish to respond online. Customers channeled from the Personalized Energy Report® to OHEC are given a tracking code to use if they wish to respond online.

Through both the mailed version and online versions of the program, customers complete a survey about their home and energy use, and in return receive the customized energy report. As an incentive for participating in the PER® and OHEC programs, customers are also offered a free package of 6 CFLs.

The Personalized Energy Report® and OHEC have two main objectives. The first is to provide energy efficiency information to customers. The second is to provide CFLs to the customers in order to achieve energy savings towards Duke Energy's program goals.

The Personalized Energy Report® survey is a 30-item questionnaire that asks customers to provide details about their home's physical characteristics. The Personalized Energy Report® itself is a four page report that provides customers with:

1. Annual energy usage by month, in two forms
2. A table showing kWh usage each month with the approximate bill for that month (assuming average energy rates)
3. A chart showing kWh usage for each month, colored to indicate winter heating and summer cooling months
4. House electricity usage disaggregated into six end use categories, based upon the customer's survey responses.
5. A scale showing the homeowner's energy usage compared with the low-to-high range of usage by similar households.
6. General energy saving tips.

Program Gateway Relationships

As part of ongoing research related to program marketing effectiveness, Duke Energy has been exploring whether some programs are gateways that potentiate other offers. Research on follow on offer uptake for PER® indicates that customers that first participate in PER® are approximately twice as likely to respond to an offer to participate in Power Manager® as compared to those that did not first participate in PER®. The reverse correlation does appear strong. This suggests that customers participating in PER® should be offered additional opportunities to participate in simple offers like Power Manager®. Duke Energy's research on this type of offer progression focuses on the 2009 period. The universe of participants that *first* received PER® and *then* a Power Manager® offer will decline as the total number of Power Manager® offers mailed increases. It may be that the ability to migrate customers through programming experiences, e.g. PER® to Power Manager®, could drive additional value for Duke Energy, by keeping customers engaged and continuing to offer relevant programming.

The OHEC Program and the Online Audit Report

The OHEC's (Online Home Energy Calculator) Online Audit Report content is identical to the Personalized Energy Report® (PER®). Aclara, the main Personalized Energy Report® (PER®) vendor, provides the look and feel of the OHEC web page, customized for each of their utility clients' color schemes. Customers can print their Online Audits off the website, and are told they will receive their CFL incentive in 1 to 2 weeks.

The Online Audit is marketed online: When customers sign up for online billing and other online services, they are also informed of the OHEC service and the six CFL incentive. The Online Audit is also marketed by mail, as a benefit of signing up for Duke Energy's On Line Services (OLS) billing system.

There is an emphasis on driving customers to the Online Audit rather than the Personalized Energy Report® (PER®). Online delivery is more cost effective for Duke Energy and can provide faster results. Currently, the mailed Personalized Energy Report® is still seen as necessary for engaging those customers who normally would not have access to online tools.

Roles & Communications

While the Personalized Energy Report® program has been offered for the past three years, the Duke Energy program manager notes that the current version is markedly different. In past years, Duke Energy implemented the program "in house" from start to finish. The current implementation by several outside vendors seems to pose some unnecessary complexity to Duke Energy's management due to the coordination needed between the outside vendors.

Duke Energy

Duke Energy designed the layout of the survey and the energy report. Duke Energy determines the schedule for the mailing campaigns as well as which customers to target. Duke Energy's Market Analytics division targets customers who have a high probability of participating in the Personalized Energy Report® based on demographic and customer data. Duke Energy specifically targets customers that have at least four months of energy usage with Duke Energy, and likely do not have access to computers and would not be able to take advantage of Duke Energy's OHEC through Duke Energy's On Line Services (OLS).

Duke Energy sends the list of targeted customers to McKay Press. McKay prints surveys that contain the customer's name, address, and a bar code representing the customer's account number. McKay then mails the surveys to the targeted customers.

The surveys use bubble-in responses so completed surveys must be sent to Kindred, a scanning vendor that subcontracts to Aclara, the main vendor for the Personalized Energy Report. Once Aclara processes the surveys and provides the participant list to Duke Energy, Duke Energy sends another vendor, Niagara Conservation Services, a list of customers who qualify for the incentive kit. The kit contains three 13watt and three 20watt CFLs, a Duke Energy pamphlet, and a thank you card.

Aclara

Aclara created the survey and provides the personalized report. Aclara processes the survey responses through their proprietary analytic engine and creates appropriate tips. The Aclara program manager reported that Aclara coordinates with Duke Energy to make sure that Aclara has enough staffing to process surveys at the time of Duke Energy's scheduled campaigns. In order to provide the customer's billing history in the Personalized Energy Report® report, Aclara must download the billing data for those customers who are targeted in the current campaign. The Personalized Energy Report® uses Aclara's proprietary Home Energy Center service.

Aclara conducts quality control by reviewing the PDF print file of the Personalized Energy Report® and inspecting certain components of the report. Their quality control procedure includes: checking that the charts show values within reasonable limits, checking that the graphics are printing correctly, and checking that the customer's home state is correctly referenced in the report. Aclara sends print files for the Personalized Energy Report® to McKay Press.

During the campaign, Aclara holds weekly meetings with Duke Energy and the other vendors to discuss outstanding issues and provide reports from Kindred, the vendor that scans the surveys. Aclara acts as the liaison between Duke Energy and Kindred.

McKay Press

McKay prints and sends out both the Personalized Energy Report® surveys and the final energy reports. The McKay project manager reports that McKay helped provide some

design elements of the Personalized Energy Report® survey so that bar codes could be used instead of customer account numbers.

McKay reports that the mail drops have been implemented smoothly. McKay's quality control procedures include using a camera matching system to ensure that the customized survey is matched and inserted in the correct addressed envelope. In the rare event that the camera matching fails, McKay performs hand checks to ensure correct mailings. After the mail drop, McKay files the postal receipt with Duke Energy.

McKay reports that things are working very well: *"We've worked out a pretty good process between [Aclara] and myself. They have a great naming convention, [it's] dated and time-stamped. I like the way that everything works."*

Niagara

Niagara sends out the CFLs for both the Personalized Energy Report® and OHEC and maintains a toll free number for questions about kit items, or to report broken CFLs. The Niagara account manager reports that the incidence of broken CFLs has been very low for the Personalized Energy Report® program, less than 1%. Niagara has fulfilled CFL orders within 3 to 4 days on average, easily exceeding their contractual requirement to fulfill kit orders within 9 days. Once the CFL orders have been fulfilled, Niagara uploads the completed shipment information to Duke Energy's databases, including information on which customers received the CFLs.

As part of Niagara's quality control, they call 5% of the Personalized Energy Report® customers to verify that the CFLs were shipped correctly, and have to date been achieving over 99% accuracy in their CFL shipments.

Niagara's account manager reports that the CFL fulfillment process is running smoothly: *"We appreciate Duke as a business partner and one of the things we appreciate about them is that their plans are well thought out and specific about what needs to be done."*

Campaign Timeline

The actual number of campaigns that Duke Energy plans depends upon the return rate necessary to achieve a certain level of participation. At the time of the interviews, the mail campaign for 2010 had concluded. Customers who return the surveys after the end of the campaign are still sent the six CFLs but they are told that they will not be receiving an energy report. The Duke Energy program manager reports that they have received no customer complaints in these situations.

Program Success

The 2010 Personalized Energy Report® program has enjoyed an unusually high 20%-24% response rate from customers with the mailer. The Duke Energy program manager attributes this in large part to the work of the Market Analytics division and their targeting of customers who are likely to participate. Another reason for the high response rate is the free CFLs incentive. TecMarket Works notes that these participation rates are

among the highest in the United States for this type of information program, if not the highest.

Future Improvements

Due to the high response rates, the interviewees were hard-pressed to identify any improvements that may increase customer participation rates. However, program marketing is constantly undergoing refinement. The Duke Energy program manager reports that they are currently testing different versions of cover letters to gauge which type of messaging draws the most interest. Duke Energy is also experimenting with follow-up letters after the survey is mailed out, to remind customers that "time is running out" to take advantage of the Personalized Energy Report.

Duke Energy is currently looking at other ways to provide feedback to their customers about energy usage. The Duke Energy program manager reports that when Duke Energy begins to collect hourly meter data, customers' energy usage will be need to be presented in the report in a completely different fashion.

The Duke Energy program manager also reports that they have long been considering analyzing the customer survey responses to identify prospective participants for other energy efficiency programs. For example, customers who report that they do not have a heat pump may be good prospects for the Residential Smart Saver program, an HVAC rebate program.

The Duke Energy program manager reports that Duke Energy is considering changes in general strategy towards the residential market. *"We are past individual programs."* This is a much-needed effort due to the number of residential programs that offer CFLs and/or home energy reports. In addition to PER®/OHEC, Duke Energy currently offers the Home Energy House Call (HEHC), which also provides a home energy report and CFL installations. The Home Energy Comparison Report is also offered in South Carolina. In 2010, Duke Energy's education program "Get Energy Smart" also provided CFL incentives if the students' parents fill out an energy survey. In addition, Duke Energy now allows customers to easily obtain CFLs through their interactive voice response system. The CFL incentives risk decreased installation rates if customer participation across all the different CFL giveaway programs is not carefully tracked, and if customer CFL installations are not regularly verified.

The Duke Energy program manager acknowledges that there are pros and cons to running similar programs through different vendors. On one hand, program changes can be made to one program without affecting the other programs' operations and goals. On the other hand, the different vendors may be giving the customers different feedback about home energy use.

Section 2: Participant Survey Results

In October 2010, 105 participants in North Carolina and 52 participants in South Carolina (out of a possible 54,492) Personalized Energy Report® program participants were contacted by phone to participate in a survey.

The original PER® surveys were filled out by the phone survey participants both online and in a physical mailing. Seventy filled out the PER® forms by mail and thirty-five filled out the PER® surveys online in North Carolina. Thirty-seven participants filled out the PER® information by mail and fifteen filled out the PER® information online in South Carolina.

Satisfaction

Participants were asked about their overall satisfaction on a one-to-ten scale with one indicating they were completely unsatisfied and ten indicating that they were completely satisfied with the following items: the Personalized Energy Report® program, information provided by the program, ease of use of the program survey, ease of use and understandability of report, time to receive the report and energy efficiency kit, quality of kit components, and the program overall.

As shown in Figure 1, participants have a very high satisfaction rate of 9.4 overall in North Carolina and 9.1 in South Carolina with the Personal Energy Report program.

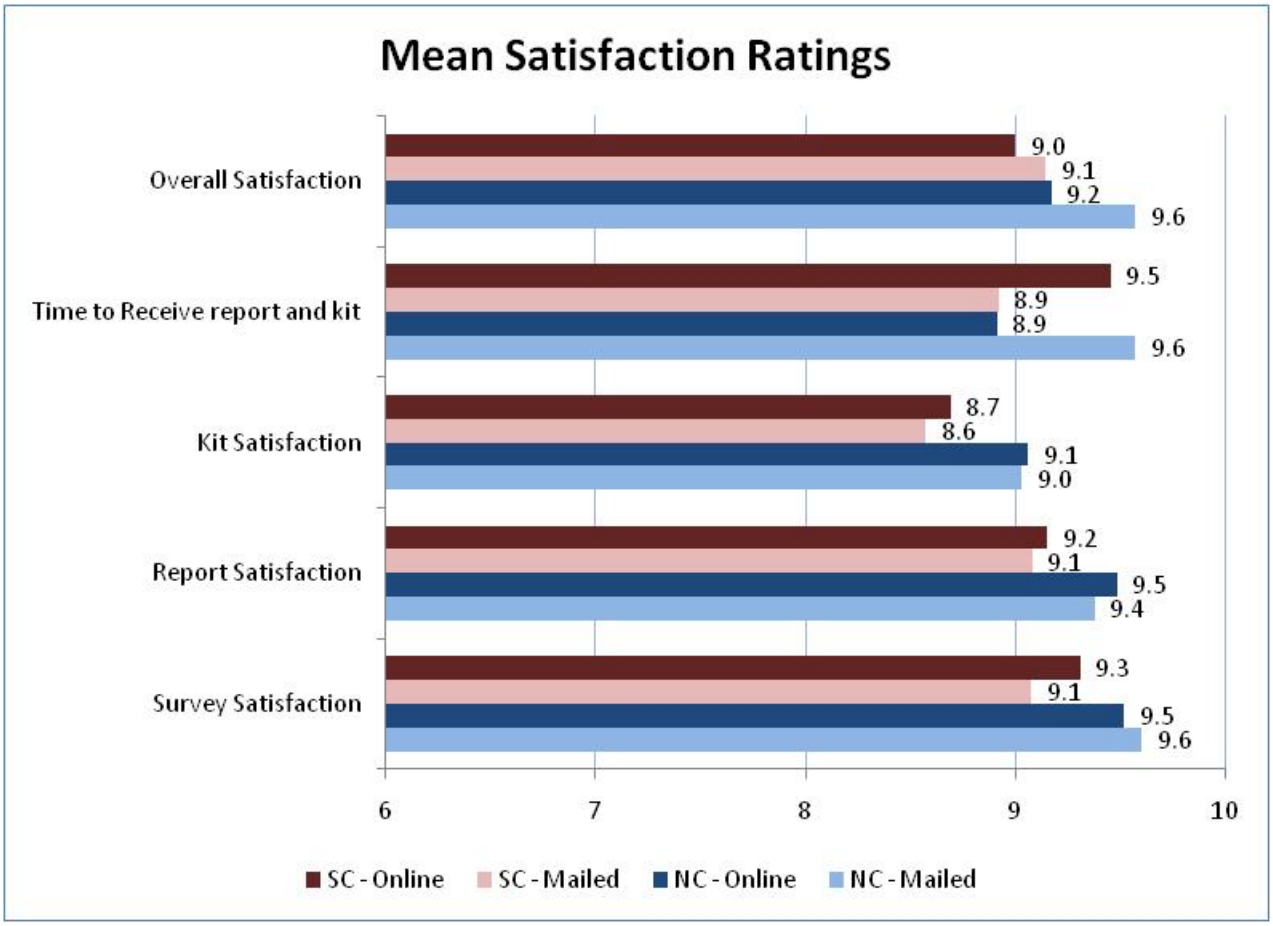


Figure 1. Mean satisfaction rating for Personalized Energy Report® (n=105 for North Carolina, n=52 for South Carolina)

When a survey respondent provided a satisfaction score that was less than eight, respondents were asked how that aspect of the program could be improved. The amount of ratings of seven or lower for each program aspect is shown below in Table 4.

Table 4. Satisfaction Ratings of 7 or Less

	NC		SC	
	N	Percentage	N	Percentage
Overall Satisfaction	5	6.7%	2	3.8%
Time to receive report and kit	6	5.7%	1	1.9%
Kit satisfaction	12	11.4%	5	9.6%
Report Satisfaction	3	2.9%	0	0%
Survey Satisfaction	4	3.8%	0	0%

In North Carolina, two respondents said that the PER® survey was too long. One participant said there was too much information in the report.

Regarding kit satisfaction:

- Five respondents would like to see better quality CFLs in the energy efficiency kit.
- Four respondents thought the CFLs were too dim.
- One respondent thought CFLs were too difficult to dispose of.
- One respondent did not like the color representation quality of the CFLs.

For report satisfaction:

- Two respondents indicated that the report provided them with no new information.
- One respondent said that the suggestions provided were too expensive to implement.

The only other improvement mentioned by respondents was in the area of overall satisfaction. One respondent reported that he or she would like coupons for CFLs with a later expiration date. However, the Personalized Energy Report® program does not send coupons to the Personalized Energy Report® participants, so this customer was likely thinking of Duke Energy's Residential Smart Saver CFL campaign instead of the Personalized Energy Report® program.

In South Carolina, two respondents suggested that Duke Energy provide higher quality CFLs in the CFL six pack, and one respondent asked for a coupon with a later expiration date (again, this customer was likely thinking of another Duke Energy CFL program). Six respondents indicated that they were already very energy conscious and had already implemented the suggestions in the report, and one respondent was not satisfied with his or her perceived energy savings achieved after implementing the suggestions in the report.

CFL Satisfaction

Participants were also asked to rate their satisfaction with the program's 13-watt and 20-watt CFLs on a one-to-ten scale with one meaning least satisfied and ten meaning most satisfied. As seen in Figure 2, the CFL satisfaction rate is high for both wattages in South Carolina with an average score of 8.7 and 8.8. The satisfaction in South Carolina for CFLs is only slightly lower at 8.6 for both the 20-watt CFLs and 13-watt CFLs.

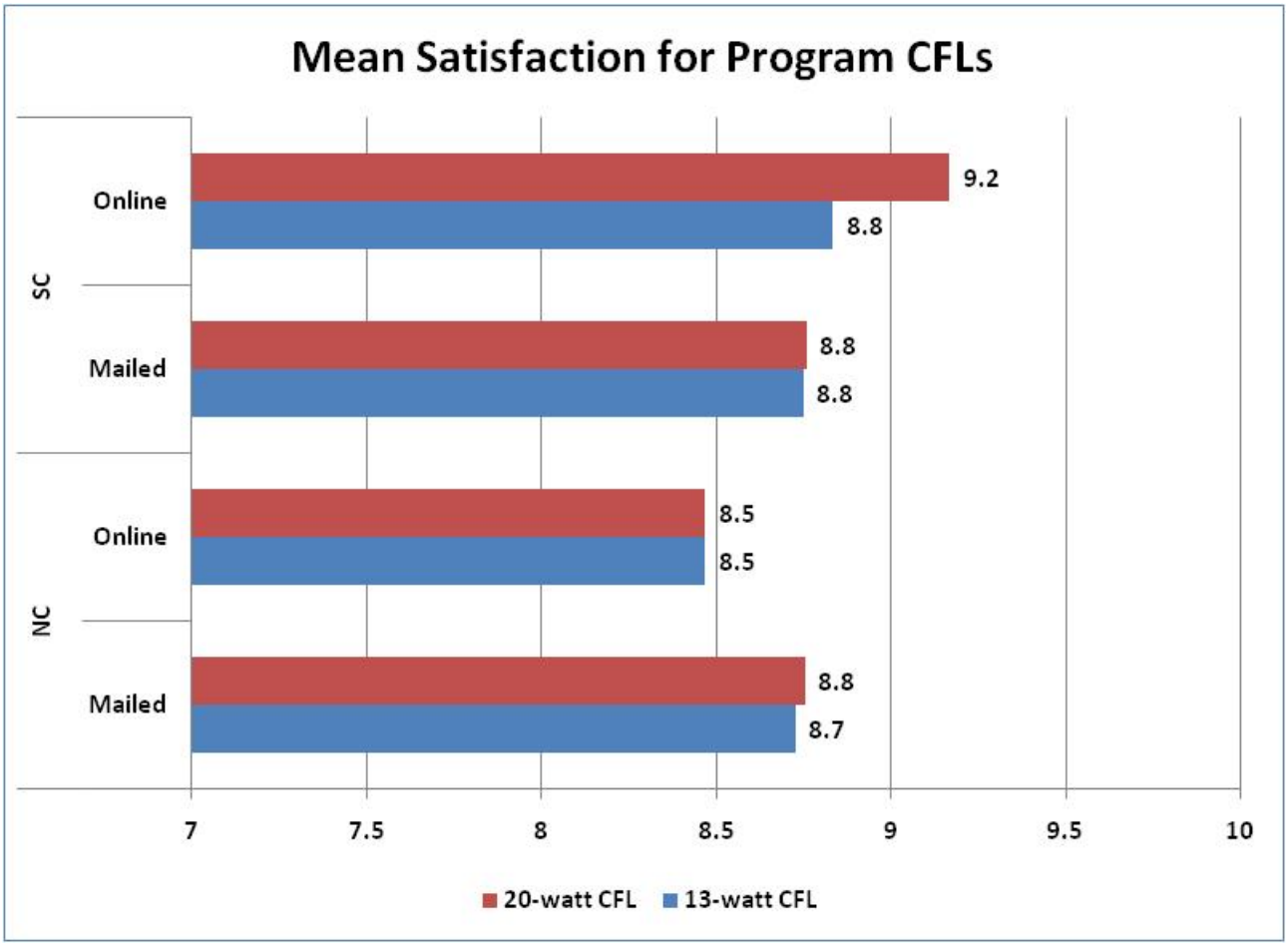


Figure 2. Mean satisfaction ratings for program CFLs (n=105 in North Carolina, n=52 in South Carolina)

Table 5. CFL ratings of seven or less

	NC		SC	
	N	Percentage	N	Percentage
20-watt	13	12.4%	5	9.6%
13-watt	13	12.4%	4	7.7%

Reasons given for ratings of seven or less include the following:

For the 20-watt bulbs in North Carolina:

- Two respondents found the CFL to be too dim
- Two respondents did not like the CFLs' color rendering
- Two respondent were concerned about the disposal of the CFLs
- One respondent said the light bulb was physically too large
- One respondent thought the CFL took too long to warm up

In South Carolina, two respondents thought that the 20-watt CFLs were too dim.

For the 13-watt bulbs in North Carolina:

- Eight respondents found the CFL to be too dim
- Two respondents cited disposal concerns with CFLs
- One respondent said that the CFLs took too long to warm up
- One respondent had a bulb that burned out quickly

In South Carolina two respondents said that the 13-watt bulb was too dim.

Likelihood of Use

In addition to satisfaction questions, phone survey participants were asked to rate whether the Personalized Energy Report® provided them with new ideas for saving energy and to rate the likelihood of them following the suggestions of the report. As shown in Figure 3, the means for the likelihood of participants taking recommended actions have a range from 6.7 to 9.0.

South Carolina participants who mailed in their survey information have noticeably lower mean ratings (6.7 and 6.9) for both categories. The range of mean ratings for all other respondent groups in both categories is 8.3-9.0.

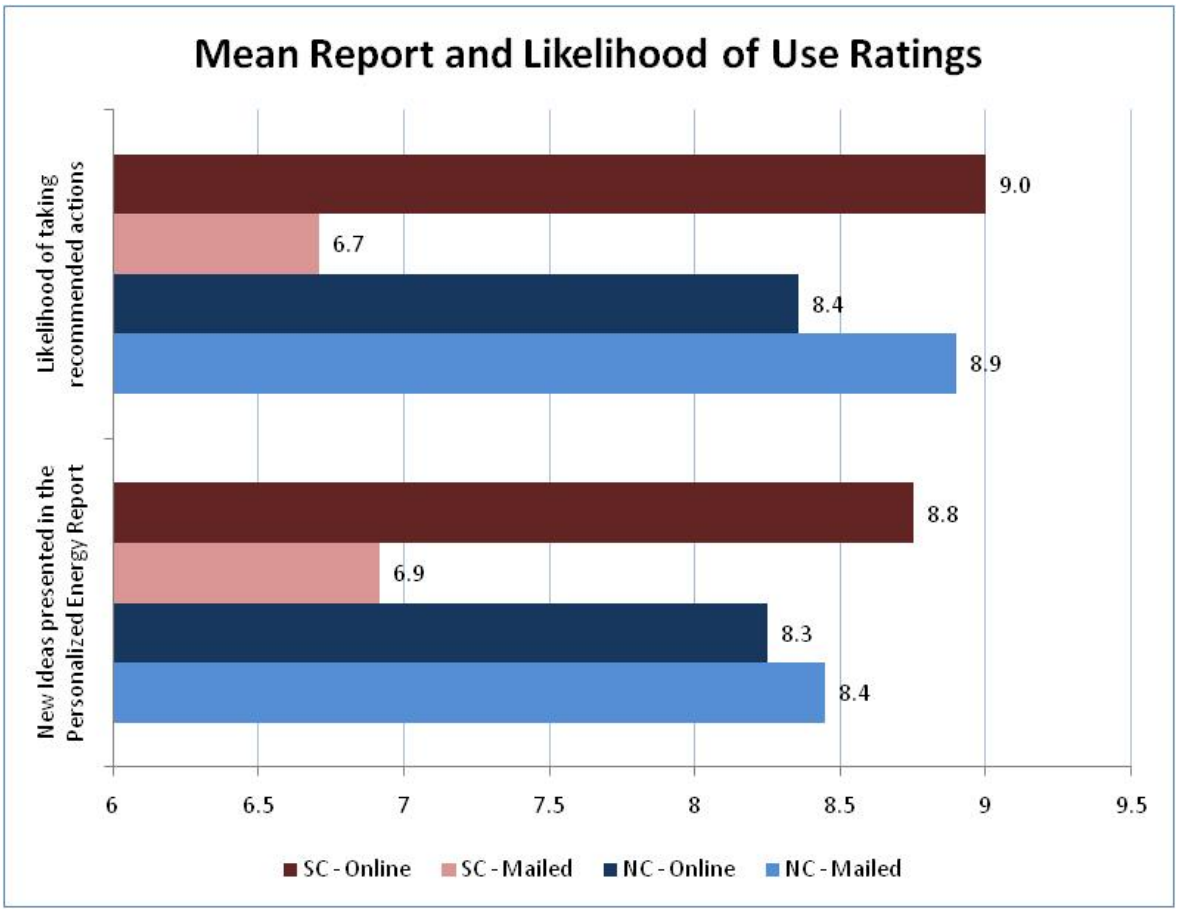


Figure 3. Mean of survey report and likelihood of use (n=105 in NC, n=52 in SC)

Table 6. New ideas and likelihood of use ratings lower than 7

	NC		SC	
	N	Percentage	N	Percentage
New ideas presented	15	14.3%	11	10.5%
Likelihood of taking action	22	20.1%	10	9.5%

Motivating Factors

Participants were asked for the factors that motivated them to participate in the Personalized Energy Report® program. Participant responses included receiving a six-pack of CFLs, wanting to reduce energy costs, information provided by the program, and past experience with another Duke Energy program. For phone survey participants who listed more than one factor, each factor was ranked according to its importance. The results are shown by state as a percentage of phone survey participants in Figure 4 and Figure 5.

The most-mentioned primary motivating factor for participation in North Carolina is the six-pack of CFLs with 38% (24% mailed plus 14% online) of participants mentioning it. A desire to reduce energy costs was the second most often mentioned primary motivating factor with a rate of 35% (24% mailed plus 11% online). In South Carolina, the top two primary motivating factors are the same but with a higher variance between factors. The six-pack of CFLs is indicated as being the primary factor by 40% of survey participants while the desire to reduce energy costs was noted as primary by 21% of participants.

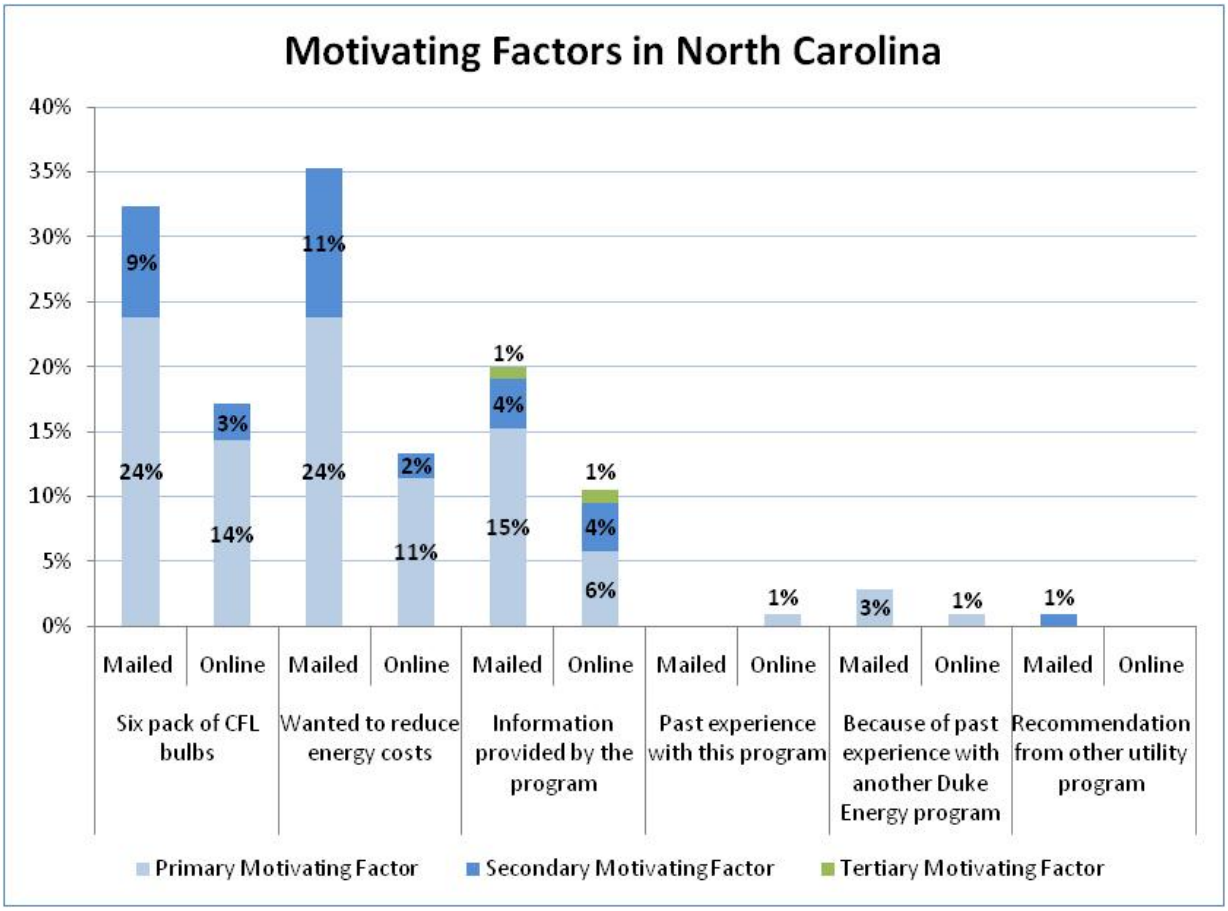


Figure 4. Motivating Factors in North Carolina

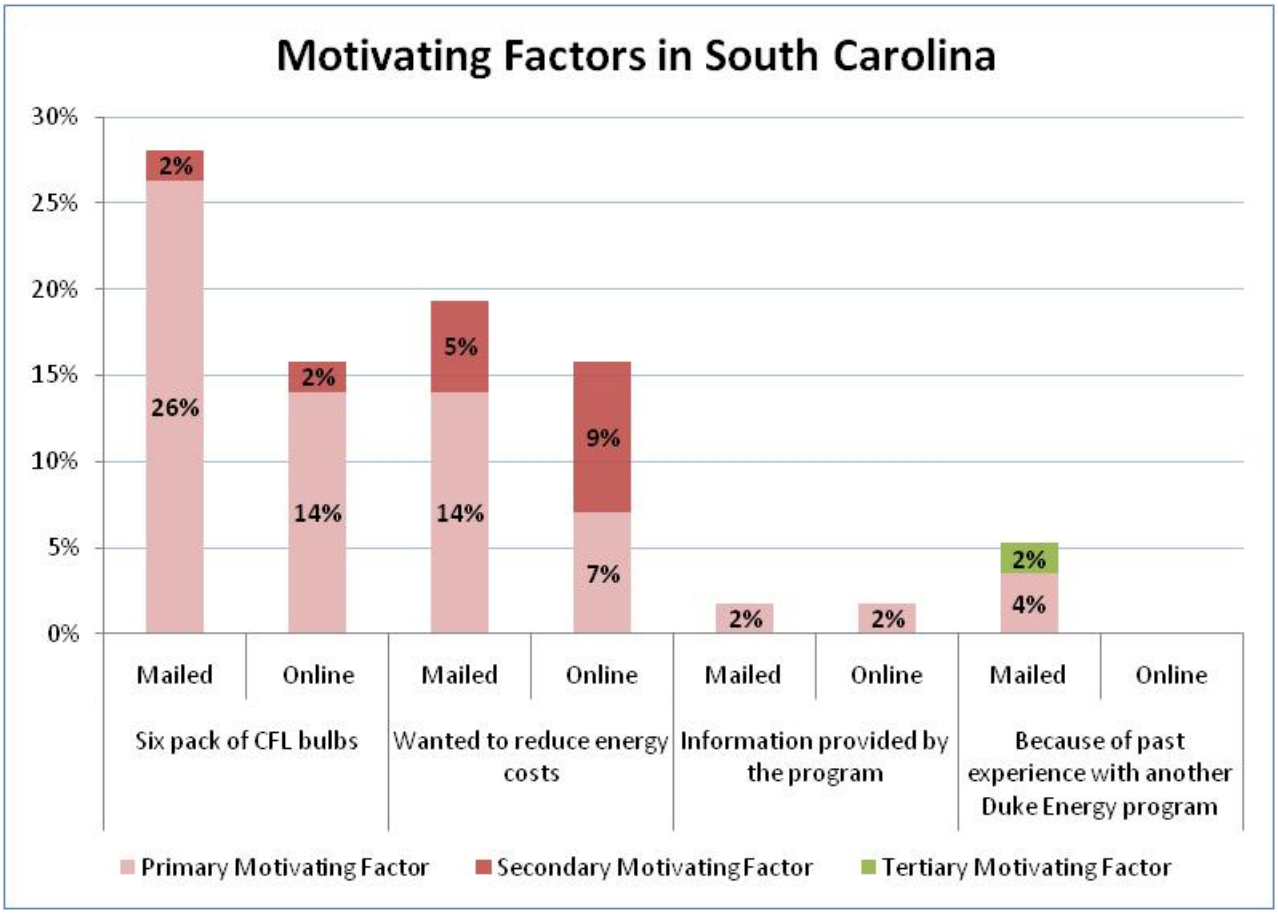


Figure 5. Motivating Factors in South Carolina

Recommendations to Others

Participants were asked if they had recommended the Personalized Energy Report® program to any person or persons after participating in the program and, if so, how many. Forty-five participants (43%) in North Carolina and eight participants (15%) in South Carolina indicated that they had recommended the Personalized Energy Report® program to another person or persons. North Carolina phone survey participants estimated that they had recommended the program to a total of 207 people (2.0 per phone survey participant). South Carolina phone survey respondents estimated that they had recommended the program to a total of 27 people (0.5 per phone survey participant).

Free Ridership

Phone survey participants were asked if they had any CFLs installed in their homes prior to taking part in the Personalized Energy Report® program, and, if so, how many were installed. Sixty-six participants in North Carolina (63%) and thirty participants in South Carolina (58%) indicated that they had pre-installed CFLs. The total number of pre-installed bulbs in North Carolina was 393 and the total number of pre-installed bulbs in South Carolina was 178. With this information, we can estimate the number of previously installed to the full program population, as shown in Table 7.

Table 7. Estimated Number of CFLs Previously Installed in Participants' Homes

	NC: 41,800 participants	SC: 12,692 participants
Number of CFLs previously installed	393	178
Estimated number of CFLs in full population of program participants	156,451	43,446
Estimated number of pre-program installed CFLs per participant	3.7	3.4

Participants' answers were divided between those who had zero to three CFLs previously installed, those who had 4 to 6, those who had 7 to 9, those who had 10 to 12 and those who had more than twelve. The results are shown in Table 8 as total numbers and in Figure 6 as a percentage of all phone survey participants.

Table 8. Pre-installed CFLs

State	Type	Pre-installed CFL range	Total Number in range	Percentage in range
NC	Mailed	0 to 3	44	41.9%
		4 to 6	24	22.9%
		7 to 9	5	4.8%
		10 to 12	5	4.8%
		More than 12	0	0%
	Online	0 to 3	25	23.8%
		4 to 6	5	4.8%
		7 to 9	1	1.0%
		10 to 12	1	1.0%
		More than 12	3	2.9%
SC	Mailed	0 to 3	25	48.1%
		4 to 6	8	15.4%
		7 to 9	0	0%
		10 to 12	3	5.8%
		More than 12	1	1.9%
	Online	0 to 3	9	17.3%
		4 to 6	5	9.6%
		7 to 9	1	1.9%
		10 to 12	0	0%
		More than 12	0	0%

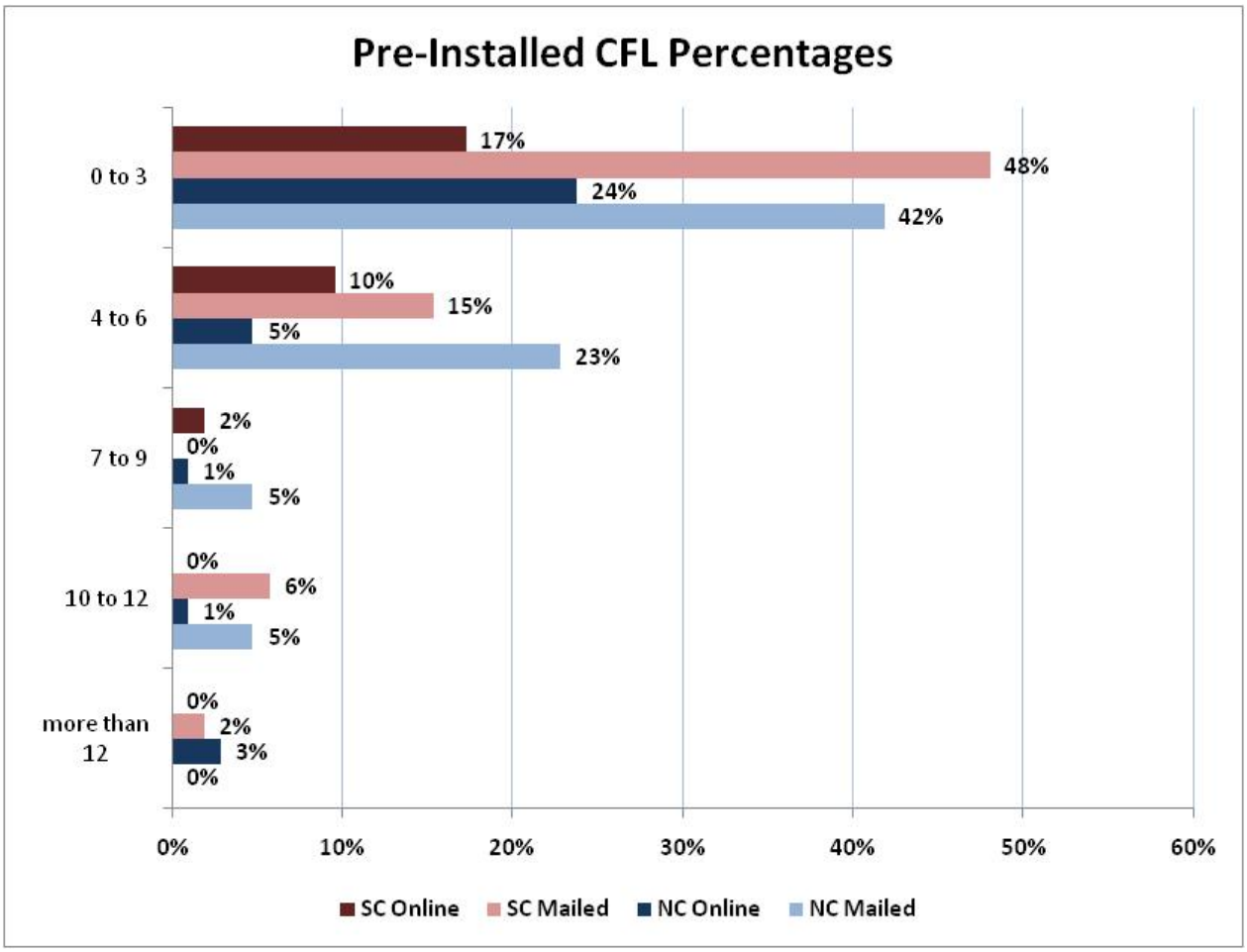


Figure 6. Pre-installed CFL percentages

In Figure 6 we can see that 15% of Personalized Energy Report® phone survey respondents in North Carolina had more than six CFLs installed before participating in the program. In South Carolina, 10% of participants indicated that they had more than six CFLs pre-installed. The freeridership results for each state are shown in Table 3 on page 8 and a weighted average was used (with 113 participants in NC and 52 in SC) to calculate a system-wide Carolinas free-ridership of 15.9%.

Spillover

Survey respondents were asked if they had purchased any additional CFLs since participating in the Personalized Energy Report® program. The results in Table 9 show that the number of additional CFLs per survey respondent is 1.23 in North Carolina and 1.27 in South Carolina.

Table 9. Additional CFLs purchased

	Number of respondents who purchased CFLs	Percentage of all respondents	Number of CFLs purchased	CFLs purchased divided by all survey respondents

NC	Mailed	13	12.4%	56	1.23
	Online	15	14.3%	77	
SC	Mailed	13	25%	52	1.27
	Online	3	5.7%	14	

Survey respondents were also asked if they had taken any action that was directly related to the information that they had received in the Personalized Energy Report. The results are shown in Figure 7.

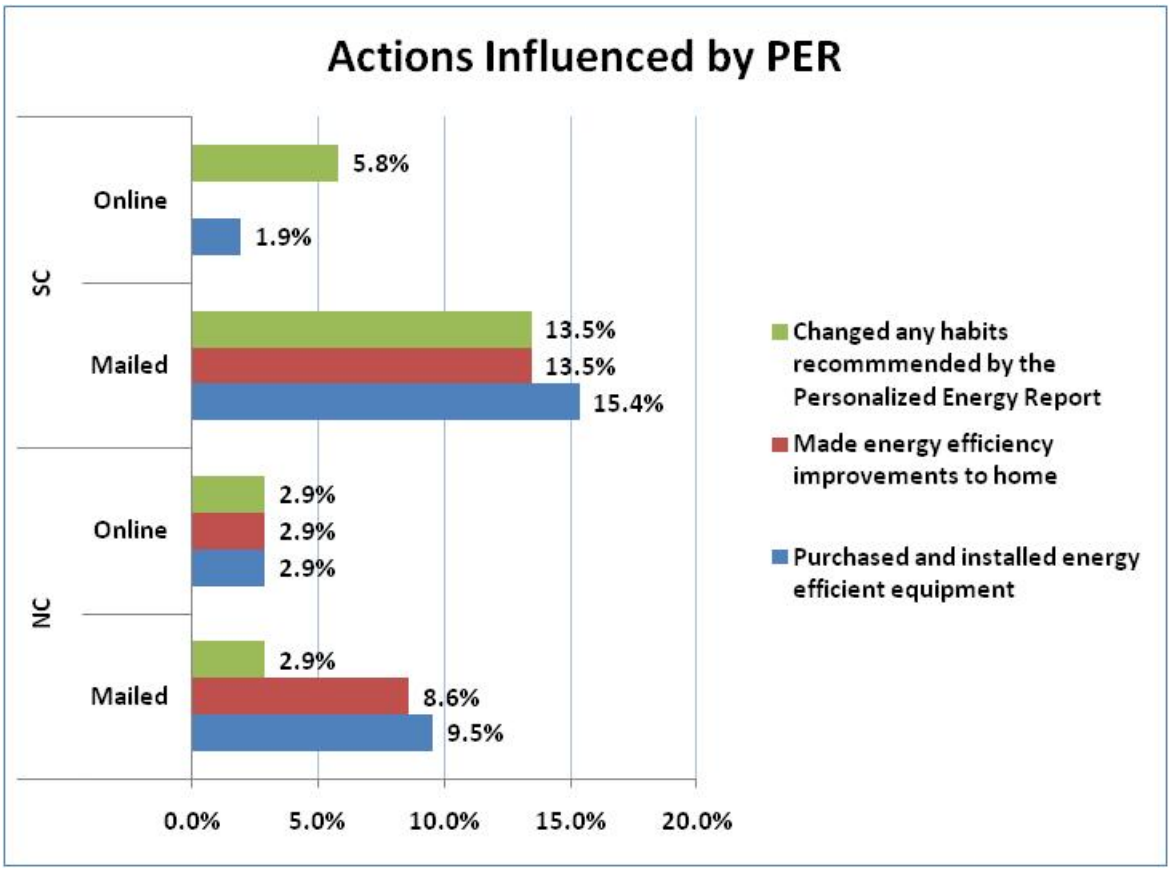


Figure 7. Actions influence by program PER® report

Survey respondents were also asked if they had taken any additional energy efficient steps at least in part as a result of what they learned in the Personalized Energy Report® program. Thirty-six out of 157 (22.9%) indicated they had taken additional steps. These actions included the following:

- Raising the thermostat in summer (n=8)
- Caulking and sealing windows (n=7)
- Installing weather-stripping around doors (n=7)
- Turning off lights when not in use (n=5)
- Unplugging appliances when not in use (n=3)

- Insulating attic (n=3)
- Insulating basement (n=3)
- Insulating walls (n=3)
- Reducing water usage with aerators and lowflow showerheads (n=3)
- Installing a storm door
- Checking house for drafts
- Keeping blinds closed

What about the Personalized Energy Report® Program Works Well
Each surveyed participant was asked what they think works well about the program Forty-seven participants cited the free CFL bulbs as what they liked the most. The remainder of the positive aspects include the information provided in the PER® report, saving energy, and the ease of use of the program. The number of each response is shown in Table 10.

Table 10. Personalized Energy Report® positively viewed components

	NC		SC	
Positively viewed component	**N**	**Percentage**	**N**	**Percentage**
Free CFLs	52	50%	27	26%
Information provided in PER®	29	28%	4	8%
Saving energy	23	22%	3	6%
Ease of use	3	6%	2	4%

Increasing Participation
Surveyed participants were asked whether they thought certain suggested changes to the program operations would increase participation in the Personalized Energy Report® program.

The most often mentioned strategy in South Carolina was to show projected savings for energy efficient measures on a customer's current bill. Four respondents mentioned this strategy. Three respondents mentioned a direct discount on the utility bill for energy efficient measures and one participant mentioned an exchange program for old light bulbs.

An increase in general advertising was mentioned by five respondents in North Carolina as an effective strategy to increase participation.

Personalized Energy Report® Changes and Additional services
Surveyed participants were asked if they would like to see any additional services as part of the Personalized Energy Report® program. One survey participant in North Carolina would like to see LED bulbs be a part of the program and one participant would like an estimate of savings for recommended actions in the report. No participants in South Carolina mentioned any addition services.

Survey participants were also asked what should be changed about the Personalized Energy Report® program. One participant in North Carolina and Duke Energy should use higher quality CFLs, and two participants in South Carolina would like more in-depth audits of their energy use.

One survey participant in South Carolina and one in North Carolina also suggested that the coupons should have a later expiration date, as their supplier of choice was out of stock and the coupons expired before they had a chance to redeem them. The Personalized Energy Report® program does not send coupons to the Personalized Energy Report® participants, so these customers were likely thinking of Duke Energy's Residential Smart Saver CFL campaign instead of the Personalized Energy Report® program.

Personalized Energy Report® Online Component

TecMarket Works reviewed the presentation, information and organization of Duke Energy's Personalized Energy Report's® online component. The survey itself is easy to fill out and presents a robust list of energy-saving tools presented with explanations. However, despite the branding of the Personalized Energy Report® as PER®, searches through Google, Yahoo, and Bing failed to return a link to the program when "Duke Energy PER®" or "Duke Energy Personal Energy Report" were typed in. Duke Energy should consider adding metadata to the program web page to enhance the searchability of the online portion of the program.

The Personalized Energy Report's online component provides an opportunity to cross-promote Duke Energy's other residential energy saving programs such as Smart $aver®, Home Energy House Call and Power Manager®. Currently there are no prominent links leading to these programs on the Personalized Energy Report® web page. Duke Energy should consider adding a link to these programs in the left-hand navigation pane for online services as well as including them in the text of the Personalized Energy Report® page.

TecMarket Works also found areas in the navigation to be improved. Specifically, adding a link to the Personalized Energy Report® to the left-hand navigation menu and linking the pie graph for monthly energy usage directly to the Personalized Energy Report® web page. The pie graph currently shows percentages in numbers when it is "moused-over", but this also creates the false impression of a broken link and can be confusing.

Duke Energy may also want to consider adding jump links in the Energy Saving Tools section as this web page is quite long and users may miss important tools by not scrolling to the bottom. Jump links would allow users to see a summary of all available tools while keeping detailed information on the same page. Jump links would also allow graphics such as diagrams or illustrations to be used with energy tips without the worry of over-lengthening the page.

Appendix A: Participant Survey Instrument

The questions below require mostly short, scaled replies from the interviewee, and not all questions will be asked of all participants. This interview should take approximately 10 to 15 minutes.

Personalized Energy Report® (PER®) Program

Participant Survey

SURVEY INTRODUCTION

If PER® participant, then contact for survey. Use five attempts at different times of the day and different days before dropping from contact list. Call times are from 10:00 a.m. to 8:00 p.m. EST or 9-7 CST Monday through Saturday. No calls on Sunday. (Sample size N =150)

SURVEY

Introduction

Note: Only read words in bold type.

Hello, my name is _____. I am calling on behalf of Duke Energy to conduct a customer survey about the Personalized Energy Report® Program. This was a survey someone in your home completed and you received a report and compact fluorescent light bulbs for your participation. May I speak with _____ please?

If person talking, proceed. If person is called to the phone reintroduce.
If not home, ask when would be a good time to call and schedule the call-back:

Call back 1: Date: _____, Time: _____ ❑AM or ❑PM
Call back 2: Date: _____, Time: _____ ❑AM or ❑PM
Call back 3: Date: _____, Time: _____ ❑AM or ❑PM
Call back 4: Date: _____, Time: _____ ❑AM or ❑PM
Call back 5: Date: _____, Time: _____ ❑AM or ❑PM

❑ Contact dropped after fifth attempt.

We are conducting this survey to obtain your opinions about the Personalized Energy Report® Program. Duke Energy's records indicate that you participated in the Personalized Energy Report® Program by completing and mailing a paper survey or an online survey. We are not selling anything. The survey will take about

5 or 10 minutes and your answers will be confidential, and will help us to make improvements to the program to better serve others. May we begin the survey?

Note: If this is not a good time, ask if there is a better time to schedule a callback.

1. **Do you recall participating in the Personalized Energy Report® Program?**

1. ❑ Yes, *begin* → *Skip to Q3.*
2. ❑ No,
99. ❑ DK/NS

This program was provided through Duke Energy. In this program, you completed a short survey about your home in <*month year*>**, and then Duke Energy provided you with energy-saving recommendations for you and your home, and you were also provided with a free six-pack of CFLs.**

Do you remember participating in this program?

1. ❑ Yes, *begin* → *Go to Q2.*
2. ❑ No,
99. ❑ DK/NS

If No or DK/NS terminate interview and go to next participant.

2. **How did you learn of the PER® Program?**

a. ____ I visited Duke Energy's website (pop-up survey)
b. ____ I got the survey in the mail -- *Did you fill out the mailed PER® survey or did you complete the survey online?*
   i. Paper ____
   ii. Online _____
c. ____ Other: _____

3. Please think back to the time when you were deciding to participate in the Personalized Energy Report® program. What factors motivated you to participate? (*do not read list, place a "1" next to the response that matches best)*

1. ____ Six pack of CFL bulbs
2. ____ Recommendation of someone else (*Probe*: **Who?**_____)
3. ____ Wanted to reduce energy costs

4. ____ The information provided by the program
5. ____ Past experience with this program
6. ____ Because of past experience with another Duke Energy program
7. ____ Recommendation from other utility program
   i. (*Probe*: **What program?** _____)
8. ____ Recommendation of family/friend/neighbor
9. ____ Other (SPECIFY)
   _____
10. ____ Don't know/don't remember/not sure (DK/NS)

If multiple responses: 3.a. **Were there any other reasons?** *(number responses above in the order they are provided - Repeat until 'no' response.)*

4. Did you have any CFLs installed in your home before you completed your PER® survey?

❑ Yes ❑ No ❑ DK

If yes, 4a. **How many did you have installed before you completed the PER® survey?**

Enter response: _____

Please answer the following set of questions with a yes or no response.

5. Do you have any cold drafts in your house during the winter?

❑ Yes ❑ No ❑ DK

6. Do your windows have water on them or look "sweaty" in the winter?

❑ Yes ❑ No ❑ DK

7. Does your cooling system keep your home comfortable?

❑ Yes ❑ No ❑ DK ❑ Don't have a cooling system

8. **Does your heating system keep your home comfortable?**

❑ Yes ❑ No ❑ DK ❑ Don't have a heating system

9. Does the temperature in your house stay even from room to room?

❑ Yes ❑ No ❑ DK

10. I'd like to talk about the CFLs that you received for participating in the PER® program. The kit came with 3 13-watt CFLs and 3 20-watt CFLs. How many of the 13-watt CFLs are you using?

a. None of them
b. 1 of the CFLs
c. 2 of the CFLs
d. 3 of the CFLs
e. Don't know

11. **For the** <first, second, third> **How many watts was the old bulb that you took out?** (repeat for all installed out of the 3 provided)

❑<=44 ❑45-70 ❑71-99 ❑100+

4**. On average, approximately how many hours per day is this light used?** (repeat for all installed out of the 3 provided)

❑<=1 ❑1-2 ❑3-4 ❑5-10 ❑11-12 ❑13-24

If less than 3:

Do you plan on using the remaining 13-watt CFLs?
❑ Yes
❑ No **Why Not?** _____
❑ Maybe/DK

12. How many of the 20-watt CFLs are you using?

f. None of them
g. 1 of the CFLs
h. 2 of the CFLs
i. 3 of the CFLs
j. Don't know

13. **For the** <first, second, third> **How many watts was the old bulb that you took out?** (repeat for all installed out of the 3 provided)

❑<=44 ❑45-70 ❑71-99 ❑100+

4**. On average, approximately how many hours per day is this light used?** (repeat for all installed out of the 3 provided)

❑<=1 ❑1-2 ❑3-4 ❑5-10 ❑11-12 ❑13-24

If less than 3:

14. **Do you plan on using the remaining 20-watt CFLs?**
    i. ❑ Yes
    ii. ❑ No **Why Not?** _____
    iii. ❑ Maybe/DK

15. **On a scale from 1-10, with 1 indicating that you were very dissatisfied, and 10 indicating that you were very satisfied, please rate your satisfaction with the kit's 13-watt CFL(s).**

very dissatisfied very satisfied
1 2 3 4 5 6 7 8 9 10

If 7 or less, 10a. **Why were you dissatisfied with the 13-watt CFLs**?

_____

_____

16. On a scale from 1-10, with 1 indicating that you were very dissatisfied, and 10 indicating that you were very satisfied, please rate your satisfaction with the kit's 20-watt CFL.

very dissatisfied very satisfied
1 2 3 4 5 6 7 8 9 10

If 7 or less, 11a. **Why were you dissatisfied with the 20-watt CFL**?

_____

_____

17. Have you purchased any CFLs since receiving the kit from Personalized Energy Report?

❑ Yes ❑ No ❑ DK

If yes, 12a. **How many?** _____

18. **Since you participated in the Personalized Energy Report® Program**,
    a. **have you purchased and installed any energy efficiency equipment?**

        1. ❑ Yes
        2. ❑ No
        3. ❑ Don't Know

    b. **have you made energy efficiency improvements in your home?**

        a. ❑ Yes
        b. ❑ No
        c. ❑ Don't Know

    c. **Have you changed any of your habits related to energy use that were recommended by the PER® report?**

        a. ❑ Yes
        b. ❑ No
        c. ❑ Don't Know

If any of the responses to questions 18a - 18c are "yes", continue. If all responses are "no" or "Don't Know", skip to question #23.

19. **What type and quantity of high efficiency equipment did you install on your own?** *PROBE TO GET EXACT TYPE AND QUANTITY AND LOCATION*

Type 1: _____ Quantity 1: _____ Location 1:_____
Type 2: _____ Quantity 2: _____ Location 2:_____
Type 3: _____ Quantity 3: _____ Location 3:_____
Type 4: _____ Quantity 4: _____ Location 4:_____

20. **Was this improvement suggested by the home energy report provided to you through the Personalized Energy Report® program?**

Type 1: _____ ❑ Yes ❑ No ❑ DK
Type 1: _____ ❑ Yes ❑ No ❑ DK
Type 1: _____ ❑ Yes ❑ No ❑ DK
Type 1: _____ ❑ Yes ❑ No ❑ DK

21. **Was this improvement suggested through a different energy efficiency program?**

Type 1: _____ ❑ Yes ❑ No ❑ DK

If yes: **Which program?**:_____
Type 1: _____ ❑ Yes ❑ No ❑ DK
If yes: **Which program?**:_____
Type 1: _____ ❑ Yes ❑ No ❑ DK
If yes: **Which program?**:_____
Type 1: _____ ❑ Yes ❑ No ❑ DK
If yes: **Which program?**:_____

22. *For each type listed in 14 above,* **How do you know that this equipment is high efficiency? For example, was it Energy Star rated?**

Type 1: _____
Type 2: _____
Type 3: _____
Type 4: _____

I'm going to read a statement about this equipment that you purchased on your own. On a scale from 1-10, with 1 indicating that you strongly disagree, and 10 indicating that you strongly agree, please rate the following statement.

23. **My experience with the Personalized Energy Report® Program in** <2009, 2010> **influenced my decision to install** <Type 1/Type 2/Type 3/Type 4> **on my own.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

24. **What other actions, if any, have you taken in your home to save energy and reduce utility bills at least in part as a result of what you learned in this program?**

Response:1 _____

Response:2 _____

Response:3 _____

Response:4 _____

Now I am going to ask you some general satisfaction statements. On a scale from 1-10, with 1 indicating that you strongly disagree, and 10 indicating that you strongly agree, please rate the following statements.

25. **The mailed survey was easy to understand. (**If an online participant**: The web site's survey was easy to understand**.)

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?_____

_____

26. **The energy report was easy to read and understand.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?_____

_____

27. **The recommendations in the PER® report provided new ideas that I was not previously considering.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?_____

_____

28. **The recommendations in the report increased the likelihood that I would take recommended actions.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?_____

_____

29. The kit I received met my expectations.

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?_____

_____

30. I am satisfied with the amount of time it took to receive the kit and report after completing the PER® survey.

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?_____

_____

31. **Overall I am satisfied with the program**.

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?_____

_____

32. What additional services would you like the program to provide that it does not now provide?

Response: _____

_____

33. Are **there any other things that you would like to see changed about the program?**

Response: _____

34. **What do you think can be done to increase people's interest in participating in the Personalized Energy Report® Program?**

Response:1 _____
Response:2 _____
Response:3 _____
Response:4 _____

35. **Have you recommended this program to others?**

If yes, **How many people did you recommend this program to?**

36. What did you like most about this program?

Response: _____

37. **What did you like least about this program?**

Response: _____

38. What other services could Duke Energy provide to help improve home energy efficiency?

Response: _____

That completes our survey, thank you for your time and feedback today! (*politely end call*)

Appendix B: Program Manager Interview Instrument

Name: _____

Title: _____

Position description and general responsibilities:

_____

_____

_____

We are conducting this interview to obtain your opinions about and experiences with the Personalized Energy Report® program. We'll talk about the Personalized Energy Report® Program and its objectives, your thoughts on improving the program, and the technologies the program covers. The interview will take about an hour to complete. May we begin?

Program Objectives

1. In your own words, please describe the Personalized Energy Report's current objectives. How have these changed over time?

2. In your opinion, which objectives do you think are best being met or will be met?

3. Are there any program objectives that are not being addressed or not being addressed as well as possible or that you think should have more attention focused on them? If yes, which ones? How should these objectives be addressed? What should be changed?

4. Should the program objectives be changed in any way due to technology-based, market-based, or management based conditions? What objectives would you change? What program changes would you put into place as a result, and how would it affect the operations of the program?

Operational Efficiency

5. Please describe your role and scope of responsibility in detail. What is it that you are responsible for as it relates to this program?

6. Please review with us how the Personalized Energy Report® operates relative to your duties, that is, please walk us through the processes and procedures and key events that allow you do currently fulfill your duties.

7. Have any recent changes been made to your duties? If so, please tell us what changes were made and why they were made. What are the results of the change?

8. Describe the evolution of the Personalized Energy Report® Program. How has the program changed since it was it first started?

9. Do you have suggestions for improvements to the program that would increase participation rates or interest levels?

10. Do you have suggestions for improving or increasing energy impacts?

11. Do you have suggestion for the making the program operate more smoothly or effectively?

Program Design & Implementation

12. *(If not captured earlier)* Please explain how the interactions between the auditors, customers and Personalized Energy Report's management team work. Do you think these interactions or means of communication should be changed in any way? If so, how and why?

13. Describe your quality control and tracking process.

14. Are key industry experts, trade professionals or peers used for assessing what the technologies or models should be included in the program? If so, how does this work?

15. Are key industry experts and trade professionals used in other advisory roles? If so how does this work and what kinds of support is obtained?

16. Describe Personalized Energy Report**'s** auditor program orientation training and development approach. Are auditors getting adequate program training and program information? What can be done that could help improve auditor effectiveness? Can we obtain training materials that are being used?

17. In your opinion, do the PER® reports cover enough different kinds of energy efficient products or recommendations?

    1. ❑ Yes 2. ❑ No 99. ❑ DK/NS

    If no, 20b. What other products or equipment should be included? Why?

_____

18. What market information, research or market assessments are you using to determine the best target markets or market segments to focus on?

19. What market information, research or market assessments are you using to identify market barriers, and develop more effective delivery mechanisms?

20. Overall, what about the Personalized Energy Report® program works well and why?

21. What doesn't work well and why? Do you think this discourages participation or interest?

22. Can you identify any market, operational or technical barriers that impede a more efficient program operation?

23. In what ways can these operations or operational efficiencies be improved?

24. In what ways can the program attract more participants?

25. How do you make sure that the best information and practices are being used in Personalized Energy Report® operations?

26. *(If not collected above)* What market information, research or market assessments are you using to determine the best target markets and program opportunities, market barriers, delivery mechanisms and program approach?

27. Are there any other issues or topics you think we should know about and discuss for this evaluation?

Appendix C: Personalized Energy Report® Paper Survey

U142D45

RECEIVE YOUR FREE, PERSONALIZED ENERGY REPORT (PER)™

[redacted]

FOR THE ADDRESS SHOWN ABOVE, PLEASE ANSWER THE FOLLOWING QUESTIONS RELATED TO YOUR HOME AND ENERGY USAGE. FILL IN THE CIRCLES COMPLETELY USING BLUE OR BLACK INK.

PROPERTY DETAILS

1. What type of home best describes your primary residence? *(check only one)*
   - Detached single family
   - Duplex / 2 family
   - Townhouse
   - Apartment / Multi – Family / (3 or more units)
   - Condominium
   - Manufactured home

2. How many levels does your home have, excluding the basement and unfinished attic?
   - 1
   - 2
   - 3

3. In what year was your home built?
   - Before 1959
   - 1960 – 1979
   - 1980 – 1989
   - 1990 – 1997
   - 1998 – 2000
   - 2001 – 2007
   - 2008

4. Does your home have an attic?
   - Yes
   - No

5. Does your home have a basement?
   - Yes, heated
   - Yes, unheated
   - No

6. Excluding bathrooms and hallways, how many rooms are in your home? *(include finished basement)*
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7
   - 8
   - 9
   - More than 9

7. How would you describe the size of the rooms in your home?
   - Above average
   - Average
   - Below average

8. Approximate size (heated area) of your home? Your answers to questions 6 & 7 above will allow us to estimate the size of your home in square feet. Or, if you know the square footage of your home, you may choose it here and we will use your input.
   - < 500
   - 500-999
   - 1000-1499
   - 1500-1999
   - 2000-2499
   - 2500-2999
   - 3000-3499
   - 3500-3999
   - 4000 or more
   - Don't know

MAIN HEATING SYSTEM

9. What is the fuel used in your primary heating system?
   - Electric
   - Natural Gas
   - Oil
   - Propane
   - Other (solar, wood, etc)
   - No heat system

10. Which of the following bests describes your home's primary heating system?
    - Electric Baseboard or ceiling cable
    - Forced air furnace
    - Standard heat pump
    - Ground source heat pump
    - Water boiler
    - Steam boiler
    - Wood heating system
    - Heat pump with gas backup
    - Heat pump with propane backup
    - Heat pump with oil backup
    - No heat system

11. How old is your heating system?
    - 0 – 4 years
    - 5 – 9 years
    - 10 – 14 years
    - 15 – 19 years
    - 20 years or greater

COOLING SYSTEM

12. Do you have a central cooling system? (If you use window or room air conditioners, you will note this in question 14)
    - No central cooling system
    - Central air conditioning
    - Heat Pump

13. If you have any cooling system, how old is it?
    - 0 – 4 years
    - 5 – 9 years
    - 10 – 14 years
    - 15 – 19 years
    - 20 years or greater

14. Do you use room or window air conditioners?
    - Yes
    - No

15. How many room or window A/Cs?
    - 1
    - 2
    - 3

16. If you have a central heating and cooling system with air ducts, are any of these ducts located in the attic?
    - Yes
    - No
    - Not applicable

Duke Energy®

17. What is your thermostat setting for a typical heating day and a typical cooling day in the afternoon?

Heating

- <67 °
- 67 – 70 °F
- 71 – 73 °F
- 74 – 77 °F
- > 77 °F
- Thermostat off/ No thermostat

Cooling

- <69 °
- 69 – 72 °F
- 73 – 76 °F
- 77 – 78 °F
- > 78 °F
- Thermostat off/ No thermostat

18. Do you have any of the following comfort issues in your home?

a. *Cold drafts in the winter*
- Yes
- No

b. *Sweaty windows in the winter*
- Yes
- No

c. *Cooling system will not keep the home comfortable*
- Yes
- No

d. *Heating system will not keep the home comfortable*
- Yes
- No

e. *Uneven temperatures between rooms*
- Yes
- No

19. How many people live in your home?
- 1
- 2
- 3
- 4
- 5
- 6
- 7 or more

20. Do you own or rent this home?
- Own
- Rent

21. What fuel is used by your water heater?
- Electric
- Natural Gas
- Propane
- Other
- None

22. What is the age of your water heater?
- 0 – 4 years
- 5 – 9 years
- 10 – 14 years
- 15 – 19 years
- 20 years or greater

23. What type of fuel do you use for clothes drying?
- Electric
- Natural Gas
- Other
- None

24. What type of fuel do you use for your cook top?
- Electric
- Natural Gas
- Other
- None

25. What type of fuel do you use for your oven?
- Electric
- Natural Gas
- Other
- None

26. a. Do you have a swimming pool?
- Yes
- No

b. *Do you have a pool heater?*
- Yes
- No

c. *What type of fuel do you use to heat your pool?*
- Electric
- Natural Gas
- Oil
- Propane
- Not applicable

27. a. Do you have a hot tub?
- Yes
- No

b. *What type of fuel do you use to heat your hot tub?*
- Electric
- Natural Gas
- Oil
- Propane

28. Would a two degree increase in your home's indoor temperature during summer weekday afternoons affect your family's comfort?
- Not at all
- A small impact
- A moderate impact
- A large impact

29. Are you planning to make any large purchases to improve the energy efficiency of your home within the next three years?
- Yes
- No
- Not sure

30. How many CFLs* do you have installed in your home?

* 0 1 4 2 0 4 5 *

31. Please print your email address in the boxes below:

*compact fluorescent light bulbs

Appendix D: Personalized Energy Report® Online Survey

Energy Survey

Describe your home by answering these questions. By completing your Home Profile you will be able to view your Personalized Energy Report (PER)®. When you finish, click Next at the bottom of the page.

Property Details

Describe your home; its age, its size, attic, and basement ...

Style: Detached single family

Levels: 2

Attic: ◉ Yes ○ No

Year built: 1980 - 1989

# of Rooms: 9

Basement type: No

Living Area: 2800 sqft.

What is the standard size of your rooms? Above average

Property Features

Describe the heating, cooling and water heating systems in your home...

Main heating system

Fuel: Natural Gas

Type: Forced air furnace

Age: 10-14 years

Water heater

Fuel: Natural Gas

Age: 20 years or greater

Secondary heating system

Cooling System

Fuel: Natural Gas

Type: Heat Pump

Room air conditioners:

○ Yes ◉ No

Age: 20 years or greater

# of Room AC Select

If you have a central heating and cooling system with air ducts, are any of these ducts located in the attic? Yes

What is your typical thermostat setting for the summer and winter seasons in the afternoon?

Summer thermostat setting 72

Winter thermostat setting 68

Do you have any of the following comfort issues in your home? (check all that apply)

- [x] Cold drafts in the winter
- [ ] Sweaty windows in the winter
- [x] Cooling system will not keep the home comfortable
- [x] Heating system will not keep the home comfortable
- [x] Uneven temperatures between rooms
- [ ] No comfort issues

Household Details

How many people live in this home?

4

Do you own or rent?

◉ Own ○ Rent

Would a two degree

Are you planning to make any large purchases to

increase in your home's indoor temperature during summer weekday afternoons affect your family's comfort?*

A moderate impact

improve the energy efficiency of your home within the next three years?*

Yes

Utility Details

Describe who pays for utilities and services...

Which, if any, utilities are paid by your landlord?

☐ Electric ☐ Gas ☐ Oil ☐ Propane

Which of the following services are paid by your landlord?

☐ Heat ☐ Hot Water ☐ Cooling

Equipment & Amenities

Select all equipment and amenities at this address

☑ Cooktop	Fuel: Electric	
☑ Oven	Quantity: 1	Fuel: Electric
☑ Clothes Dryer	Quantity: 1	Fuel: Electric
☑ Swimming Pool	Pool heater: ○ Yes ◉ No	Fuel: Select
☐ Hot Tub	Fuel: Select	

About Me

How many CFLs do you have installed in your home?

15

If you have a promotion code, please enter it in the following box.

2001

Duke may use the information I have provided to offer me optional, unregulated services applicable to my home.

Yes No

How many CFLs do you have installed in your home?

Select

If you have a promotion code, please enter it in the following box.

Appendix E: Example of PER and Online Report

PERSONALIZED ENERGY REPORT (PER)®
July 13, 2011

Duke Energy.

[redacted]

Dear Customer:

Thank you for joining thousands of households that have taken steps to save energy and money by requesting a **Personalized Energy Report (PER)®**. This report analyzes your past energy usage and evaluates your answers from the energy survey, to provide:

- A history and seasonal chart of your energy use
- A pie chart estimating how much energy is used
- A comparison of your energy use to similar homes
- Tips that help you save energy and money.

A copy of your report is also available online at www.duke-energy.com when you sign in to Online Services. When you sign in to manage your account, be sure to visit the Home Energy Center, where you will find a wide assortment of energy saving tips, tools and helpful charts.

Sincerely,

K. Griffin

K. Griffin
Personalized Energy Report (PER)® Manager

[redacted]

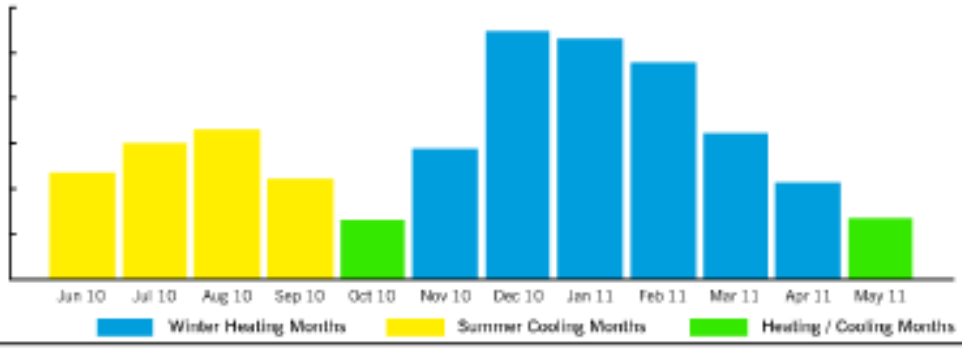
YOUR PERSONALIZED ENERGY REPORT (PER)®	
Prepared for	[redacted]
Account No.	[redacted]
Date Prepared	July 13, 2011
Type of Home	Apartment
Home Size	990
Year Home Built	1980 - 1989
Space Heating Fuel	Electricity
Water Heating Fuel	Electricity

YOUR MONTHLY ELECTRIC USAGE WITH AN APPROXIMATE ELECTRIC CHARGE*

JUNE 2010 - MAY 2011		
Bill Month	Electricity Usage (kWh)	Approximate Bill*
Jun 10	882	$106
Jul 10	1,122	$135
Aug 10	1,234	$148
Sep 10	835	$100
Oct 10	488	$59
Nov 10	1,083	$130
Dec 10	2,047	$245
Jan 11	1,987	$238
Feb 11	1,779	$213
Mar 11	1,211	$145
Apr 11	796	$95
May 11	514	$62
Total	13,978	$1,676

***Important.** Average energy rates are used in this report. The bill amounts in this table and following charts will not match your actual energy costs. For detailed information on your actual bills, visit "Energy Usage and Cost Details" in your Online Services account at www.duke-energy.com.

A SAMPLE OF YOUR HOME'S MONTH-TO-MONTH ELECTRIC USE*



* Note that your energy use can be impacted by seasonal weather.

SAVE MONEY WITHOUT SACRIFICING COMFORT WITH POWER MANAGER®

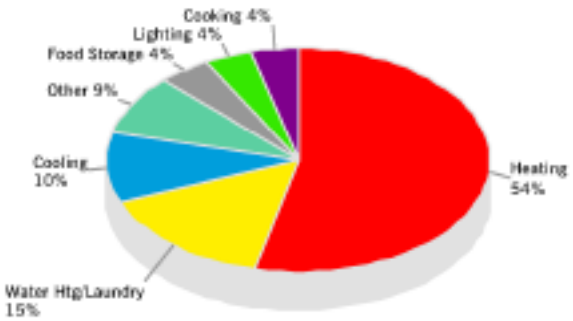
Power Manager® is a free energy offer that helps preserve the environment and keep energy costs low. It works this way. Duke Energy installs a small device on the outside of your outdoor air conditioning unit at no cost to you. On days when demand for power is especially high, the device turns your air conditioning unit off for only a few minutes each half hour and then automatically turns it back on. You stay comfortable because the indoor air conditioner's fan continues to run to circulate air throughout your home. The benefits to you:

- **Save now.** For just signing up, you save now by receiving a one-time credit of $25 or $35 on your Duke Energy bill.
- **Save later.** Whenever we use the Power Manager® device to turn your air conditioning unit off and then on, you receive a credit on your electric bill based on the price of electricity at the time, the option you choose and duration of the event.
- **Help preserve the environment.** By reducing the demand for electricity and delaying the need to build additional power plants in our region.

To sign up or learn more about Power Manager®, visit **www.duke-energy.com/powermanager.asp**, or call **1-877-392-4848**.

HOW YOUR HOUSEHOLD USES ELECTRICITY

2010-2011 ANNUAL COST BREAKDOWN	
Heating	$900
Water Htg/Laundry	$253
Cooling	$171
Other	$144
Food Storage	$73
Lighting	$68
Cooking	$67
Total	**$1,676**



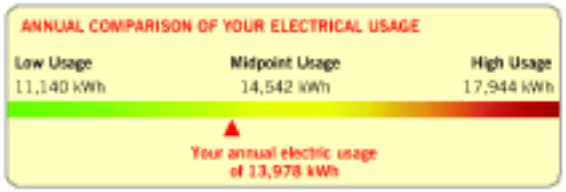
The dollar amounts and percentages in this pie chart are estimates based on inputs you provided on your survey. They are not based on actual measured readings from your home.

YOUR HOME'S ANNUAL ELECTRIC USAGE COMPARISON TO SIMILAR HOMES

The scale to the right shows you how your household's annual electric usage compares with the range of usage by similar households serviced by Duke Energy in Ohio.

This comparison considers your home's fuel blend, the number of people in your family, and other information you provided in your questionnaire.

Using electricity wisely is good for the environment, saves you money, and may reduce the need to build more power plants in Ohio. And that's good for everybody.



RECEIVE A REBATE AND REDUCE YOUR ENERGY BILL WITH SMART $AVER®

The Smart $aver® program from Duke Energy rewards customers with a rebate up to $400 when they replace their current heating or air conditioning system with a high efficiency system. If this is the year you're buying a new heating or cooling system for your home, you can save hundreds of dollars in annual operating costs by installing a qualified system and experience greater comfort in your home.

QUALIFYING SYSTEMS	CUSTOMER REBATES
Heat Pump (14.00 SEER or greater with a variable speed (ECM) fan)	$200
Air Conditioner (14.00 SEER or greater with a variable speed (ECM) fan)	$200
Geothermal Heat Pump (10.50 EER or greater with a variable speed (ECM) fan)	$200
Gas Furnaces (90.00% AFUE or greater)*	$200

*Gas Furnaces with 90.00% AFUE or greater combined with a qualifying **air conditioner or heat pump** as described above can receive a rebate of $400.
For more information visit **www.duke-energy.com/ohio/savings/smart-saver.asp**, or call **1-866-783-6209**.

ENERGY SAVING TIPS FOR YOUR HOME

HEATING

In the winter, if you manually set your thermostat down to save money while you're gone, when you return, reset your thermostat to the normal temperature setting. Setting the thermostat really high won't help it heat up any faster.

When heating your home, try to minimize the number of times that doors to the outside are opened and closed; cold outside air enters your home each time you open the door.

The use of ceiling fans in the winter is most effective in rooms with very high ceilings, where warm air rises and collects above the living space. Normal rooms of 8 to 10 foot ceilings will see little benefit from fan usage.

If you've turned down your thermostat in the winter to save money, you may be uncomfortable in the evening hours when you are less active. For these short periods, consider using a portable heater to warm the room that you occupy instead of turning up the thermostat.

COOLING

In the summer, if you manually set your thermostat up to save money while you're gone, when you return, reset your thermostat to the normal temperature setting. Setting the thermostat really low won't help it cool down any faster.

In the summer, use the exhaust fans in your kitchen and baths to exhaust hot air and moisture. Both the heat and the humidity is an extra load on your air conditioner.

When air conditioning your home, try to minimize the number of times that doors to the outside are opened and closed; hot and humid outside air enters your home each time you open the door.

When air conditioning, avoid activities that add heat and humidity to your home during the hottest parts of the day. This includes cooking, bathing, clothes drying and dishwashing.

WATER HEATING & LAUNDRY

Your dishes should not need rinsing before putting them in the dishwasher, but if you do, use cold water instead of hot.

If you are thinking about purchasing a new clothes washer or dishwasher, look for ENERGY STAR® models. These energy efficient models save energy, save money and help the environment.

WEATHERIZATION

Heavy curtains or the use of window quilts will help reduce heat loss at night during the heating season. When the sun is shining, open the covering and allow the sun to help heat the room.

During the heating season, keep window shades open during the day to benefit from the heat of the sun. Close the window shades at night to keep the heat in.

LIGHTING

The money you spend on light bulbs is only 5-10 percent of your total lighting costs. The other 90-95 percent is the cost of electricity. Energy efficient compact fluorescent lights cost more to purchase, but only use about one fourth the energy to supply the same amount of light.

Take advantage of daylight whenever possible and turn off unneeded lighting. Fixtures with photocells and motion detectors are an excellent way to save on your lighting costs.

Use dimmers to control the amount of light you need. Dimming the lights to half the illumination cuts energy consumption roughly in half. (Note: For compact fluorescent lights, use only bulbs that are rated for use with dimmers.)

Look for the ENERGY STAR® label on light bulbs and light fixtures. These models save energy, and money, and help the environment.

MISCELLANEOUS

Check refrigerator door seals by closing the door on a dollar bill. If you can easily pull the dollar out then the seal is not very effective and needs to be replaced.

Keep your refrigerator out of direct sunlight and in as cool a location as possible. A 10 degree increase in the surrounding air temperature can result in 20 percent higher energy consumption.

If your refrigerator door is sometime left ajar, it may run continuously and waste energy. If you find this happens frequently, make sure the refrigerator is level or even leaning back a very small amount. This allows the door to easily close with each use.

Refrigerators operate most efficiently when full but not overloaded.

ENERGY STAR® is owned by the United States Environmental Protection Agency, which is not affiliated with Duke Energy Corporation.

[redacted]

Appendix F: Responses to Questions Repeated from the Personalized Energy Report® Implementation Survey

Survey Respondents in North and South Carolina were asked the following five questions:

1. Do you have any cold drafts in your house during the winter?
2. Do your windows have water on them or look sweaty in winter?
3. Does your cooling system keep your home comfortable?
4. Does your heating system keep your home comfortable?
5. Does the temperature in your house stay even from room to room?

These questions are on the PER®/OHEC Survey which can be found in Appendix C: Personalized Energy Report® Paper Survey. TecMarket Works was asked to include these questions in the evaluation survey so that the results could be compared. TecMarket Works does not have the results for the initial survey, so only a summary of their most recent responses are presented in the table below.

Table 11. North Carolina OHEC

		Yes		No		Don't Know	
		N	Percent	N	Percent	N	Percent
Cold Drafts?	Mailed	18		51		1	
	Online	9		25		1	
	Total	**27**	**25.7%**	**76**	**72.4%**	**2**	**1.9%**
Sweaty Windows?	Mailed	20		49		1	
	Online	4		30		1	
	Total	**24**	**22.9%**	**79**	**75.2%**	**2**	**1.9%**
Cooling System Comfortable ?	Mailed	67		3		0	
	Online	33		2		0	
	Total	**100**	**95.2%**	**5**	**4.8%**	**0**	**0%**
Heating System Comfortable ?	Mailed	66		3		1	
	Online	33		1		1	
	Total	**99**	**94.3%**	**4**	**3.8%**	**2**	**1.9%**
Temperature Even?	Mailed	46		23		1	
	Online	25		10		0	
	Total	**71**	**67.6%**	**33**	**31.4%**	**1**	**0.9%**

Table 12. South Carolina OHEC

		Yes		No		Don't Know	
		N	Percent	N	Percent	N	Percent
Cold Drafts?	Mailed	8		22		1	
	Online	2		11		0	
	Total	**10**	**23.3%**	**33**	**76.7%**	**1**	**2.3%**
Sweaty Windows?	Mailed	5		25		1	
	Online	1		12		0	
	Total	**6**	**14.0%**	**37**	**86.0%**	**1**	**2.3%**
Cooling System Comfortable	Mailed	27		3		1	
	Online	13		0		0	

?	Total	**40**	**93%**	**3**	**7.0%**	**1**	**2.3%**
Heating System Comfortable ?	Mailed	30		0		1	
	Online	13		0		0	
	Total	**43**	**100%**	**0**	**0%**	**1**	**2.3%**
Temperature Even?	Mailed	27		3		1	
	Online	12		1		0	
	Total	**39**	**90.7%**	**4**	**9.3%**	**1**	**2.3%**

Process and Energy Impact Evaluation of the Home Energy House Call Program in North and South Carolina

Final Report

Prepared for
Duke Energy

139 East Fourth Street
Cincinnati, OH 45201

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Summary of Findings

Energy Savings

A billing analysis was conducted to estimate the energy savings from the program. The billing analysis relies upon a statistical analysis of actual customer-billed electricity consumption before and after participation in the Home Energy House Call (HEHC) program to estimate the impact for kit and recommended measures from the audit. The billing analysis used consumption data from HEHC participants in North Carolina (5,321 customers) and South Carolina (1,859 customers)[1] that participated between November of 2008 and July of 2010. A panel model specification was used that analyzed the monthly billed energy use across time and participants. The model included terms to control for the effect of weather on usage, as well as a complete set of monthly indicator variables to capture the effects of non-measureable factors that vary over time (such as economic conditions and season loads). The estimated impacts are included in Appendix C: Estimated Model, and a summary of the results is shown below:

	Total
Savings (kWh/yr)	901
T-value	10.39
R-Square	61%
Sample Size (overall model)	293,338 observations (14,001 homes)

The kW and therm savings in Table 1 below were estimated based on the responses to the customer survey regarding what they installed, scaled by the overall population estimate of kWh presented above. Estimates for the free-ridership and spillover were also based on the customer survey, and are discussed in detail later in the report.

[1] Ohio HEHC participant consumption data points (n=6821) were also included in the billing analysis.

Table 1. Summary Table: HEHC Gross Savings and Net Adjustments

Metric	Result
Number of Program Participants	7,180 from Nov. 2008 to July 2010
Gross kW per participant	.105
Gross kWh per participant	901
Gross therms per participant	18.4
Free-ridership rate	• CFLs: 48.3% • Showerheads: 0.6% • Faucet Aerators: 0.6% • Weather-stripping: 12.8% • Outlet Gaskets: 0.8%
Spillover rate	• CFLs: 6.8% • Showerheads: 1.2% • Faucet Aerators: 0.0% • Weather-stripping: 4.6% • Outlet Gaskets: 9.7%
On-site inspection adjustment	• CFLs: 20.7% • Showerheads: 3.0% • Faucet Aerators: 1.0% • Weather-stripping: 7.0% • Outlet Gaskets: 4.0%
Net Adjustments to be applied to Gross values	• CFLs: 43.8% • Showerheads: 97.6% • Faucet Aerators: 98.4% • Weather-stripping: 84.8% • Outlet Gaskets: 104.5%
Total Weighted Adjustments	• kW: 70.8% • kWh: 62.6% • therms: 100.7%
Net kW per participant	.074
Net kWh per participant	564
Net therms per participant	18.5
Measure Life	• CFLs: 5 years • Showerheads: 10 years • Faucet Aerators: 10 years • Weather-stripping: 5 years • Outlet Gaskets: 20 years • Overall Measure Life: 7 years****
Cost-effectiveness for DSMore	

*kW, kWh, and therm savings per participant include both kit items and audit recommendations
**Free-ridership and spillover rates are derived from analysis of participant survey data
***On-site inspection eliminates the need for false response and self-selection bias adjustments
****Overall measure life is a weighted average derived from the effective useful life of the individual kit items. The weights were assigned based on each item's contribution to gross kWh savings.

Customer Satisfaction

Based on 103 surveys done of a random sample of 2,418 participants in North and South Carolina that participated between June of 2009 and January of 2010, the customers' satisfaction with the program is very high with an overall satisfaction score of 9.2 on a 10-point scale. This is a very high level of satisfaction for an energy efficiency program and reflects well on the program and the program's sponsor. They were satisfied with the audit (9.0 out of 10) and with the energy efficiency starter kit (9.3 out of 10).

Motivating Factors

The primary factor was a desire to reduce energy costs with 79 participants (76.7%) indicating it as a factor and 54 (52.4%) indicating it was the most important factor motivating them to participate in the program. Receiving an energy audit was the second-most cited motivating factor.

What Customers Like Most and Least

Customers were most pleased with the free audit and energy-saving kits. The most common area noted for improvement was the need for a follow-up audit and more intensive energy-saving options for participants who had already met all recommendations in the Home Energy House Call audit. These results indicate that customers want to go beyond the typical approaches to energy savings and are looking for other options.

Recommendations

- While customer satisfaction for the audit and kit items is high, many customers expressed a desire for more far-reaching energy-saving options than those presented in the audit. A subset of customers (near 10%) wants to further reduce their energy use and is looking for help to identify any and all approaches for accomplishing their objectives. This indicates that there may be a number of customers who want to go to the next level of energy efficiency and move into the more costly and deeper savings options. One-quarter of the survey participants had already been considering an energy audit before joining the program, and following the audit, 10% requested more information in the form of follow-up services to help identify additional energy saving opportunities. This suggests the Home Energy House Call program has potential for engaging customers who are interested in saving activities that are beyond the low to no-cost savings of the audit report. Duke Energy has an opportunity to capture additional savings from these participants through expanded and coordinated services. In considering these services, Duke Energy should not be limited to only those services that pass a traditional cost effectiveness test, but rather develop services so that the incentives are structured for the individual to make the net savings achieved cost effective. For these additional measures and support needs, the incentives may not need to be as high as 50% of the incremental cost as some of Duke Energy's other programs. For example, if customers need new windows, the incentive can be structured so that the savings are cost effective for that measure.

- Information gathered during the Home Energy House Call audit can be used to identify prospective participants who may benefit from Duke Energy's other energy efficiency programs. This would allow Duke Energy to target promotions and outreach to those who may be more likely to participate in other programs. If the auditors are not currently doing so, the auditors could also present information about other relevant programs during the audit and explain how these could help customers accomplish their energy savings objectives. The home audit is an expensive and unique channel for communicating directly with a homeowner who has already identified themselves as being interested in energy efficiency. Auditors do urge customers to go online to find out about other Duke Energy programs. However, asking customers to go on the Duke Energy website to search for information themselves may incur an information cost. Duke Energy should take advantage of this opportunity to remove that cost and make it easier for the customer to plan future energy efficiency steps. Program auditors need to be representatives of not just the audit, but all approaches by which savings can be achieved.

- Duke Energy should proactively help customers identify higher-cost measures that would have more impact. Past evaluations of the HEHC that was implemented by Duke Energy in Ohio found that customers that have participated in the HEHC do adopt more expensive recommendations such as insulation upgrades. Better promotion of higher-impact measures would allow Duke Energy to contribute to the customer's understanding of energy efficient actions they could take now and later, particularly since customers are not eligible for another Home Energy House Call audit for three years.

- RECOMMENDATION: With the permission of the customer, auditors should remove the old incandescent light bulbs from the customer's home and dispose of them. This would decrease any chance that customers might remove the CFLs and put back the old incandescent light bulbs.

- RECOMMENDATION: Share participant data from other programs that offer free CFLs so that the HEHC participants are not automatically eligible for the additional 12 CFLs if they had previously received a set from another program. This will allow Duke Energy to achieve higher installation rates across their portfolio of programs and achieve greater cost effectiveness from CFL measures.

- RECOMMENDATION: If the regulatory agency allows gas savings to be claimed by the gas utilities, Duke Energy should explore the idea of collaborating with the gas companies to share costs and capture gas savings.

- RECOMMENDATION: Duke Energy should consider tracking customer participation across programs. This would allow Duke Energy to determine whether HEHC might have influenced participants to subsequently participate in other rebate programs. If the referral mechanism is not producing sufficient

participation in other Duke Energy energy efficiency programs, consider approaches to increase the effectiveness of the referral mechanism.

- RECOMMENDATION: Duke Energy or its evaluation contractor should schedule an evaluation survey of a sample of HEHC customers to determine their adoption 1 to 2 yrs after participation to identify longer-term savings. This would allow Duke Energy to obtain better longitudinal information about customer actions that might not be captured by annual program evaluations, and better estimate longer-term energy savings.

- RECOMMENDATION: Duke Energy should explore the idea of marketing the HEHC as a limited-time offer within the areas targeted for upcoming service by the auditors. This may increase the perceived scarcity and thus value of the audit, and also would enable audits to be completed within a geographical region before moving operations to another region, increasing cost effectiveness.

- RECOMMENDATION: Duke Energy should help customers prioritize the audit recommendations. Auditors should spend more time finding out what barriers customers might have to the higher savings items so that they might try to address those barriers in a face-to-face conversation with cost effective offers. The HEHC provides a very rare and expensive opportunity for Duke Energy's agents to communicate directly with their customers. Duke Energy should consider using this opportunity to encourage customers to discuss their specific questions and concerns with the auditors with the specific goal of being able to achieve additional savings. Duke Energy should also consider what other unique opportunities might be available through this channel of communication and see how it might best be leveraged. The HEHC should be considered to be much more than just a "live" version of a survey, but should recommend all ways that the customer can save energy and offer incentives on those measures to speed their implementation. For example, if they see that siding or windows are needed, it would be an opportunity to offer underlayment insulation or more efficient windows. Incentives can be calculated to be cost effective.

Introduction

This document presents the evaluation report for Duke Energy's Home Energy House Call (HEHC) Program as it was administered in North and South Carolina. An impact analysis was performed using a billing analysis comparing the pre and post program energy consumption levels of program participants.

The evaluation was conducted by TecMarket Works with assistance from Integral Analytics and Yinsight. The survey instruments were developed by TecMarket Works. The survey was administered by TecMarket Works. Integral Analytics performed the billing analysis. Yinsight (a TecMarket Works subcontractor) conducted the in-depth interviews with program management.

Methodology

This section presents the approach for conducting this assessment.

Development of the Surveys

TecMarket Works developed a customer survey for the Home Energy House Call (HEHC) Program participants to be implemented after they have had time to install at least some of the measures in the kit and to follow the recommendations offered during the home energy audit. The survey asked the customer for information specific to each of the measures included in the Energy Efficiency Starter Kit. In addition, the participant was asked to report the actions that they had taken that were caused in whole or in part by the recommendations provided in the HEHC audit report. For each measure that was installed and for each recommendation taken, the participant was asked questions pertaining to their intentions to take that action without the intervention of the program. This information was used to estimate program free-ridership for the purpose of informing program managers of the level of free-ridership and for the purpose of adjusting gross savings in order to report net impact.

The survey was conducted with a random sample of 103 HEHC participants. These participants were surveyed by TecMarket Works. To help focus the survey, the questions asked were based on key results of an earlier study employing an identical approach for similar measures. The experience from the previous study[2] allowed this study to use those questions that were most informative to the energy impact estimation process and eliminate those questions that were found to have little impact on the results of the energy savings calculations. This allowed the HEHC survey to be shorter and more focused, yet still provide the information needed to estimate savings. The surveys can be found in Appendix A: Participant Survey Instrument.

Installation Rates of Kit Items

The items distributed in the kit include the following measures.

1. Two (2) 13-watt CFLs
2. One (1) 20-watt CFL
3. 17' Roll of Closed Cell Foam Weatherstrip
4. 4 Outlet gaskets
5. 2 Switch gaskets
6. Low flow showerhead
7. Bathroom aerator
8. Kitchen aerator

Participants were asked if they installed each item in the Home Energy House Call kit. The results are summarized in Table 2 below. CFLs had by far the highest installation rate with 95 percent of survey respondents reporting that they had used the 20-watt CFL as well as both 13-watt CFLs. The rest of the kit measures had installation rates between

[2] Roth, Johna, Nick Hall, Pete Jacobs. "Energy Impact Evaluation of the Personalized Energy Report Program in Kentucky". TecMarket Works, July 27, 2007.

31-62%. A more in-depth look at installation rates and energy savings can be found in the impact section.

Table 2. Respondent Installation Rates

Measure	Status	Number of Participants (n=103)	Percentage
13 watt CFLS	Installed	98	95%
	Planned	3	3%
20 watt CFLs	Installed	98	95%
	Planned	3	3%
Weather-stripping	Installed	32	31%
	Planned	33	32%
Outlet/Switch Gaskets	Installed	55	53%
	Planned	11	11%
Showerheads	Installed	59	57%
	Planned	16	16%
Faucet aerators	Installed	64	62%
	Planned	22	21%

Free-ridership and Spillover

Free-ridership and spillover were calculated for each measure in the Energy Efficiency Starter Kit. The level of free-ridership was determined by using the responses to three questions in the survey (found in Appendix A: Participant Survey Instrument). The three questions and the level of free-ridership and/or spillover that was applied to the energy savings are presented in Table 3 below, using the CFL as an example measure. All other possible combinations of answers to the series of questions resulted in 0% free-ridership and 0% spillover.

Table 3. Free-ridership and Spillover Factors for Energy Efficiency Kit Measures

6a: Did you have any CFLs installed before you got the kit?	6b:Were you planning on buying <additional> CFLs before you got the kit?	6c: Have you purchased any CFLs since you got the kit?	% Free-ridership	% Spillover
yes	yes	yes	100	
yes	yes	no	100	
yes	no	yes		75
no	no	yes		100
no	yes	no	50	
no	yes	yes	50	50
Don't Know	yes	yes	75	25
Don't Know	yes	no	50	
Don't Know	no	yes		100
yes	already installed in all available sockets	yes	100	

yes	already installed in all available sockets	no	100	
Don't Know	maybe	yes	25	50
yes	maybe	yes		25
yes	maybe	no	25	
no	maybe	yes		50
yes	don't know	yes		75
no	don't know	yes		100
yes	yes	don't know	100	
yes	already installed in all available sockets	don't know	100	
don't know	yes	don't know	50	
no	yes	don't know	50	

Table 4. Measure Free-Ridership and Spillover

Measure	Number of participants with free-ridership	Number of participants with spillover	Free-ridership percentage	Spillover Percentage	Mean units per participant with spillover
CFLs	68	14	48.3%	6.8%	17
Low flow Showerhead	1	1	0.6%	1.2%	1
Aerators	1	0	0.6%	0.0%	NA
Weather-stripping	32	10	12.8%	4.6%	25 feet
Outlet/Switch gaskets	2	9	0.8%	9.7%	6.1

Audit Free-ridership

Free-ridership was also calculated for the home energy audit as an independent analysis to determine the level of participants that would have had their homes audited if the HEHC were not made available. All other possible responses to these questions were counted as 0% free-ridership.

Table 5. Questions to Estimate Free-ridership for the Home Energy Audit

Considering an audit before the program?	if not available through the program, would you still have purchased an audit?	If yes, would you have purchased it within a year?	% Free-ridership
yes	yes	yes	100
yes	yes	no	50
yes	yes	don't know	25

As shown in Table 6, twenty-eight (28%) of the surveyed participants were considering an audit of their home before enrolling in the program, but only two (1.9%) would have purchased one if they wouldn't have received one through the program.

Table 6. Consideration of Audit Before Program Participation

	Yes	No	DK/NS
Considered before HEHC	28	72	3
Purchased without HEHC	2	81	20
Purchased within a year without HEHC	2	94	7

Two participants responded in a manner that labeled them as a free-rider. One participant had a free-ridership level of 100% and the other had a free-ridership level of 25%. Over the 103 participants, the overall free-ridership level for the program's audit is low at 1.2%.

Section 1: Billing Analysis

This analysis presents the results of the billing analysis of Duke's Home Energy House Call (HEHC) Program North Carolina and South Carolina.[3] This analysis relies upon a statistical analysis of actual customer billed electricity consumption before and after participation in the HEHC program to estimate the impact of the program. Table 7 presents the results of this billing analysis.

Table 7. HEHC Average Annual kWh Savings: Audit and Kit

State	Audit Only	Kit	Total
North Carolina	634	541	1,175
South Carolina	515	348	863

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.

[3] To increase the efficiency of the model, a single model was estimated over Ohio, North Carolina, and South Carolina customers. This report addresses only the results for the Carolinas.

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*
ß = 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 HEHC kit as well as recommended measures, is done by including a variable which is equal to one for all months after the customer received the kit and the report. [4] The coefficient on this variable is the savings associated with the kit. In order to account for differences in billing days, the usage was normalized by days in the billing cycle. The estimated electric model is presented in Table 8.[5]

Table 8. Estimated Savings Model – dependent variable is daily kWh usage, Sept 2008 through August 2010 (savings are negative)

Independent Variable	Coefficient (kWh/d)	t-value
HEHC Audit	-1.68	-4.11
Received Kit as part of Audit	-1.12	-2.74
Overall HEHC participation	-2.47	-10.39
Sample Size	293,338 observations (14,001 homes)	
R-Squared	61%	

This estimated model shows that the HEHC program (both kits and recommended measures) results in an average annual savings of 1,388 kWh. This estimate is statistically significant, with all estimates significant at the 90% confidence interval.

[4] By defining the participation variable as a 1/0 indicator variable, it effectively captures all the savings associated with participating in HEHC, including any CFLs that were installed as part of the audit.
[5] The model includes an autocorrelation correction term as well as weather terms and monthly indicator terms in addition to the variables presented in Table 1, which were not included in order make interpretation clearer. The full model is shown in Appendix C: Estimated Model.

Section 2: Participant Survey Results

Motivating Factors

Participants were asked to list all of the factors that motivated them to participate in the program in the order of their importance. The primary factor was a desire to reduce energy costs with 79 participants (76.7%) indicating it as a factor and 54 (52.4%) indicating it was the most important factor motivating them to participate in the program. Receiving an energy audit was the second-most cited motivating factor. Sixty-seven participants (65%) indicated the audit itself as a factor and twenty-five (24.2%) said it was the most important factor motivating participation. Other motivating factors cited included the energy efficiency kit (53 participants), the program incentives (25 participants), the technical assistance (17 participants), the recommendation by a third party (10 participants) and the information provided by the program (1 participant).

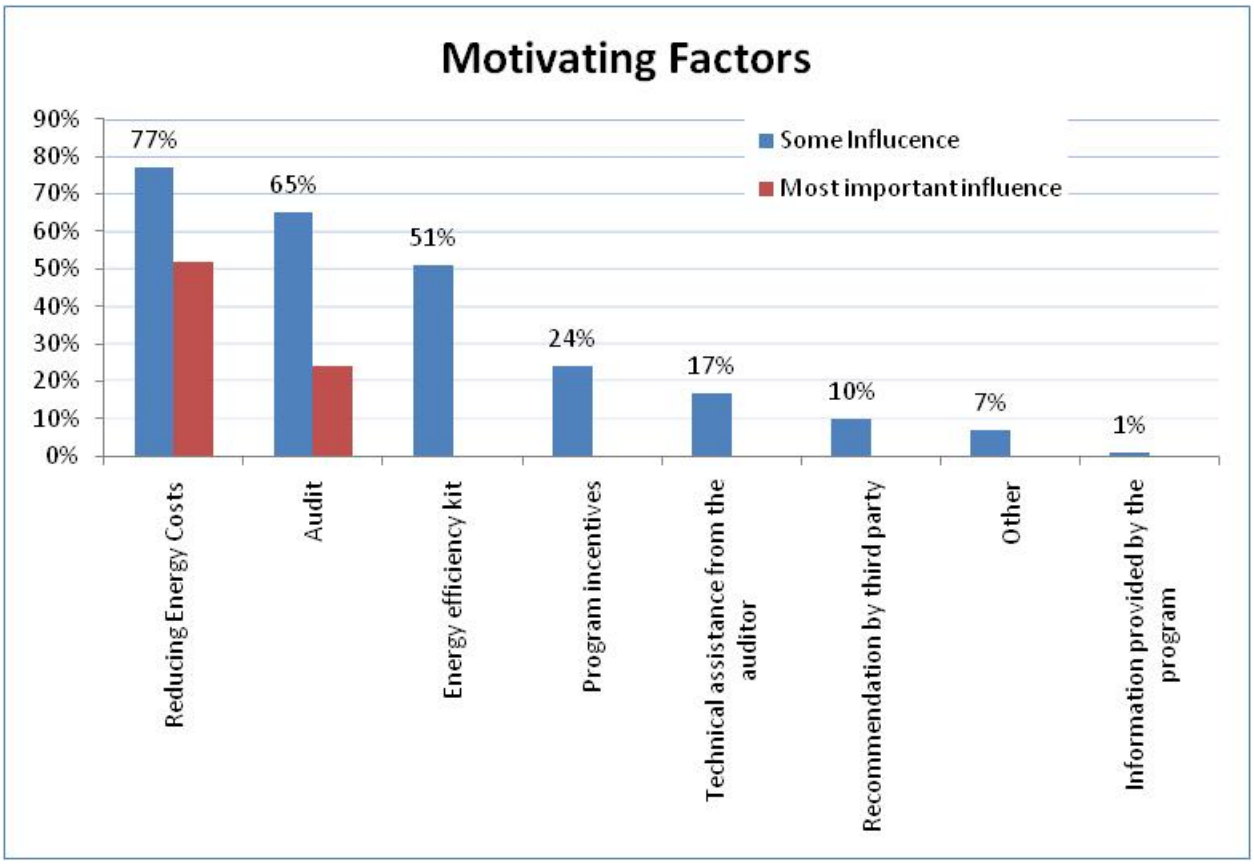

Figure 1. Motivating Factors for HEHC Participants in the Carolinas

The "other" reasons for participating in the HEHC program are presented below.

- "I had an audit previously in Florida and thought it was helpful."
- "I'm president of my neighborhood association and wanted to try out the audit before recommending it to neighbors."
- "I wanted to know more about a recently purchased house."

- "I recently had insulation installed and wanted to see if it was done correctly."
- "I wanted to make my home warmer."
- "I wanted to find ways to help the environment."

Energy Efficiency Purchases Since Enrollment in HEHC

Of the 103 participants surveyed, nineteen indicated that they have made additional energy efficient upgrades since their enrollment in the HEHC program. These purchases are summarized in Table 9 below.

The table shows that of the thirty improvements made by these nineteen participants, fourteen of them were suggested in the home audit report, and sixteen were not suggested by the audit report. While the audit helps them make energy efficiency decisions, it is not the source of all of their energy efficiency actions. In order to gauge the influence of the audit in the actions taken by each home, we asked participants to rate the importance of the audit in their decision to take an action. The influence column presents the value associated with HEHC's influence on the decision to install the measure indicated. On a scale of 1 to 10, with 10 indicating that the decision was made with a very strong influence by their participation in the HEHC program, the mean response was 8.65, indicating that in most cases the program had an influence on the participant's decision to move forward and install the energy efficient measures.

Table 9. Energy Efficiency Purchases Since HEHC Enrollment

Respondent	Action Taken	Quantity	Location	Suggested In Audit?		How do you know it's efficient?	Influence
				Yes	No		
1	Heavier curtains	1	Home		X		5
2	Replaced door	1	Home	X			5
3	New Air Conditioner	1	Home		X	Energy Star rated	10
4	New Dishwasher	1	Home		X	Energy Star rated	8
	Attic fan sealed	1	Attic	X			10
	Turned down water heater	1	Basement	X			10
5	New Dishwasher	1	Home		X	Energy Star rated	10
	Adjusts thermostat	1	Home	X		Recommendation of auditor	10
6	Adjusts thermostat	1	Home	X		Recommendation of auditor	10
7	Thermal curtains	1	Home	X		Recommendation of auditor	10
8	Replaced refrigerator	1	Home		X	Energy star rated	9
	Solar outside lights	1	Outside		X	Solar	4
9	Lowered thermostat	1	home	X		Recommendation of auditor	10

10	Attic fan	1	Attic		X		5
11	Washer	1	Home		X	Energy Star rated	8
	Dryer	1	Home		X	Energy star rated	8
12	Replaced front door	1	Home	X		Recommendation of auditor	10
14	Adjusted door seal	1	home	X		Recommendation of auditor	10
	Adjusted window seal	1	Home	X		Recommendation of auditor	10
15	Sunsetter awning	1	Home	X		Recommendation of auditor	5
16	Refrigerator	1	Home		X	Energy star rated	7
	Low flow toilet	1	Home		X		7
17	Refrigerator	1	home		X	Energy star rated	9
	Dishwasher	1	Home		X	Energy star rated	9
18	Insulation	1	basement	X		Recommendation of auditor	10
19	Insulation	1	Attic	X		Recommendation of auditor	10
	Turned water heater down	1	Basement	X			10
	Sealed windows	1	Home	X		Recommendation of auditor	10
	Thermal curtain	1	Home		X		10

DOE Energy Savers Booklet

Participants were asked “Did you read the "DOE Energy Savers" Booklet?” Seventy (67.9%) answered yes. Participants were then asked if they shared and discussed the booklet with their family. Forty-one participants (39.8%) answered yes. Participants were also asked to list any improvements made based on advice in the booklet in 10 areas.

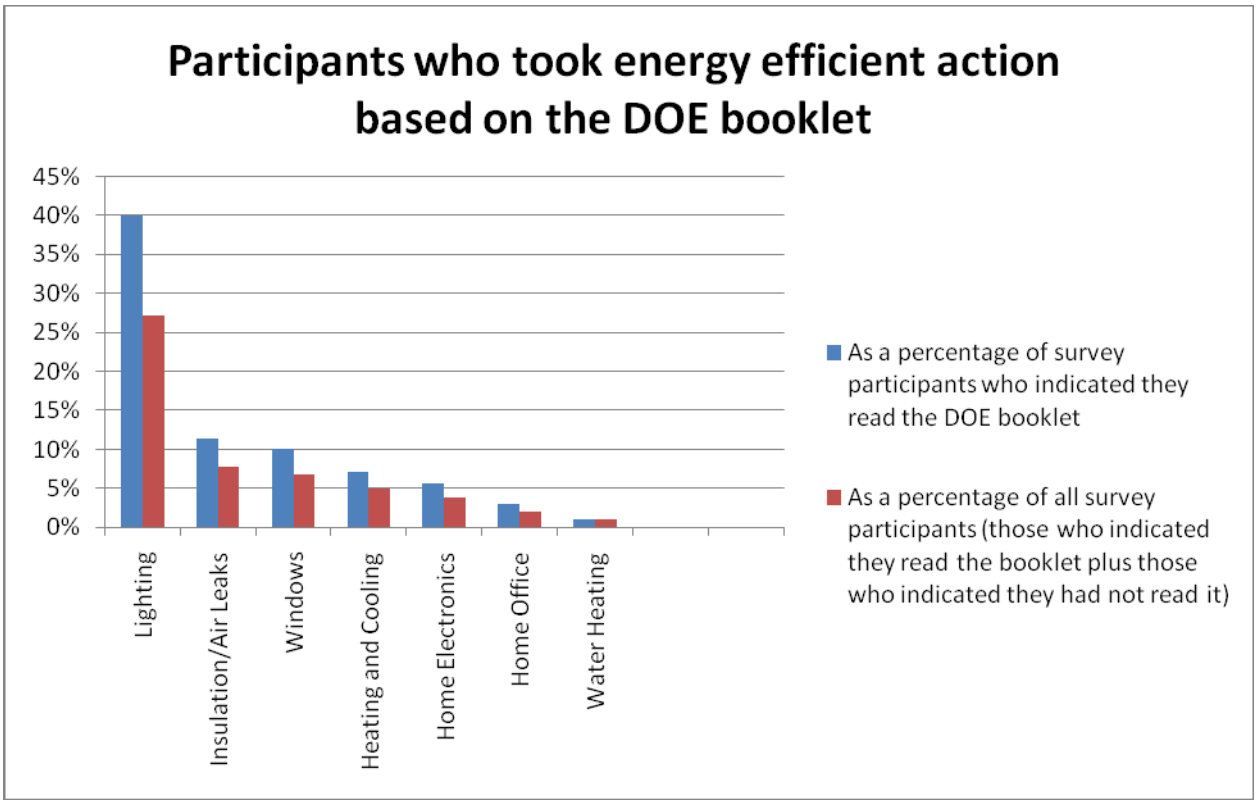

Figure 2. Participants who took energy efficient actions based on the DOE booklet

CFL Informational Magnet and Safe Handling Tips

Survey participants were asked if they recalled receiving an informational CFL magnet (as seen in Appendix D: HEHC Kit Magnet) in the Home Energy House Call kit. Thirty (27%) respondents remembered seeing the magnet and fifteen (13.5%) of respondents indicated that they had placed the magnet on their refrigerator. Seven respondents (6.3%) said that the magnet was still in the HEHC box, and eight of the respondents that reported that they remembered seeing the magnet further reported that they either no longer knew of its whereabouts or had thrown it out.

Participants were also asked if they had visited Duke Energy's web site to read the CFL safe handling tips. Twelve participants reported that they had visited Duke Energy's web site and were able to find the CFL safe handling tips. Four respondents reported that they were unable to find the CFL safe handling tips. While this number represents only 3.6% of total survey respondents, it is one-third of all respondents who reported visiting Duke Energy's web site.

Three of the eight respondents who visited Duke Energy's web site said that they learned new information from the content. Two participants said they were previously unaware that CFLs required any safe handling techniques, and one participant said he had a higher opinion of CFLs after visiting Duke Energy's web site.

Participant Satisfaction Survey

Participants were asked for their levels of satisfaction on a 1 to 10 scale (with one being the lowest and ten being the highest) for the kit measures as well as aspects of the program. The survey can be found in Appendix A: Participant Survey Instrument and the results of the satisfaction questions are presented below.

Measure Satisfaction

The surveyed participants were satisfied with the measures provided Home Energy House Call kit. Table 10 below shows the respondents' mean satisfaction scores with various measures.

Both the 13-watt and 20-watt CFLs had the highest ratings at 9.4. The lowest satisfaction (8.3, still a high score) was with the bathroom aerator.

Table 10. Mean Satisfaction with Kit Measures

Measure	Average Rating	N	Percentage of ratings at or below 7
13 watt CFL	9.4	96	5.2%
20 watt CFL	9.4	96	7.3%
Low flow showerhead	8.7	60	16.7%
Bathroom aerator	8.3	64	21.8%
Kitchen aerator	8.4	66	30.3%
Outlet gasket	9.4	72	2.8%
Switch gasket	9.3	72	6.9%

In addition to satisfaction ratings, participants who did not previously have a kit measure installed but still chose not to use a measure were asked why that was the case.

For CFLs, five respondents indicated that they thought the bulbs were either too dim (n=33) or did not have a pleasing quality of light (n=5).

The highest cited reason for not installing the low flow showerhead was a preference that the participant already had one installed (n=12). The other cited reason was a preference for a higher pressure showerhead (n=4).

For aerators, the highest cited reason for non-use was that the aerator did not fit in the participants faucet (n=10); reduced flow (n=4) was the other reason listed.

For gaskets, one participant stated that that he or she felt the measure was unnecessary and another indicated that he or she was afraid of electricity.

Program Satisfaction

The surveyed participants are very satisfied with the Home Energy House Call program. Table 11 below shows the respondents' mean satisfaction scores with various aspects of the program.

Table 11. Mean Satisfaction with Program Components

Metric	Average Rating	N	Percentage of ratings at or below 7
Web Site usability	9.3	63	0%
Scheduling audit	9.3	100	2%
Interactions with auditor	9.4	100	0%
Knowledge of auditor	9.3	103	0%
Audit report	9	102	0%
New ideas from recommendations	8.4	96	3.1%
Likelihood of using recommendations	8.5	97	0%
Interactions with Duke Staff	9.1	99	4%
Energy efficiency kit quality	9.3	102	0%
Overall Satisfaction	9.2	103	1.9%

Overall program satisfaction is very high at 9.2. Surveyed participants rated their satisfaction with the auditors who came to their homes and performed the audit. On a 1 to 10 scale, the auditors' friendliness, help, and knowledge were rated at 9.3. The lowest satisfaction rating (8.4) was with the audit report providing new ideas for improving efficiency.

For ratings at or below 7, participants were asked to list possible improvements to the program. The responses are bulleted below.

- Provide more new information in the audit materials for people who have already done the basics (n=4)
- Make it easier and more convenient to schedule the audit (n=3)
- Supply more reliable power (n=4)

Services and Program Changes Participants Would Like

We asked the 103 surveyed participants what other services they would see be a part of the HEHC program. Their responses are bulleted below.

- Follow-up visit to evaluate the results of the changes (n=5)
- Make the audit mandatory
- Provide more reliable CFLs

We asked the surveyed participants what could be done to increase interest and participation in the program. Their suggestions are below.

- More advertisement (n=15)
- Emphasize the savings on utility bills (n=4)
- Offer more incentives (n=4)
- Lower people's rates if they adopt the program (n=2)

What Participants Liked Most

We asked the participants what they liked most about the program. Their responses are bulleted below.

- The program was free (n=12)
- The energy efficiency kit (n=11)
- The information it provided (n=7)
- Reducing bills (n=4)
- Auditor was kind and helpful
- It feels like we made a difference

What Participants Liked Least

We also asked the surveyed participants what they liked least about the program. Their responses are below.

- The audit didn't go far enough (n=6)
- CFL coupon expired too early (Note: The Home Energy House Call Energy Efficiency kit included actual CFLs. The customer may have been thinking of another Duke Energy program, such as the CFL initiative, that issues coupons for free CFLs.)
- Showerhead was difficult to install

Savings Distributions

There are some 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 and is using them effectively. In the case of this evaluation, it was determined that the engineering

estimates derived from this methodology were unreliable and they were not used to estimate impacts in favor of a more reliable billing analysis approach.

These self-reported behaviors concerning what they would have installed without the program were used in the computation of the net to gross ratio. 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. Instead of adjusting for these biases, on-site verification efforts were employed to establish a more reliable bias factor that resulted in the collapse of these two biases into a single adjustment factor termed the "on-site inspection adjustment".

Level of Discounting for Biases

The net savings estimate from the free-ridership and spillover adjustments obtained via the survey, were then further adjusted to account for the results of the on-site verification visits. The level of adjustment for each measure is presented below. There was no discounting applied to savings acquired as a result of audit recommendations.

Table 12. On-site Inspection Adjustments

Measure	On-site Inspection Adjustment
CFLs	20.7%
Weather-stripping	7.0%
Outlet gaskets	4.0%
Showerhead	3.0%
Aerators	1.0%

Section 3: Program Operations

Program Description

The Home Energy House Call (HEHC) is a home audit program where energy specialists visit customers to provide a visual inspection of their house's characteristics and appliances. The specialists provide a customized energy report to educate customers on the low-cost and no-cost actions they could take to lower their energy bills. Customers also receive an energy efficiency starter kit containing CFLs and other low-cost measures that the auditor can install for no charge. In 2009 the energy efficiency starter kit contained one 20 watt and two 13 watt CFLs, one low flow showerhead, one bathroom faucet aerator, one kitchen faucet aerator, one small roll of Teflon tape for plumbing installations, two foam insulation gaskets for light switch plates, four foam outlet gasket insulators, 17 feet of closed-cell foam weather-stripping, one CFL refrigerator magnet with the Duke Energy logo, a booklet with tips saving energy that is produced by DOE, and a pamphlet with installation instructions for the kit items. As mentioned above, the auditors are also able to install some of the measures upon request. Just recently, Duke Energy began emphasizing CFL installations and started asking the auditors to reach an objective of 6 CFLs installations per household between the kit and additional bulbs.

The HEHC is marketed to Duke Energy customers by direct mail. These mailings target customers within specific regions for more efficient routes for the auditors in order to increase productivity. Customers have to meet certain requirements for eligibility. Customers must: 1) be a Duke Energy customer, 2) own their homes, 3) have four months of billing history, and 4) have one of the following: electric heat, central air or an electric water heater.

For this process evaluation, the evaluation team interviewed:

1. Thermo-Scan Inspections project manager
2. Market analysis consultant for Duke Energy
3. Account manager at Prototype, the mail vendor
4. Two project managers at Customer Link
5. Duke Energy's new HEHC program manager
6. WECC manager, in lieu of departing program manager.

Roles

WECC. Wisconsin Energy Conservation Corp (WECC) holds the contract with Duke Energy and administers the HEHC program through several subcontractors. WECC also developed a computerized scheduling tool that allows the different vendors to access the same database of customer appointment information. This database is verified by WECC on a bi-monthly basis to make sure it matches the Duke Energy participation database.

Customer Link. Customer Link provides the call center and staff that schedules audits using the common scheduling tool developed by WECC. Customer Link's staff also explains the benefits of the HEHC program, answers customer questions about the

program, and informs customers about what items the energy efficiency kit contains. Customer Link is responsible for rescheduling customers in the event they wished to cancel. They report the results of their interactions with customers to Duke Energy every week. They also process the business reply cards (BRCs) for customers interested in scheduling and participating in the program.
Customer Link is contractually obligated to answer 80% of customer calls within 30 seconds or less, and they reported that they consistently have been able to meet that goal. To maintain that level of service, Customer Link works with the rest of the HEHC management team to track upcoming HEHC mail drops. This allows them to line up enough staff to handle the increases in call volume that follow each mailing.

To maintain high call quality, customer calls are monitored by Customer Link management and by Duke Energy. Once a week, the entire HEHC team listens in on randomly-selected inbound and outbound calls. Every month, Duke Energy scores 50 calls in areas such as the staff's product knowledge, customer service, and customer experience. The Customer Link project managers report that their staff are required to score at least 92% but have consistently scored above 96%. The Customer Link project managers reported that they constantly work with Duke Energy and the auditors to make things easier for the customer including offering evening and Saturday appointments. *"Our reps enjoy it; we're helping customers save money, we're helping the environment."*

Once Duke Energy began emphasizing CFL direct installations, Customer Link added language to their call center scripts to educate the customers about the additional CFLs that were available to them from the auditors. These additional CFLs are only available if the auditor is able to install them in high use sockets during the visit.

Thermo-Scan Inspections (TSI) Project Manager. TSI conducts the audits for the HEHC program, with 7 auditors for Carolinas. (for OH: With 9 auditors for OH). The TSI project manager takes the lead in scheduling audits in a way that maintains even workflow. The TSI project manager plans the mailings across Duke's service territory by zip codes in order to use the auditors most efficiently. Mailings are sent first to zip codes that have high numbers of potential participants and that could be served in a timely manner by auditors who are available in that geographic region. In the past, the timing of the mailings had not been tightly coordinated with the audit scheduling so that WECC and TSI had difficulty maintaining enough staffing at the right times. Duke Energy has a new program manager whom WECC credits with helping to improve scheduling by providing more accurate forecasting of program participation rates. "She's doing a great job of leading everybody to consensus."

Duke Energy's Market Analytics Department. The company that conducts the audits takes the strategic lead in determining the geographic regions for the next HEHC mailing. Once they determine the regions' zip codes, Duke Energy's Market Analytics Department provides a count of how many eligible participants there are in each zip code. Duke Energy filters customers within a zip code according to the participation requirements: prospective participants must have been a Duke Energy customer for over

4 months, own their single family home, and have at least one of the following three usages: electric heat, electric hot water, or central air conditioning.

ProtoType mail vendor. After Duke Energy pulls the customer information according to zip codes, the data is sent to ProtoType, the mail vendor that verifies the addresses against the National Change of Address (NCOA) database before sending out the mailers. Larger mailings are divided into batches of approximately 1500 mailers and sent out across a few days so that customers do not overwhelm the Customer Link call center. The account manager at the mailing company reported that there are very few returned mailers. After each mail drop, ProtoType sends to Duke Energy the list of customers who received the mailers and the proof of mailing for invoicing purposes. The account manager communicates with the Duke Energy program manager approximately twice or three times a week, with standing meetings on Fridays for regular updates on the mailings.

Thermo-Scan Inspections' auditors. The auditors are all trained to be certified BPI (Building Performance Institute) analysts by WECC, who has certified BPI trainers. The training program consists of one week of classroom and field training. After the coursework and tests, new auditors have to shadow an experienced auditor for a week before they are allowed to conduct audits independently. The TSI project manager accompanies each of the auditors on "ride-alongs" once or twice each quarter. While this is a time-consuming task, it provides an opportunity for the project manager to give feedback and share good practices that she sees being used by other auditors. WECC also conducts their own quality assurance ride-alongs but TSI reported they have not yet received any feedback on the auditors' performance.

Duke Energy also collects customer feedback about their audit experience using business reply cards. Those replies are shared with TSI at regular meetings. The reply cards consist of eight questions in which the customers are asked whether they were contacted in a timely manner by TSI, whether the scheduling was to their convenience, whether the auditors clearly explained the audit process and recommendations, whether the auditors responded to specific customer concerns and whether the report was easy to understand.

Audit Process

Duke Energy reported that each auditor tries to conduct 5-6 audits a day, four days a week. The auditor visits the customer's home and fills out an 80-item survey using a PC laptop. The audit is a visual audit so an auditor will only make a visual inspection of a house's insulation thickness.

The survey questions in the HEHC are very similar to the ones in Duke Energy's Personalized Energy Report® (PER®) survey, with the addition of 11 on-site questions that are specific to a house's insulation and ductwork. The auditor conducts the visual inspection according to the sequencing of the questions on the survey, and then makes recommendations as to how the homeowner could increase their energy efficiency and lower electric bills. The recommendations are recorded on the PC laptop or an onsite paper report. After the audit, the survey responses are uploaded to the WECC database.

WECC reported that the customer's demographic and appliance information were originally intended to be shared with Duke Energy's other energy efficiency programs so that prospective participants could be identified for other programs. For example, customers who had an old appliance might be contacted by a program that rebated appliance upgrades. At the time of these interviews, WECC reported that the survey responses and participant information are not shared with other programs.

Auditors track the recommendations made to each customer on the survey form. They focus their recommendations on low-cost and no-cost actions. The Duke Energy program manager reported that there is no particular emphasis on larger measures nor on rebates for those larger measures because customers tend not to adopt recommendations that would require more cost. "*We hope that [the customer] is self-motivated to go out and take on additional measures…There is information on the website about other programs that they can research.*"

Operational Efficiency

Duke Energy reported that they have recently had "overwhelming" responses to the program and that the program's popularity through word of mouth has caused some difficulty with scheduling audits. *"They're starting to be aware of the need for energy efficiency."* At the times these interviews were conducted in mid-July, Duke anticipated that the programs goals would have been met by the end of July of 2010. Due to the high demand, the program was trying to meet the audit requests in high density zip codes, and had not yet been able to target the low density zip codes.

The contents of the kits provided during the audit have not been changed since the inception of the program; however, TSI reported that they have attended several meetings with Duke Energy to determine how the kit could be improved. One idea is to move away from the "kit" concept and offer direct installs of the kit's items. Other measures considered by the HEHC team include chimney pillows and radiant barriers for the attic, however, there is no clear consensus by HEHC managers as to whether these are good candidates for the kit. Duke Energy is in the process of considering whether to add specialty fluorescent lamps for candelabras and flood lights. The potential impact and cost effectiveness of these kit candidates are reviewed by Morgan Marketing Partners, using the DSMore modeling tool. Niagara Conservation is the company that provides the energy efficiency kits, and they also monitor new technologies and measures that might be added to the kits.

Direct Installs

When the program first began, auditors offered to install measures for customers but did not have a specific measure installation objective. Duke Energy now emphasizes CFL installations and essentially requires auditors to try to install an additional six CFLs in each household, if the customers allow it. The energy efficiency starter kits contain 3 CFLs and auditors may install up to 12 more for a total of 15 CFLs per household. However, one TSI project manager reports that the auditors are averaging over two CFL installations from the kit, but 25% installations from the additional 12 CFLS that were

available. This is fewer than targeted but this is only a single observation based on an interview with the project manager.

Installation of water measures is low. This is mainly because of liability concerns with old plumbing, and auditors installed showerheads and aerators only when the old fixtures could be removed by hand.

The weather-stripping is suitable for sealing small areas such as around a ceiling access panel; however it is rarely installed.

TSI reported that customers regularly request other types of CFLs and that Duke Energy is conducting analyses to determine whether it would be cost effective to include some specialty CFLs.

Barriers to CFL Installations

WECC was responsible for fulfilling Duke Energy's CFL installation goal of six CFLs per home. WECC has produced and shared with Duke Energy a memo on customer barriers to installing more CFLs. They have also started tracking CFL installations by each auditor. Their data shows that some auditors were installing more CFLs than others, indicating that some auditors are more effective at overcoming customer barriers. WECC has already started working with TSI to train auditors on ways to address customers' concerns about issues such as the mercury content in CFLs and proper disposal of CFLs. WECC has also encouraged Duke Energy to start offering specialty bulbs, and has provided auditors with a prioritized list of CFL installation locations targeting higher use areas first.

One reason customers do not want CFLs installed in their homes was because they were unwilling to remove incandescent bulbs that are still in good working order. The TSI project manager suggested that perhaps Duke Energy should require customers to install all three CFLs in the kit as a condition of receiving the free home energy audit service. Auditors also do not take away the old incandescent bulbs after putting in new CFLs, and instead leave them with the customer.

Coordinating CFL Programs

The TSI project manager reported that one of the biggest barriers to CFL installation is that many of the customers were found to have a small stock of new CFLs that had not been installed. Duke Energy has been offering several energy efficiency programs that each provide homeowners with free CFLS: the Home Energy House Call, the Personalized Energy Report, and the "Power In Energy" grade school education program. Customers in the PER® program receive an energy efficiency starter kit that contains 6 CFLs with a mail-in coupon good for an additional 6 CFLs. Customers in the grade school education program receive 2 CFLs in an energy efficiency starter kit. There may be non-governmental organizations that also give away CFLs.

Program Successes

Most of the people interviewed agree that the teamwork between the implementers at the different organizations is excellent. The scheduling process is a successful collaboration between Duke Energy, WECC, Thermo-Scan Inspections, and Customer Link. These team members meet twice a week in order to coordinate future mailings with auditor availability. The team also shares feedback from customers and takes action as necessary to address problems that arise. As one interviewee said, *"We work through snags as a team."* Another agreed, *"Teamwork makes dreamwork!"*

The Duke Energy Home Energy House Call program is so well run that it has served as a source of best practices for other utilities. The TSI project manager reported that TSI has also implemented house call programs for several other utilities, and that the Duke Energy HEHC was perceived by her peers as an example of an implementation success. *"It's perceived by people here and at WECC that this Duke House Call program is running very smoothly. When something comes up for them, they come ask me how we're handling it."*

Even with the recent management changes at both Duke Energy and WECC, the HEHC is running well and still finds ways to improve. *"I thought things were running fine before, and we've [still] made huge improvements…If you would have [asked] me a year ago, I would have had more [issues] to discuss. Right now things are working really well."*

Program Areas to be Improved

Collaborating with gas utilities. Many homes in Duke Energy's service territory have gas water heaters. For these customers, Duke has considered the idea of not offering measures that only have gas savings, such as the low flow showerheads and aerators. However, the management team decided to keep the gas measures in the kit because of their low cost. The TSI project manager also suggested to Duke Energy that they might coordinate with the gas companies to conduct a joint House Call.

Capturing energy savings from HEHC recommendations. Duke Energy has only claimed energy savings from the direct installations of the audit measures. However, the TSI project manager believed that customers were purchasing and installing large measures on their own as a result of the audit's recommendations, such as upgrading heat pumps. The savings from some of these installations may be captured by Duke Energy's other programs if customers take advantage of rebates given by other Duke Energy energy efficiency programs. Duke would ultimately be able to claim those energy savings that are influenced by HEHC, even if the savings were not attributed to HEHC. However, other energy savings may slip through the cracks, unless the evaluation effort captures them via customer surveys, if customers upgrade because of an HEHC recommendation and for some reason they did not apply for any rebate.

Even if the evaluation focuses on recommendation savings the energy savings may not be captured if the HEHC's impact is evaluated too soon after customer participation.

Residential customers may need time to budget for the recommended costly upgrade of a major appliance. With these cases, HEHC's influence may be substantial but not measurable until several months or even several years after program participation.

Increasing Participation Rates

Participation in HEHC has averaged 2% of mailers sent out. While the HEHC program has met its audit goals well before the end of the program year, Duke Energy is still interested in improving the response rate in order to lower the program's brochure printing and mailing costs.

The program might also be marketed more efficiently if the HEHC was only offered within a specific period of time. TSI is contractually obligated to audit a customer within 45 days of the customer's response to a mailer. Customers have been known to respond as late as 14-15 weeks after they received the mailers. Because the auditors usually have already moved their activities to another geographic region, serving those customers necessitates a long drive. This decreases cost effectiveness and increases cost per customer served. To motivate customers to respond in a more timely manner, TSI has recommended to Duke that HEHC be marketed as a limited time offer (e.g. good for 4 weeks) but to also let the customer know that the audit would be available again at another specified time in the future.

Related to the limited-time offer idea is the idea of seasonal marketing. The TSI project manager suggested that another tactic to make the HEHC more appealing might be to make the marketing of HEHC seasonally appropriate, focusing on cooling costs in the summer and heating costs in the winter. TecMarket notes that the HEHC audit should still be comprehensive, covering ways to reduce both cooling and heating costs.

Duke Energy is in the process of developing a probability model to predict likely participants based upon demographic information such as the square footage of the home, customer energy usage, the age of the home, and customer income bracket. Duke plans to test the model by comparing the predicted participation rates against actual participation rates. Duke has already confirmed that there were seasonal fluctuations in program participation that correspond to increased customer interest during the summer heating and winter cooling seasons. This supports the suggestion of targeting the mailers' marketing message to emphasize the specific cost concerns that customers may have during the current season.

Improving Audit Presentation

The WECC manager believes that the survey around which the audits are conducted could be improved greatly. He reported that the survey tool was originally designed as an interim tool, but was never updated. He believes that the survey questions could be re-ordered so that the customer could better understand what the auditors are recommending. WECC staff members who have participated on audit "ride alongs" have reported to him that the audit presentations are a little "choppy" from the customer's perspective. The presentation also does not focus on recommendations that are most important for saving energy or actions that can provide deep lasting savings. He suggests

that more of the auditors' time should be sent discussing higher-impact recommendations and explaining their benefits to the customer. The WECC manager said that Duke Energy has been informed of this and Duke Energy has begun observing audits more carefully to see if they could be improved from the customer's perspective.

Appendix A: Participant Survey Instrument

The questions below require mostly short, scaled replies from the interviewee, and not all questions will be asked of all participants. This interview should take approximately 10 to 15 minutes.

Home Energy House Call Program

Participant Survey

Contact Module
SURVEY INTRODUCTION

If Home Energy House Call participant, then contact for survey. Use five attempts at different times of the day and different days before dropping from contact list. Call times are from 10:00 a.m. to 8:00 p.m. EST or 9-7 CST Monday through Saturday. No calls on Sunday. (Sample size N =100)

SURVEY

Introduction

Note: Only read words in bold type.

Hello, my name is _____. I am calling on behalf of Duke Energy to conduct a customer survey about the Home Energy House Call Program. May I speak with _____ please?

If person talking, proceed. If person is called to the phone reintroduce.
If not home, ask when would be a good time to call and schedule the call-back:

Call back 1:	Date: _____,	Time: _____	❑AM or ❑PM
Call back 2:	Date: _____,	Time: _____	❑AM or ❑PM
Call back 3:	Date: _____,	Time: _____	❑AM or ❑PM
Call back 4:	Date: _____,	Time: _____	❑AM or ❑PM
Call back 5:	Date: _____,	Time: _____	❑AM or ❑PM

❑ Contact dropped after fifth attempt.

We are conducting this survey to obtain your opinions about the Home Energy House Call Program. Duke Energy's records indicate that you participated in the Home Energy House Call Program. We are not selling anything. The survey will take about 10 minutes and your answers will be confidential, and will help us to make improvements to the program to better serve others. May we begin the survey?

Note: If this is not a good time, ask if there is a better time to schedule a callback.

1. **Do you recall participating in the Home Energy House Call Program?**

1. ❑ Yes, *begin* → *Skip to Q3.*
2. ❑ No,
99. ❑ DK/NS

This program was provided through Duke Energy. In this program, you registered to receive a home energy audit. In return, the auditors provided you with custom energy-saving recommendations for you and your home, and you were provided with a free energy efficiency kit with 10 measures, such as a low flow showerhead, CFLs, and outlet gaskets.

Do you remember participating in this program?

1. ❑ Yes, *begin* → *Go to Q2.*
2. ❑ No,
99. ❑ DK/NS

If No or DK/NS terminate interview and go to next participant.

2. Please think back to the time when you were deciding to participate in the Home Energy House Call program. What factors motivated you to participate? ***(do not read list, place a "1" next to the response that matches best)***

1. ____ The audit
2. ____ The energy efficiency kit
3. ____ The program incentives
4. ____ The technical assistance from the auditor
5. ____ Recommendation of someone else (*Probe*: **Who?**_____)
6. ____ Wanted to reduce energy costs
7. ____ The information provided by the Program
8. ____ Past experience with this program
9. ____ Because of past experience with another Duke Energy program
10. ____ Recommendation from other utility program
    i. (*Probe*: **What program?** _____)
11. ____ Recommendation of family/friend/neighbor

12. ____ Advertisement in newspaper (*Probe:* **For what program?** _____)
13. ____ Radio advertisement (*Probe:* **For what program?** _____)
14. ____ Other (SPECIFY) _____
15. ____ Don't know/don't remember/not sure (DK/NS)

If multiple responses: 2.a. **Were there any other reasons?** *(number responses above in the order they are provided - Repeat until 'no' response.)*

Free-Ridership Questions

3. **Before you heard about the Home Energy House Call from Duke Energy, had you already been considering getting a home energy audit?**

1. ❑ Yes
2. ❑ No
3. ❑ Don't Know

4. **If the audit from Duke Energy's Home Energy House Call Program had not been available, would you still have:**

4a. **Purchased an audit?**

1. ❑ Yes
2. ❑ No – *skip to question 5*
3. ❑ Don't Know – *skip to question 5*

4b. **Would you have purchased the audit within the next year?**

1. ❑ Yes
2. ❑ No
3. ❑ Don't Know

If the auditor installed CFLs during the home audit, ask questions 5-8. If no bulbs were installed, skip to question X:

5. **Did you remove any of the** <# of installed CFLs> **CFLs that the auditor installed when visiting your home?**

1. ❑ Yes
2. ❑ No
3. ❑ Don't Know

If yes, 5a and 5b. **How many did you remove?** _____

5b. Why did you remove them?

a. Not bright enough
b. too bright
c. did not like the light
d. too slow to start
e. mercury concerns
f. burned out
g. not working properly
h. other: _____

Did you have any CFLs installed in your home before you requested the HEHC audit or received the kit from the program?

❑ Yes ❑ No ❑ DK

6. **Now I'd like to talk about the energy efficiency kit that you received for participating in the Home Energy House Call program. I'm going to read a list of the items included in the kit, and for each one, please tell me if you have installed the item. Are you using the…**

6a. **Both 13-watt CFLs** ❑ Yes – *triggers follow up questions CFL a-CFL g*.
❑ Yes, but just one – *triggers follow up questions CFL a-CFL g*.

❑ No **Do you plan on using these CFLs?** ❑ Yes – *triggers CFL e – CFL g*.
❑ No ❑ Maybe/DK

Why Not?
❑ DK

6b. **20-watt CFL** ❑ Yes – *triggers follow up questions CFL a-CFL g*.

❑ No **Do you plan on using this item?** ❑ Yes – *triggers CFL e – CFL g*.
❑ No ❑ Maybe/DK

❑ DK

CFLa. How many watts was the old bulb that you took out? (repeat for all installed out of the 3 provided)

❑<=44 ❑45-70 ❑71-99 ❑100+

CFLb**.** On average, approximately how many hours per day is this light used? (repeat for all installed out of the 3 provided)
❑<=1 ❑1-2 ❑3-4 ❑5-10 ❑11-12 ❑13-24

CFL c. On a scale from 1-10, with 1 indicating that you were very dissatisfied, and 10 indicating that you were very satisfied, please rate your satisfaction with the kit's 13-watt CFL(s).

very dissatisfied very satisfied
1 2 3 4 5 6 7 8 9 10

CFL d. On a scale from 1-10, with 1 indicating that you were very dissatisfied, and 10 indicating that you were very satisfied, please rate your satisfaction with the kit's 20-watt CFL.

very dissatisfied very satisfied
1 2 3 4 5 6 7 8 9 10

CFL e. Were you planning on buying <additional> **CFLs for your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ Maybe ❑ DK

❑ No, already have them installed in all available sockets – *skip to next series*

CFL f. **Have you purchased any CFLs since receiving the kit from Home Energy House Call?**

❑ Yes ❑ No ❑ DK

If yes, CFL g. **How many?** _____

6c. **Low flow showerhead** ❑ Yes – *triggers follow up questions LFS a-i (and below)*

❑ No **Do you plan on using this item?** ❑ Yes – *triggers LFS f-i*.
❑ No ❑ Maybe/DK

❑ DK

LFS a. Was it easy to install?

❑ Yes ❑ No ❑ DK

If no, Why not? _____

LFS b. Typically how many showers per week are taken using this showerhead?

❑ 0-4 ❑ 5-10 ❑ 11-15 ❑ 16-20 ❑ 21+

LFS c. Would you estimate that the water coming out of this showerhead is…

❑ Less than the old unit
❑ About the same as the old unit
❑ More than the old unit

LFS d. On a scale from 1-10, with 1 indicating that you were very dissatisfied, and 10 indicating that you were very satisfied, please rate your satisfaction with the kit's low flow showerhead.

very dissatisfied									very satisfied
1	2	3	4	5	6	7	8	9	10

LFS e. *If yes to 6c:* Did you use the teflon tape included in the kit when you installed the showerhead?

❑ Yes
❑ No
❑ DK

LFS f. Did you have any low flow showerheads installed in your home before you received the kit from the Home Energy House Call program?

❑ Yes ❑ No ❑ DK

LFS g. Were you planning on buying a low flow showerhead for your home before you received the kit from the Home Energy House Call program?

❑ Yes ❑ No ❑ Maybe ❑ DK

❑ No, already have them installed in all showers – *skip to next series*

LFS h. Have you purchased any additional low flow showerheads since receiving the kit from Home Energy House Call?

❑ Yes ❑ No ❑ DK

If yes, **LFS i. How many?** _____

6f. **kitchen faucet aerator** ❑ Yes – *triggers follow up questions KFA a-h.*
❑ No **Do you plan on using this item?** ❑ Yes – *triggers KFA e-h.*
❑ No ❑ Maybe/DK

❑ DK

KFA a. Was it easy to install?
❑ Yes ❑ No ❑ DK

If no, Why not? _____

KFA b. Was there an aerator already installed that you had to remove?
❑ Yes ❑ No ❑ DK

KFA c. Would you estimate that the water coming out of this aerator is…
❑ Less than the old unit
❑ Same as the old unit
❑ More than the old unit

KFA d. On a scale from 1-10, with 1 indicating that you were very dissatisfied, and 10 indicating that you were very satisfied, please rate your satisfaction with the kit's kitchen faucet aerators.

very dissatisfied very satisfied
1 2 3 4 5 6 7 8 9 10

KFA e. Did you have any faucet aerators installed in your home before you received the kit from the Home Energy House Call program?

❑ Yes ❑ No ❑ DK

KFA f. Were you planning on buying any faucet aerators for your home before you received the kit from the Home Energy House Call program?

❑ Yes ❑ No ❑ Maybe ❑ DK

❑ No, already have them installed in all available faucets – *skip to next series*

KFA g. Have you purchased any additional faucet aerators since receiving the kit from Home Energy House Call?

❑ Yes ❑ No ❑ DK

If yes, **KFA h. How many?** _____

6g. **bathroom faucet aerator** ❑ Yes – *triggers follow up questions BFA a-h*
❑ No **Do you plan on using this item?** ❑ Yes – *triggers BFA e-h.*
❑ No ❑ Maybe/DK

❑ DK

BFA a. Was it easy to install?
❑ Yes ❑ No ❑ DK

If no, Why not? _____

BFA b. Was there an aerator already installed that you had to remove?
❑ Yes ❑ No ❑ DK

BFA c. Would you estimate that the water coming out of this aerator is…
❑ Less than the old unit
❑ Same as the old unit
❑ More than the old unit

BFA d. On a scale from 1-10, with 1 indicating that you were very dissatisfied, and 10 indicating that you were very satisfied, please rate your satisfaction with the kit's bathroom faucet aerators.

very dissatisfied									very satisfied
1	2	3	4	5	6	7	8	9	10

BFA e *(skip e-h if KFA e-h answered*). **Did you have any faucet aerators installed in your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ DK

BFA f . **Were you planning on buying any faucet aerators for your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ Maybe ❑ DK

❑ No, already have them installed in all available faucets – *skip to next series*

BFA g. Have you purchased any additional faucet aerators since receiving the kit from Home Energy House Call?

❑ Yes ❑ No ❑ DK

If yes, **BFA h. How many?** _____

6h. **outlet gaskets** ❑ Yes – *triggers follow up questions OG a-g*
❑ No **Do you plan on using this item?** ❑ Yes – *triggers OG d-g*.
❑ No ❑ Maybe/DK

❑ DK

OG a. How many did you install on the interior walls of your home?
❑ 1-2 ❑ 3-5 ❑ 6-8 ❑ 9-12 ❑ DK

OG b. How many did you install on the exterior walls of your home?
❑ 1-2 ❑ 3-5 ❑ 6-8 ❑ 9-12 ❑ DK

OG c. On a scale from 1-10, with 1 indicating that you were very dissatisfied, and 10 indicating that you were very satisfied, please rate your satisfaction with the kit's outlet gaskets.

very dissatisfied very satisfied
1 2 3 4 5 6 7 8 9 10

OG d. **Did you have any outlet gaskets installed in your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ DK

OG e. Were you planning on buying any outlet gaskets for your home before you received the kit from the Home Energy House Call program?

❑ Yes ❑ No ❑ Maybe ❑ DK

❑ No, already have them installed in all available outlets – *skip to next series*

OG f. Have you purchased any additional outlet gaskets since receiving the kit from Home Energy House Call?

❑ Yes ❑ No ❑ DK

If yes, **OG g. How many?** _____

6i. **switch gasket insulators** ❑ Yes – *triggers follow up questions SGI a-g.*
❑ No **Do you plan on using this item?** ❑ Yes – *triggers SGI d-g.*
❑ No ❑ Maybe/DK
❑ DK

SGI a. How many did you install on the interior walls of your home?
❑ 1-2 ❑ 3-5 ❑ 6-8 ❑ 9-12 ❑ DK

SGI b. How many did you install on the exterior walls of your home?
❑ 1-2 ❑ 3-5 ❑ 6-8 ❑ 9-12 ❑ DK

SGI c. On a scale from 1-10, with 1 indicating that you were very dissatisfied, and 10 indicating that you were very satisfied, please rate your satisfaction with the kit's switch gaskets.

very dissatisfied very satisfied
1 2 3 4 5 6 7 8 9 10

SGI d. Did you have any switch gaskets installed in your home before you received the kit from the Home Energy House Call program?

❑ Yes ❑ No ❑ DK

SGI e. Were you planning on buying any switch gaskets for your home before you received the kit from the Home Energy House Call program?

❑ Yes ❑ No ❑ Maybe ❑ DK

❑ No, already have them installed in all available windows – *skip to next series*

SGI f.. Have you purchased any additional switch gaskets since receiving the kit from Home Energy House Call?

❑ Yes ❑ No ❑ DK

If yes, **SGI g. For how many switches?** _____

6j. **weather-stripping** ❑ Yes – *triggers follow up questions WS a-e.*
❑ No **Do you plan on using this item?** ❑ Yes – *triggers WS b-e.*
❑ No ❑ Maybe/DK

❑ DK

WS a.How many feet did you install?
❑ 1-5 ❑ 6-10 ❑ 11-17 ❑ DK

WS b. Did you have any weather-stripping installed in your home before you received the kit from the Home Energy House Call program?

❑ Yes ❑ No ❑ DK

WS c. Were you planning on buying any weather-stripping for your home before you received the kit from the Home Energy House Call program?

❑ Yes ❑ No ❑ Maybe ❑ DK

❑ No, already have them installed around all available doors – *skip to next series*

WS d. Have you purchased any additional weather-stripping since receiving the kit from Home Energy House Call?

❑ Yes ❑ No ❑ DK

If yes, **WS e. For how many doors?**

_____

Audit recommendations:

If "Your home needs attic ducts insulated to R-19" was recommended:

Did you insulate your attic ducts as recommended in the Home Energy House Call Audit Report?

❑ Yes ❑ No ❑ DK

If yes, what did you do: _____

If "Your home needs attic ducts sealed" was recommended"
Did you seal your attic ducts as recommended in the Home Energy House Call Audit Report?

❑ Yes ❑ No ❑ DK

If yes, what did you do: _____

If "Your home needs attic insulation" was recommended:
Did you insulate your attic as recommended in the Home Energy House Call Audit Report?

❑ Yes ❑ No ❑ DK

If yes, what did you do: _____

If "your home needs basement wall insulation" was recommended:
Did you install basement wall insulation as recommended in the Home Energy House Call Audit Report?

❑ Yes ❑ No ❑ DK

If yes, what did you do: _____

If "Your home needs garage ducts insulated to R-19" was recommended:
Did you insulate your garage ducts as recommended in the Home Energy House Call Audit Report?

❑ Yes ❑ No ❑ DK

If yes, what did you do: _____

If "Your home needs garage ducts sealed" was recommended:
Did you seal your garage ducts as recommended in the Home Energy House Call Audit Report?

❑ Yes ❑ No ❑ DK

If yes, what did you do: _____

If "Your home needs insulation in the floor or around perimeter of the home" was recommended:
Did you insulate in the floor or around the perimeter of the home as recommended in the Home Energy House Call Audit Report?

❑ Yes ❑ No ❑ DK

If yes, what did you do: _____

If "your home needs wall insulation" was recommended:
Did you insulate your walls as recommended in the Home Energy House Call Audit Report?

❑ Yes ❑ No ❑ DK

If yes, what did you do: _____

Did you make any other changes to your home as a result of the Home Energy House Call Audit Report?

❑ Yes ❑ No ❑ DK

If yes, what did you do: _____

13. **Do you recall receiving the CFL magnet that was included in the kit?**

❑ Yes ❑ No ❑ DK

If yes, 13b. **Where is it?** _____

15a. **Have you visited Duke Energy's website to read the CFL safe handling tips?**

❑ Yes ❑ No ❑ DK

If yes, 15b. **Were you able to find the CFL safe handling tips on Duke Energy's web site?**

❑ Yes ❑ No ❑ DK

If yes, 15c. **Did what you read about CFL safe handling tips on Duke Energy's web site change your opinion of CFLs?**

❑ Yes ❑ No ❑ DK

If yes, 15d. **How?** _____

16. **Did you read the "DOE Energy Savers" Booklet?**

❑ Yes ❑ No ❑ No, but I will ❑ DK

***If yes,* Did you read and discuss the book with your family?**

❑ Yes ❑ No ❑ No, but I will ❑ DK

Have you taken any actions based on the advice in the booklet in the following areas?

Insulation/Air Leaks ❑ Yes ❑ No ❑ No, but I plan to ❑ DK
If yes, what did you do: _____

Heating and Cooling ❑ Yes ❑ No ❑ No, but I plan to ❑ DK
If yes, what did you do: _____

Heating and Cooling ❑ Yes ❑ No ❑ No, but I plan to ❑ DK
If yes, what did you do: _____

Water Heating ❑ Yes ❑ No ❑ No, but I plan to ❑ DK
If yes, what did you do: _____

Windows ❑ Yes ❑ No ❑ No, but I plan to ❑ DK
If yes, what did you do: _____

Lighting ❑ Yes ❑ No ❑ No, but I plan to ❑ DK
If yes, what did you do: _____

Appliances ❑ Yes ❑ No ❑ No, but I plan to ❑ DK
If yes, what did you do: _____

Home Office ❑ Yes ❑ No ❑ No, but I plan to ❑ DK
If yes, what did you do: _____

Home Electronics ❑ Yes ❑ No ❑ No, but I plan to ❑ DK
If yes, what did you do: _____

Driving/Car Maintenance ❑ Yes ❑ No ❑ No, but I plan to ❑ DK
If yes, what did you do: _____

Renewable Energy ❑ Yes ❑ No ❑ No, but I plan to ❑ DK
If yes, what did you do: _____

Spillover Questions

17. **Since you participated in the Home Energy House Call Program, have you purchased and installed any other type of energy efficiency equipment or made energy efficiency improvements in your home that were recommended by the audit report?**

1. ❑ Yes
2. ❑ No
3. ❑ Don't Know

18. **Did you order additional energy efficiency kits?**

1. ❑ Yes
2. ❑ No
3. ❑ Don't Know

If yes, 18a. **What did you do with the additional kits?**

_____
_____

19. **What type and quantity of high efficiency equipment did you install on your own?** *PROBE TO GET EXACT TYPE AND QUANTITY AND LOCATION*

Type 1: _____ Quantity 1: _____ Location 1:_____
Type 2: _____ Quantity 2: _____ Location 2:_____
Type 3: _____ Quantity 3: _____ Location 3:_____
Type 4: _____ Quantity 4: _____ Location 4:_____

20. **Was this improvement suggested by the home energy audit provided to you through the Home Energy House Call program?**

Type 1: _____ ❑ Yes ❑ No ❑ DK
Type 1: _____ ❑ Yes ❑ No ❑ DK
Type 1: _____ ❑ Yes ❑ No ❑ DK
Type 1: _____ ❑ Yes ❑ No ❑ DK

21. *For each type listed in 19 above,* **How do you know that this equipment is high efficiency? For example, was it Energy Star rated?**

Type 1: _____
Type 2: _____

Type 3: _____
Type 4: _____

I'm going to read a statement about this equipment that you purchased on your own. On a scale from 1-10, with 0 indicating that you strongly disagree, and 10 indicating that you strongly agree, please rate the following statement.

22. **My experience with the Home Energy House Call Program in** <2099, 2010> **influenced my decision to install** <Type 1/Type 2/Type 3/Type 4> **on my own.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

23. **What other actions, if any, have you taken in your home to save energy and reduce utility bills at least in part as a result of what you learned in this program?**
Response:1 _____
Response:2 _____
Response:3 _____
Response:4 _____

Now I am going to ask you some general satisfaction statements. On a scale from 1-10, with 1 indicating that you strongly disagree, and 10 indicating that you strongly agree, please rate the following statements.

24. **The web site's form for getting the kit was easy to understand and complete**.

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?_____
_____

25. **Scheduling the home energy audit was easy to do.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?_____
_____

26. **The interactions and communications I had with the energy auditor were satisfactory.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know ❑ Not Applicable (no interaction)

If 7 or less, **How could this be improved**?_____
_____

27. **The energy auditor was helpful and knowledgeable.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know ❑ Not Applicable (no interaction)

If 7 or less, **How could this be improved**?_____
_____

28. **The audit report was easy to read and understand.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?_____
_____

29. **The recommendations in the audit report provided new ideas that I was not previously considering.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?_____
_____

30. **The recommendations in the audit report increased the likelihood that I would take recommended actions.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?_____
_____

31. **The interactions and communications I had with Duke Energy staff was satisfactory.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know ❑ Not Applicable (no interaction)

If 7 or less, **How could this be improved**?_____
_____

32. **The measures I installed from in the energy efficiency kit were of satisfactory quality.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?_____
_____

33. **Overall I am satisfied with the program**.

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?_____
_____

34. **What additional services would you like the program to provide that it does not now provide?**

Response: _____
_____

35. Are **there any other things that you would like to see changed about the program?**
Response: _____

36. **What do you think can be done to increase people's interest in participating in the Home Energy House Call Program?**

Response:1 _____
Response:2 _____
Response:3 _____
Response:4 _____

37. **What do you like most about this program?**
Response: _____

38. **What do you like least about this program?**
Response: _____

Thank you, that completes our survey, but we are looking for residential customers to participate in a research study in which a Duke Energy representative will visit homes to look for additional ways in which Duke Energy can help to reduce their customers' energy bills. If you choose to participate, a Duke Energy representative will visit your home at your convenience in June. The appointment would take about 30 minutes. We will only use your data for internal purposes and your responses will be grouped with other households. This will help us to improve Duke Energy's Home Energy House Call program. As a thank you, you will receive a $50 Visa pre-paid check card that will be mailed within 8 weeks of your participation. Are you interested in participating?

1. ❑ Yes
2. ❑ No – **OK, thank you for your time and feedback today!** (*politely end call*)

If Yes: **A Duke Energy representative will be calling your home to schedule your appointment. After the home visit, you will receive a $50 Visa pre-paid check card that will be mailed within 8 weeks of your participation. Can you please provide the best phone number to reach you:**

1. ❑ Number on file
2. ❑ Different number: _____

OK, thank you for your time and feedback today! (*politely end call*)

Appendix B: Program Manager Interview Instrument

Name: _____

Title: _____

Position description and general responsibilities:

_____

_____

_____

We are conducting this interview to obtain your opinions about and experiences with the Home Energy House Call program. We'll talk about the Home Energy House Call Program and its objectives, your thoughts on improving the program, and the technologies the program covers. The interview will take about an hour to complete. May we begin?

Program Objectives

1. In your own words, please describe the Home Energy House Call's current objectives. How have these changed over time?

2. In your opinion, which objectives do you think are best being met or will be met?

3. Are there any program objectives that are not being addressed or not being addressed as well as possible or that you think should have more attention focused on them? If yes, which ones? How should these objectives be addressed? What should be changed?

4. Should the program objectives be changed in any way due to technology-based, market-based, or management based conditions? What objectives would you change? What program changes would you put into place as a result, and how would it affect the operations of the program?

Operational Efficiency

5. Please describe your role and scope of responsibility in detail. What is it that you are responsible for as it relates to this program?

6. Please review with us how the Home Energy House Call operates relative to your duties, that is, please walk us through the processes and procedures and key events that allow you do currently fulfill your duties.

7. Have any recent changes been made to your duties? If so, please tell us what changes were made and why they were made. What are the results of the change?

8. Describe the evolution of the Home Energy House Call Program. How has the program changed since it was it first started?

9. Do you have suggestions for improvements to the program that would increase participation rates or interest levels?

10. Do you have suggestions for improving or increasing energy impacts?

11. Do you have suggestion for the making the program operate more smoothly or effectively?

Program Design & Implementation

12. *(If not captured earlier)* Please explain how the interactions between the auditors, customers and Home Energy House Call's management team work. Do you think these interactions or means of communication should be changed in any way? If so, how and why?

13. Describe your quality control and tracking process.

14. Are key industry experts, trade professionals or peers used for assessing what the technologies or models should be included in the program? If so, how does this work?

15. Are key industry experts and trade professionals used in other advisory roles? If so how does this work and what kinds of support is obtained?

16. Describe Home Energy House Call**'s** auditor program orientation training and development approach. Are auditors getting adequate program training and program information? What can be done that could help improve auditor effectiveness? Can we obtain training materials that are being used?

17. In your opinion, do the audits cover enough different kinds of energy efficient products or recommendations?

    1. ❑ Yes 2. ❑ No 99. ❑ DK/NS

    If no, 20b. What other products or equipment should be included? Why?

_____

18. What market information, research or market assessments are you using to determine the best target markets or market segments to focus on?

19. What market information, research or market assessments are you using to identify market barriers, and develop more effective delivery mechanisms?

20. Overall, what about the Home Energy House Call program works well and why?

21. What doesn't work well and why? Do you think this discourages participation or interest?

22. Can you identify any market, operational or technical barriers that impede a more efficient program operation?

23. In what ways can these operations or operational efficiencies be improved?

24. In what ways can the program attract more participants?

25. How do you make sure that the best information and practices are being used in Home Energy House Call operations?

26. *(If not collected above)* What market information, research or market assessments are you using to determine the best target markets and program opportunities, market barriers, delivery mechanisms and program approach?

27. Are there any other issues or topics you think we should know about and discuss for this evaluation?

Appendix C: Estimated Model

This appendix presents the estimated statistical models used in the impact evaluation. Two models were estimated, one that distinguishes the savings from the audit and the kit, and another that estimates the total program impacts. For both models, the dependent variable is monthly usage (in kWh/day) for the period Sept 2008 through August 2010. The independent variables in the model are:

- An indicator variable that is equal to one for all months after participating in HEHC, broken out by Ohio and the Carolinas. In the first model, participation is captured by the Audit variable, as well as a variable denoting whether or not the customer received a kit as part of the audit (the Kit variable).
- Weather terms, specifically temperature, dew point, and humidity, which correspond to the weather conditions for the month.
- Monthly indicator variables, denoted in the tables as MMMYY terms, where MM is the month and YY is the year. These variables are equal to 1 if the observation is for that month, and zero otherwise.
- The number of observations are the total number of monthly billing data records used in the model.

Table: *Audit and Kit savings*

	Coefficient (t-statistic)
Audit, Ohio	-3.391***
	(-8.08)
Audit, Carolinas	-1.679***
	(-4.11)
Kit, Ohio	-2.520***
	(-6.02)
Kit, Carolinas	-1.123**
	(-2.74)
Temperature	0.0938
	(1.66)
Dew Point	-0.0769
	(-1.23)
Humidity	0.238***
	(8.50)
sept08	16.06***
	(11.07)
oct08	11.89***
	(5.05)
nov08	18.82***
	(6.47)
dec08	35.88***
	(10.84)
jan09	46.29***
	(16.51)
feb09	47.91***
	(15.12)
march09	38.13***
	(10.96)
april09	31.44***
	(8.65)
may09	30.39***
	(8.07)

june09	37.90***
	(9.89)
july09	50.58***
	(13.06)
aug09	50.14***
	(12.74)
sept09	44.93***
	(11.32)
oct09	33.30***
	(8.35)
nov09	30.87***
	(7.70)
dec09	41.68***
	(10.46)
jan10	55.88***
	(19.76)
feb10	52.60***
	(16.44)
march10	41.86***
	(12.05)
april10	34.47***
	(9.46)
may10	31.31***
	(8.29)
june10	44.60***
	(11.50)
july10	62.80***
	(15.92)
Observations	293388

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table: *Total Savings*

	Coefficient (t-statistic)
Total HEHC, Ohio	-5.504***
	(-23.61)
Total HEHC, Carolinas	-2.469***
	(-10.39)
Temperature	0.0936
	(1.65)
Dew Point	-0.0758
	(-1.21)
Humidty	0.237***
	(8.46)
sept08	16.04***
	(11.06)
oct08	11.84***
	(5.03)
nov08	18.78***
	(6.46)
dec08	35.85***
	(10.83)
jan09	46.29***
	(16.51)
feb09	47.88***
	(15.11)
march09	38.08***
	(10.95)
april09	31.38***
	(8.63)
may09	30.31***
	(8.05)
june09	37.80***
	(9.87)
july09	50.45***
	(13.03)
aug09	50.00***
	(12.71)
sept09	44.79***
	(11.29)
oct09	33.14***
	(8.32)
nov09	30.69***
	(7.65)
dec09	41.50***
	(10.41)
jan10	55.72***
	(19.70)
feb10	52.39***
	(16.38)
march10	41.59***
	(11.98)
april10	34.16***
	(9.38)
may10	30.95***
	(8.19)
june10	44.20***
	(11.39)
july10	62.37***
	(15.81)
Observations	293388

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix D: HEHC Kit Magnet

Final Report

Evaluation of Duke Energy's "Get Energy Smart" Program in North and South Carolina

A Process and Impact Evaluation Report

Prepared for
Duke Energy

139 East Fourth Street
Cincinnati, OH 45201

November 17, 2011

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Executive Summary

About This Report

This report presents the process and impact evaluation findings for the evaluation of the "Get Energy Smart" Program, also known as the K12 Curriculum Program or the Energy Education in Schools Program. For this report, we interviewed eight participating teachers, the program manager, and program implementation managers and staff from Scholastic. We also surveyed student families.

According to the program information:

> "The "Get Energy Smart" program goal is to educate children and their families about wise energy usage in their homes and personal choices they can make to save money, protect the environment and address climate change. The curriculum was designed to allow teachers to incorporate the materials into their existing math/science instructional schedules with supplemental activities on the Web.
>
> The lessons are short, but relevant, and create opportunities for interactive, hands-on learning. Students and families can perform an on-line energy audit of their own homes, which creates an energy report for each participating family. After students perform the audit, those that live in Duke Energy territory receive a free energy efficiency starter kit containing information and the following items:
>
> - 2 CFLs (one 13 Watt CFL, and one 20 Watt CFL)
> - Efficient showerhead
> - 3 low flow aerators
> - Weather stripping
> - Educational materials
> - Personalized Energy Survey report
> - Business reply card (BRC)
> - Bag for testing water flow
> - Outlet and light switch insulators
> - Refrigerator magnet
> - Night light
> - Light-up ring for kids
>
> Students that do not live in Duke Energy territory receive a kit containing the following Items:
>
> - 13 Watt CFL (60 Watt Equivalent)
> - Duke Energy Labeled DOE Energy Savers Booklet
> - Water Flow Meter Bag
> - Duke Energy Supplied Toy (Glow Ring)
> - 8 Outlet Gasket Insulators

For the time period June 2009 to April 2010, Duke Energy has provided 8,385 kits to program participants in North and South Carolina who live in and outside of the Duke Energy service territory.

Summary of Findings and Recommendations

An overview of the key findings and recommendations identified through this evaluation is presented below.

There were 8,385 student family participants in the K12 program from June 2009 to April 2010, 6,006 in North Carolina and 2,379 in South Carolina. Table 1 and Table 2 below present the average number of kits distributed by participating teacher, school, and school district. For this program period, there were 113 school districts with participating schools. In these 113 school districts, 850 schools had a total of 1,857 teachers that participated in the K12 program. The average number of kits distributed per participating teacher was 3.3 in North Carolina and 2.9 in South Carolina.

Of the 8,385 kits distributed, 2,503 kits (29.9%) were sent to Non-Duke Energy customers in the Carolinas.[1] These kits contained fewer items, as described in the above text box. Note that these numbers represent the number of Duke Energy customers that completed the survey and requested kits between April 27, 2009 and June 7, 2010, not actual kit distribution. The number of kits sent would be slightly lower because Duke Energy did not send kits to customers that have received energy efficiency kits through other Duke Energy programs.

Table 1. Distribution of Energy Efficiency Kits in North Carolina

Jurisdiction: NC	Average Number of Kits Requested by Non-Duke Energy Customers	Average Number of Kits Requested by Duke Energy Customers	Total Kits Requested	Range of Number of Kits, Duke Energy and Non-Duke Energy Customers
School District (n=74)	21.9	58.1	6006	0-491
School (n=624)	2.6	7.0		0-145
Teacher (n=1,324)	1.2	3.3		0-35

Table 2. Distribution of Energy Efficiency Kits in South Carolina

Jurisdiction: SC	Average Number of Kits Requested by Non-Duke Energy Customers	Average Number of Kits Requested by Duke Energy Customers	Total Kits Requested	Range of Number of Kits, Duke Energy and Non-Duke Energy Customers
School District (n=39)	21.4	38.1	2379	0-644
School (n-226)	3.8	6.7		0-169
Teacher (n=533)	1.6	2.9		0-45

[1] 1,646 out of 6,006 (27.4%) kits went to Non-Duke Energy customers in North Carolina.
857 out of 2,379 (36.0%) kits went to Non-Duke Energy customers in South Carolina.

Evaluation Contractor's Recommendations for Duke Energy to Consider

The following program recommendations are provided by TecMarket Works, the independent evaluation contactor. The recommendations are provided to allow Duke Energy to review them with the program manager and the lead administrator so that each recommendation can be accepted, rejected or modified according to the best judgment of the program design professionals.

1. **Develop a coordinated school targeting and entry-contact strategy that takes advantage of all effective market development efforts to reach newly targeted schools.** For most schools targeted by the program, successful entry into the school is based on Scholastic's market presence and history serving schools, and their reputation as a curriculum builder. This is the primary market development theory regarding why delivering the program through organizations like Scholastic is the preferred approach. It builds on existing relationships and service history. That is, the program delivery success hinges on Scholastic's presence and reputation as a high-quality training support organization to the schools targeted by the program. However, teacher interviews suggest that for some schools, Duke Energy's Business Relations Manager (BRM) relationship with the schools can also be a "door opener" and may, in some circumstances, provide a more effective access route to the school administrators who need to approve the program for their schools. In addition, Duke Energy has other relationships that can be used to gain support. For example, the Duke Energy Foundation has contacts with school administrators and teachers and provides supportive funding to many schools. They also take part in school board activities and support educational development in the state via a number of efforts. For some schools, entry into the school can be expedited by leveraging Duke Energy' existing relationship through their BRMs[2] or through Duke Energy's extended community relations. These relationships and organizations can be considered when developing a school district contact strategy. This strategy can employ a phased approach for gaining access to new schools so that the support for the program is present and the administrators are receptive enough that they can push the push the program within their schools.

2. **Select program assessment metrics carefully when evaluating second year program energy savings.** Because the second program year will be implemented with several design changes as well as different fielding approaches compared to the first year, it will be important to understand the relationship between program operations and success (energy savings). Duke Energy and Scholastic should consider developing a set of performance metrics that help track the effects of the program to the operational components that deliver that success. One approach would be to develop several metrics and assess the success of the program across these multiple metrics so that the assessment focuses on savings achieved but also for delivery effectiveness. Such metrics can include savings per teacher, savings per school, savings per district, installations per teacher, surveys and return cards returned per teacher/school/district, students reached per month, etc. These performance metrics can then be compared with the program's operational procedures to identify changes that increase effectiveness and those that do not.

[2] BRM: Business Relations Managers, sometimes knows as the customer representatives

3. **Train program team members on the methodology that is used to calculate energy savings.** All team members should be made to understand that the energy savings are estimated by extrapolating the data from the measures reported on the BRC to the entire population. The requirement to achieve a at least a 20% rate of BRC returns stems from the need to minimize self-selection bias by drawing a sample from a wide range of households, not just those households that might already be more receptive to energy efficiency. This better understanding may allow program team members to find other ways of increasing the representativeness of the sample without resorting to high BRC return incentives. See next recommendation as an example.

4. **Consider other methods of decreasing response bias by increasing representativeness of the BRC sample.** The survey and BRC returns that the program is experiencing at this time should be considered the minimum level of acceptance for those teachers who have adopted the program for their classrooms. Surveys and BRC returns should be much higher. We see no reason why surveys and BRC return rates should not be provided by 50% of the students and their parents if it were presented as a homework assignment. Methods should be developed for increasing the BRC response rates. For example, playing upon known methodologies for multi-student partnership efforts, such as randomly divided into pairs and every pair could be asked to make a commitment to have at least one student return the BRC from each pair and the other report to the class the measures installed. The random pairing of students would decrease response bias by encouraging responses from students who tend not to respond.

5. **Work with neighboring utilities to share credit of achieving energy savings.** In a time when energy efficiency and carbon reduction is of increasing importance, growing numbers of states have school energy efficiency programs that overlap geographical regions. While it is important to understand an individual program's achievements for the purpose of improving program operations and program design, utilities should be given energy savings credit for contributing to overall energy supplies in their states and their market transformation efforts to achieve an energy supply objective. A case made to the regulatory agencies for sharing credit would be strengthened by coordination between neighboring utilities. However, splitting individual students within a single class to receive different levels of support based on the location of their parents homes can be expected to substantially decrease cost effectiveness by driving up costs per in-territory student and lower savings by not including all students. We recommend working with the Commission to resolve this issue to: a) count all savings regardless of territory, or b) exclude this program from a cost effectiveness requirement and allow recovery of all costs and incentives as a condition of implementation, or 3) determine if the program can be made cost effective through continued improvements such that it can become cost effective by counting only the savings from homes in Duke Energy's territory, or d) consider terminating the program. We specifically recommend that Duke Energy work with the Commission to allow savings from schools operating in multiple utility territories to be credited to the sponsoring utility so that territorial issues do not impact program energy credits or act to erode the apparent cost effectiveness of the program. Base the argument on the fact that it is the energy supplies of the <u>state</u> that are the focus

of the legislation and or regulatory policy behind cost effective energy supplies provided to the energy consuming population of the state. If this is not successful, examine the cost effectiveness of the program based on Duke Energy's territory savings and determine if the program is cost effective, can be made cost effective, can be exempted from contributing to a cost effective portfolio, or if it should be terminated.

6. **Continue to explore new program operations, enrollment, and marketing strategies to increase program cost effectiveness.** Duke Energy is working with Scholastic to test new approaches for improving the design and operations of this program. We compliment Duke Energy and Scholastic for their continued efforts to improve the program and encourage the continuation of this improvement approach. For example, in the Carolinas, Duke Energy is considering a new school strategy that does not require in-person visits. For this strategy, DVD presentations are being considered as a way to market to schools that are geographically hard to reach, making personal visits expensive. In assessing this strategy Duke Energy and Scholastic should continue to explore whether DVD is an effective presentation tool for serving as a replacement for in-person program enrollment visits. If this strategy is effective in the Carolinas, consider using this approach in Ohio as well.

   In addition, there is some concern on the part of Scholastic that mass marketing efforts are not permitted. Scholastic, on the other hand, recommends the use of local mass marketing efforts to develop positive community support for the program prior to contacting administrators and teachers during the enrollment phase. These options should be tested to determine what actions are worth perusing on a program basis. However, these efforts have to be considered within a cost effectiveness framework for the program as a whole within the portfolio. If the program cannot be made cost effective, it makes little sense to spend additional dollars building public support for a program that will not continue as a part of the portfolio. We recommend that both Duke Energy and Scholastic explore these and other options to build a program that is both cost effective and that uses an approach that improves response, participation and energy savings to become more cost effective over time.

7. **Review how many 3rd and 4th Grade classes the targeted schools have so that schools receive the appropriate number of teacher kits.** The number of 3rd and 4th grade classrooms was over-estimated in the 2009-2010 program year, resulting in too many kits being sent to the teachers. This was not reported as an issue in the current evaluation, and the average number of kits per school dropped from 11 in 2009 to 7.6 kits in 2010. This issue has likely been resolved as of this report, though further inquiries should be performed to ensure that the appropriate number of teacher kits are being distributed to the schools.

Teacher-Provided Recommendations for Duke Energy To Consider

In addition to the recommendations provided by the evaluation contractor, several teachers provided recommendations that can be considered by the program design professionals. TecMarket Works presents these recommendations from the interviewed teachers from both the Ohio program and the assessment of the program in the Carolinas so that ideas expressed across both states are considered within each state. However, we do not elevate these recommendations to be included with the recommendations from the evaluation contactor. The evaluation contractor recommendations are those that TecMarket Works suggest be implemented into the program (above). The teacher recommendations are provided without judgment as to their appropriateness for the K12 program. These including the following:

- Increase the level of educational and results-related program promotions (flyers, brochures, school examples, etc.) provided to the teachers and school administrators in time to be effectively used.
- Update the program materials to today's standards by adding a multi-media element such as a DVD video or online class activities.
- Develop and incorporate a day-to-day educational/activities planner to stretch the impact of the activities out over several days
- Add a more flexible incentive for teachers to make the effort worthwhile to the teachers who are responsible for success; the incentive can be cash for the class, class activities, or credits for class supplies or other incentives valued by teachers.
- Redesign the website to make it more user-friendly for students and teachers
- Add more online content for students to access at home that would focus on increasing key behaviors and measure installations.
- Develop a simple game for the students to play with their family that would reinforce the behaviors needed and the installation of measures. Distribute it with the kit.
- Develop a song that students can sing in the class or at home that sends a behavior and use message.
- Develop a downloadable application for smartphones that parents and children could use together to track their savings.
- Include a component in which the students write a report of the use of the kit items and have the program incent the report to make it attractive to students and teachers.

Teacher Comments

The teachers also provided additional comments on the program and its operations. These comments are summarized below.

- "The packet of materials was great. Children love being able to touch and hold things."
- "The lessons were brought down to the right level for my class, and "The Magic School Bus" holds a high level of interest for children."
- "The prepaid envelopes were great. We didn't have those last year and I think it made a real difference."
- "The materials need to be designed specifically for the children who are to be exposed to them. The lines of type in some of the materials are still too small."

- "Bring out the integration between the Magic School Bus story and the curriculum's focus and the program's objectives so that they directly support each other."
- "Add more multimedia elements – online, songs, videos, presentations."
- "Need to more effectively structure the program's focus and materials so that it integrates smoothly with the school curriculum that we must follow as well as state standards."

Student Family Surveys (Business Reply Cards, or BRCs)

One hundred sixty-two (162) families that live in Duke Energy's service territory in the Carolinas returned the BRC. The survey asked the families about what kit items they used and their satisfaction with the items. The most commonly installed items with over 80% installation rates were the kit's 13-watt and 20-watt CFLs and the night light. Respondents also indicated their highest levels of satisfaction with the CFLs, as presented in the table below.

	Percent Installed or Used	Mean Satisfaction Score
13-watt CFL	88.9%	8.8
20-watt CFL	82.7%	8.9
night light	81.5%	8.5
booklet	75.3%	8.5
low flow showerhead	70.4%	8.5
kitchen aerator	61.7%	8.5
bathroom aerator	56.2%	
switch and outlet gaskets	53.1%	8.3
water temp card	49.4%	8.4
water flow meter bag	19.8%	7.6

Impact Findings

Table 3 presents the per customer kWh savings associated with the K12 program. These results are obtained based on the results of the billing data analysis. Since the billing analysis uses actual energy usage to estimate impacts, and is the entire population of Duke Energy participants, it was deemed that this is a more accurate estimate of the program impact than the estimate from in the engineering analysis.

Table 3. Energy savings associated with the K12 program

	kWh	t-value
Per Participant Annual Savings (Gross)	249.2	6.00
Per Participant Annual Savings (Net)	205.2	6.00

The kWh impacts in Table 3 are from the statistical analysis of participants' monthly electricity billing data. Since the billing data cannot provide insight into impacts by measure, these impact estimates were based upon the engineering analysis impacts, adjusted by the ratio of the overall kWh savings between the billing analysis and the engineering analysis (23%). The engineering analysis also provides the net to gross ratio. Therefore, while the overall result is driven by the

billing analysis, an engineering analysis is also required. Both approaches are discussed in the report.

Introduction

This report presents the findings for the evaluation of the Get Energy Smart Program, also known as "Power in Energy". The Get Energy Smart Program provides energy efficiency informational and educational support and resources to 3rd and 4th grade teachers for them to incorporate into their lesson plans. The goal of the program is to use students as an information route to achieve cost effective savings in the homes of the children using the support and assistance of the parents.

There were 1,324 teachers in North Carolina and 533 teachers in South Carolina that participated in the program during the time period of October 2009 and May 2010, and TecMarket Works received the contact information for 140 teachers in North Carolina and 133 teachers in South Carolina that agreed to be interviewed. The evaluation was comprised of interviews with five of the 140 teachers in North Carolina and three of the 133 teachers in South Carolina. The objective of the interviews was to determine program satisfaction, and to gather feedback on the curriculum and to obtain suggestions for improvements. The complete interview instrument can be found in Appendix A: Teacher Interview Instrument.

Program Description

The Energy Efficiency Education Program for Schools reaches out to 3rd and 4th graders in Duke Energy's service territory to educate them about energy efficiency in their homes. Students are given Duke Energy's home energy audit survey to complete. These surveys can be returned to the teacher or mailed back to Duke Energy in prepaid envelopes. The survey can also be taken online. Once the surveys are received and processed, Energy Efficiency Starter kits containing low-cost, energy efficient measures are sent to the home. The kit also contains a business reply card that asks the family to indicate which of the measures in the kit were installed.

Process Methodology

This study consisted of reviews of program materials to understand the focus and scope of the program, process evaluation interviews with Duke Energy program managers, Scholastic program administrators and school teachers implementing the program. The interviews focused on methods of operation and implementation, experiences and perspective associated with program design, approaches and results, and levels of satisfaction with the program's materials, communications, and delivery components. The interviews with the teachers also assessed process issues including the ease of signing up for the program, the quality and completeness of the curriculum, the value of the energy recommendations provided and other subjects (see instrument in. In addition, participating students' families were sent surveys.

Impact Methodology

Engineering Estimates

Engineering algorithms were used to estimate savings from all measures as detailed in Appendix E: Impact Algorithms.

Billing Analysis

The analytical method employed to evaluate the impacts of the K12 program relied upon a panel data approach where data are available both across households (i.e., cross-sectional) and over time (i.e., time-series). With this type of 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 that allows different variables across homes that do not vary over the estimation period (such as square footage, heating system, etc.) to 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).

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 unique constant terms representing each unique household.

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

$$y_{it} = \alpha_i + \lambda_t + \beta x_{it} + \delta Part_{it} + \varepsilon_{it}$$

where:

y_{it}	=	the electricity use for home *i* during month *t* (normalized by the number of days in that month)
α_i	=	constant term for site *i*
λ_t	=	A vector of monthly indicators for all months in the model. This is included to capture trends in electricity use over time across all customers that cannot be captured by weather terms or post-treatment variables. These terms lessen the possibility of biased impact estimates from the influence of omitted variables.
ß	=	vectors of coefficients
x_{it}	=	vector of variables that represent factors causing changes in energy consumption for home *i* during month *t* (i.e., weather)
δ	=	the coefficient indicating the effect of the program
$Part_{it}$	=	a variable indicating that home *i* was a participant during month *t*
ε_{it}	=	error term for home *i* during month *t*.

The weather terms included in the model are the heating and cooling degree days for that month, tied to the customer location, and to capture the overall trend in electricity usage, monthly indicator variables were used for each month in the analysis (i.e., time effects).

Snapback and Persistence

The theoretical additional energy and capacity used by customers that may occur from implementing an energy efficiency product, often called "snapback" if it occurs, is by design already captured in the impact evaluation through the billing analysis approach. The billing analysis approach uses actual energy use between the pre and post condition compared to what would occur without the program (control). All market or program effects conditions, including snapback, are already accounted for in this evaluation method. Further, there is little to no literature or snapback analysis within the evaluation industry that has been able to identify a snapback condition. The so-called snapback that has recently been referenced in the press has been the impact of normal electric demand growth that shows up in all customers as new products, services, and technologies are acquired and used. However, as noted above, any snapback that does occur would be captured in the evaluation design because of the use of pre and post billing analysis.

The billing data analysis, by using usage data from customers who participated as long as over a year ago, indicates that the impacts of the K12 program are likely to persist for at least one year. However, the evaluation did not address how long these savings are likely to persist over time because the time span of the available data was not sufficient to address this issue.

Process Evaluation Findings

Program Objectives

All the program team members who were interviewed were clear about the objective of the program.

- *"To promote energy efficiency behavior in families, reduce the amount of energy needed by families in the area. To help families save money. To promote Duke Energy's goals of protecting the environment."*
- *"To teach and encourage students and families in NC elementary schools to become more energy efficient at home and in the community."*
- *"[Primary goal is] demonstrating kWh savings by distribution of energy measures into the homes. Second is educating our customer base."*
- *"To educate students about energy efficiency along with state-determined curriculum. Provides kids and families opportunities to receive energy efficient products."*

Roles

Duke Energy serves as the administrator of the program with Scholastic playing a key collaborative role to implement the program under Duke Energy's direction. As the Duke Energy program manager explains, "*Duke brings the business requirements and Scholastic shows how they can meet that need and deliver the program."* Niagara Conservation provides fulfillment of the Energy Efficiency Starter Kits to the students and their families. The staff from all three companies have regular communications through quarterly in-person meetings, monthly reports on outreach activities performed by Scholastic, weekly reports on survey returned, as well as weekly phone calls. The collaboration is working very well according all the interviewees. Duke Energy draws upon Scholastic's expertise and feedback but is responsible for leading the strategic planning. The Duke Energy program manager conducts process checks by accompanying state coordinators on visits and events and provides feedback on their marketing and on operational strategy. The Duke Energy program manager also facilitates event and sponsorship opportunities.

Curriculum

The program targets all 3rd and 4th grade classes within Duke Energy's service territory. Each teacher is sent a boxed kit containing materials that were designed as turnkey lessons on energy efficiency, aligned with each state's curriculum standards in science, math, and language arts, integrated across those disciplines. The materials consist of three lessons with activity sheets for each lesson. These lessons are also available online for those teachers who have Smartboard technology. The lessons are designed by Scholastic's in-house staff. Scholastic has built a national reputation for creating educational materials and they leveraged their core expertise in this area to design appealing lesson plans for the Energy Efficiency Education Program.

Along with the lessons in each box is a booklet of energy saving ideas and 30 family involvement envelopes that contain the Duke Energy home audit survey (Personalized Energy Report) adapted for this program by adding artwork from the Magic Schoolbus program. Postage paid return envelopes accompany each survey.

Program Targeting, Marketing and Incentives

The Energy Efficiency Education Program targets all 3rd and 4th grade classes within Duke Energy's Service Territory. In many cases, the schools draw from neighborhoods that are partly serviced by another utility, but students outside of Duke Energy's footprint are not counted by Duke Energy in their goals. Students outside of Duke Energy's footprint are not excluded from the lessons, but their families receive a different energy kit. Their kits do not contain energy efficiency measures and do not contain the Personalized Energy Report. The students outside of Duke Energy's footprint used to receive the same energy efficiency kit. However, after Duke Energy was instructed by one state's regulatory agency that Duke Energy could not claim energy savings outside of Duke Energy territory the kit was adjusted to reflect that decision, lowering the cost of the Non-Duke territory kit and the energy savings that could be achieved. This change is consistent with Duke Energy's goal to standardize all programs to maximize design and implementation efficiency and cost effectiveness. TecMarket Works agrees that it makes little sense to spend money to achieve save energy in a home from which the savings cannot be claimed. However, Duke Energy needs to work with the Commissions to acknowledge that energy efficiency ultimately benefits the Carolinas. If the Commissions agree that education on energy efficiency is an important objective, then savings from schools operating in multiple utility service territories need to be acknowledged in some fashion. The issue of territorial boundaries between neighboring utilities should not be the major barrier.

The program is marketed to the schools and teachers by the state program coordinators. In first year of the program, there were two coordinators for North Carolina, and one each for Ohio and South Carolina. For the second year, there will only be one coordinator for the state of North Carolina. These coordinators have a wide range of responsibilities, including holding informational meetings with administrators, curriculum supervisors, and instructional specialists. They also provide teacher training on energy efficiency and conduct school assemblies and other outreach events for students.

The program includes incentives designed to increase both teacher and student participation. Teachers can receive 15 free classroom books when five or more of their students return the surveys. Teachers were also given an opportunity to win a trip to New York City. However, the teacher interviews indicate that the New York trip was not a good incentive for many teachers because the chance of winning is perceived to be low and not everyone valued a trip to New York. An incentive needs to be attractive to the teachers for it to function as an action inducer.

When students return the home audit survey, their family receives an Energy Efficiency Starter Kit containing a number of low-cost energy efficient measures. In addition to receiving the Energy Efficiency Starter Kit, students who return the surveys are also eligible to participate in a drawing for another incentive. In the first year, the additional survey return incentive was a MacBook Pro laptop computer. In the second year, the survey return incentive will be an Apple iPad.

Sent at the same time as each Energy Efficient Starter Kit is the household's Personalized Energy Report (PER) and a business reply card (BRC) on which the students are asked to indicate how well they liked each measure and whether they installed the measure. To increase the BRC return rates, students are told that that they would be eligible for another incentive drawing. In the first program year, this BRC incentive was an iPod Classic. In the second program year, this incentive will be a Flip mini video camera.

The state program coordinators have found during the first year that the most effective way to market the program was through in-person presentations to the schools. Coordinators report that survey return rates were highest in these schools. The student presentations last approximately 45 minutes, and one program coordinator reports that these presentations are a treat for the students because *"a lot of schools don't have money for bells and whistles".* Because electricity is not in the 4th grade curriculum, the state coordinators work to tie the topic of energy efficiency to whatever subject matter the students are currently studying. As an example, if the students are studying plants, one coordinator included a presentation of how plant matter is transformed into coal, which is then used to power electric plants.

> *"I'm getting kids powered up to help their families save money. I'm a good will ambassador, speaking to 200 kids at a time. Everybody walks away feeling good about Duke Energy and Scholastic."*

Energy Efficiency Starter Kits

Once the surveys returned, Duke Energy sends a list of customers to Niagara Conservation for fulfillment of the Energy Efficiency Starter Kits. Niagara Conservation is responsible for shipping the kits to the student families and uploading the fulfillment data into Duke Energy's participation database. It is this database that is filed with the regulatory commission.

Duke Energy and Niagara Conservation determined the components of the kit collaboratively. The measures in the kit needed to be easy for the homeowner to understand and to install. They needed to be low cost, simple to use, and useful to the homeowner. The components of the kit are the same for all three states.

Each kit includes:

- 2 CFLs: 1 13-watt, 1 20-watt
    - Or 8 CFLs: 4 13-watt, 4 20-watt
- Efficient showerhead
- 3 low flow aerators
- Weather stripping
- Educational materials
- Personalized Energy Survey report
- Business reply card (BRC)
- Bag for testing water flow
- Outlet and light switch insulators

- Refrigerator magnet
- Night light
- Light-up ring for kids

The fulfillment process seems to be running smoothly; none of the Energy Efficiency Education Program staff have mentioned any issues about the fulfillment of the kits. Typical comments received during the interview were, "*Everything is working well; every step is working well*." Niagara also receives and tracks customer calls in regards to the kit and report that there are very few calls for this program. Customers call when the occasional item is broken, and a replacement is sent out immediately. Other times, customers call in order to find out where they can obtain more of certain kit components. Niagara reports, "*People generally like the materials that we send out*." All the calls are tracked and reported to Duke Energy on a regular basis. The Duke Energy program manager reports that the program team members are "*always looking for things to add or remove from the kit*".

Surveys

The adapted PER survey itself was perceived to be one of the biggest barriers to participation in the first year for two reasons: 1) the survey was long and some questions required additional research by the homeowner, and 2) the survey asked for the last four digits of the customer's social security number. At the time of this evaluation, both problems had been resolved and the solutions are described below.

The survey was taken from another Duke Energy program, the Personalized Energy Report (PER) program. That program is targeted to adult homeowners who may have been already interested in energy efficiency. There are a number of differences between PER decision-makers and EE Education Program decision-makers. PER customers are more likely to be self-selected and be more open to adopting energy efficiency measures and recommendations. EE Education Program decision-makers are parents whose priority toward energy efficiency is unknown. They may be less receptive to energy efficiency recommendations than the PER customers. This means that their interest in EE perhaps should have been piqued prior to asking them to fill out a 30 question survey that contained detailed questions about their household characteristics. Even though the process of completing the survey was intended as a family activity, in many cases the students attempted to respond by themselves. For example, one question asked what kind of fuel was used in the home heater. Students did not understand this question.

The Duke Energy program manager and the Scholastic coordinators together have identified a number of improvements to be made to the survey for the second year of the Energy Efficiency Education Program. The new survey is designed by Scholastic to be less overwhelming than the 30-question survey, and to have a more educational look and feel that was appropriate for the target customer segment. From a messaging perspective, the Duke Energy program manager thought that interspersing the detailed questions of the PER survey with grade school cartoons may have confused customers. Surveys will be simpler, consisting of only six questions, each tied into an educational learning point that was emphasized in the lessons. The new survey will also have questions in English on one side and Spanish on the other.[3]

[3] In the first year, a Spanish version of the 30-question survey was available online.

Duke Energy's home energy survey asked for both the customer account number and the last four digits of the customer's social security number for verification. In most school systems, however, social security numbers are not allowed to be used as IDs. One administrator expressly forbade the teachers to hand out the surveys because it asked for the social security number. After many discussions with Duke Energy, the teachers were allowed to tell students to cross the social security number request off the survey.

Duke Energy receives all the paper and online surveys after which a third party vendor enters the information into a survey response tracking database. The data from the surveys are then passed on to Scholastic on a weekly basis. Scholastic's third party vendor is responsible for maintaining a composite of the data, parsing out activity by school. Scholastic also reviews the data to make sure that multiple teacher surveys are reconciled in the cases when minor variations in spelling are treated as separate records. This has posed a slight problem, as teachers cannot receive their 15 book incentive if the returned surveys are recorded under different spellings of their name prohibiting a grouping of surveys for specific teachers. This problem is being addressed by changing the way information is put into the database so that surveys can be better linked to a specific teacher regardless of spelling errors or incomplete data[4].

Business Reply Card (BRC)

The business reply card contains nine questions asking whether the family like the measure and whether they intend to install them. The program coordinators, however, felt that the BRC, on which saving calculations are based are often overlooked in the kit. *"[It's] not shocking that a piece of paper in box of goodies is not returned.*" Duke Energy and Scholastic have already taken actions to address this problem and Scholastic has been asked to redesign the card so that it will stand out. The newly redesigned card is in a bright pink color, shaded from dark pink to light pink so that it will stand out and increase the response rate.

Scholastic's service contract includes targets for number of returned surveys and number of returned business reply cards (BRCs). The target number of surveys differs from state to state. Per Scholastic's contract with Duke Energy, Scholastic is expected to deliver a BRC return rate of two out of ten distributed, or 20% of the total sent out in the Energy Efficiency Kits. There is some confusion on the part of Scholastic's managers about the way the BRCs are used in determining program achievements. More than one interviewee believed that only those measures that were reported on the BRC as being installed are counted toward the energy savings. Based upon that belief, they thought that the program's energy savings were grossly under-reported because they were sure that more kits were being used than the raw number of returned BRCs would indicate. However, this is not the case. Savings are credited to the program as a function of the typical per-participant installs as predicted by the surveys that are returned. Another interviewee believed that the target of returning 20% of BRCs was an unreasonably high target and should be replaced by another indicator of actual measures installed. TecMarket Works disagrees and suggests that the goal be no less than 20%. Response rates lower than 20% will require adjusting savings projections to factor in larger reductions of savings estimates to offset self-selection bias. The higher the response rates, the more confident

[4] The program staff report that for the second program year, a new vendor has been chosen to input survey data into the database.

we are that the savings projections are accurate. If the teachers can assign the survey and BRC as homework, and they can be given feedback about which of their students did or did not return those two short surveys, TecMarket Works does not see why survey and BRC return rates could not reach 50% of participating students.

Overcoming Barriers

The Energy Efficiency Education Program was designed to anticipate known barriers to participation. For teachers, the turnkey lesson materials were offered as a solution if the teachers "*didn't want another paper to grade*." Program coordinators also suggested to teachers that they use the surveys as extra credit homework, or that the survey participation rates could be presented as a game to reach 100% participation.

Program coordinators are always searching for ways to improve participation. Teachers were invited to brainstorm ways to increase student participation and share those ideas. For example, one teacher shared the success she had when she "*included a personal note to the parents with the surveys that were sent home*". The program coordinators took that idea and created templates of notes that could be adapted by other teachers if they also wished to send personalized notes home with their students.

There are also a number of barriers to parent participation. The program coordinators are aware that there are too many demands on parents' attention, to the extent that parents regularly do not sign and return even critical documents such as their children's report cards. To try to help students get their parents' attention, one program coordinator devised scenarios for the school presentations and coached the students: "*When your parents ask you what is this, don't say 'I don't know…' say 'This is awesome! If you fill this out you get this cool kit!*'"

The barriers to parent participation severely impact the survey and BRC return rates. Currently these two items are the main metrics measuring program success. The Duke Energy program manager reports that while the team is still considering marketing to parents, they are wary of doing so because then the program becomes similar to other residential EE survey programs and "*diminishes the education objective*" because according to interviewees it "*just comes down to the survey itself".*

Lessons Learned

Duke Energy and Scholastic believe that one of the main barriers to reaching the program goals in the first year was the difficulty of getting "buy in" from the schools. They have developed a new contact strategy that targets school districts and the schools in that district, instead of approaching schools individually. Scholastic's long-standing reputation as a high quality educational resource to schools has also helped the coordinators to open doors that would not have been possible for an unknown company. One program coordinator was able to leverage her pre-existing network of educators to gain access to administrators at the district level, with great success. This access was critical because it allowed coordinators to use their most effective tool for motivating student participation: the school coordinator's in-person presentation.

The program staff have now refined their entry-contact approach to the following three steps.

1. Approach top-level school administrators first, to gain their approval
2. Provide information about program to curriculum administrators and teachers
3. Make an in-person presentation to the students.

Another lesson learned by the Energy Efficiency Education Program was that in a few cases they really needed Duke Energy to help gain access to the district-level administrators. For example, one program coordinator, after months of resistance from a school district, finally was able to contact a Duke Energy Business Relations Manager (BRM) who immediately was able to procure permission from the school district. At the start of the program coordinators were asked not to contact BRMs until they received permission for that contact. A program coordinator reported they did not receive this permission until Sept 2009, months after the request for permission. The Scholastic program coordinators suggest that the program would run more cost-effectively if Duke Energy could ask the BRMs to meet with program coordinators and make sure they are aware of the EE Education program. Duke Energy has also established a respected role as a supporter of education through the Duke Energy Foundation. The relationships established through the Duke Energy Foundation might also provide opportunities to gain entry to school districts.

Second Year Changes

The program team agrees that the biggest improvement that could be made to the program has already been addressed, in the redesign of the survey itself.

In an effort to make the program more cost effective, the program management team decided to use lower-cost incentives for the return of the surveys and the business reply cards. This enabled them to hold drawings more frequently, allowing the program managers to advertise the EE Education Program more frequently when they announce the drawing winners.

Program Growth

Any program's first year's start-up and launch costs are higher than steady-state operational costs when compared to the energy savings achieved. In the first year the Energy Efficiency Education program needed to develop a new curriculum and needed to gain entry to school districts at the administrator level. In the second year of program operation, the state coordinators expect to reap some of the benefits of the groundwork that they have laid during the first year. The coordinators expect more teachers to participate the second year per dollar of recruiting efforts, reducing total cost per school and cost per unit of energy saved:

"*In the past year we had the teachers who were adventurous and" explorer" types pick up the kit. We're going to have more of the* [mainstream] *teachers this year, with the administrative support and teacher training that we're setting up. We're getting to the bell curve*."

The coordinators have had more lead time during which to introduce the lesson materials to the teachers.

"*When you drop it to them in the fall, they don't know how to use it, even though it bears the Scholastic brand, which has been used in schools forever. It's not like they were skeptical, it was just not seen across the board."*

In general, the coordinators have had more time to coordination with school events. The coordinators are currently getting ready for a marketing push in October 2010 to coincide with Energy Awareness Month. The coordinators have had more time to arrange their efforts to match the timing for the teacher in-service training workshops that are held at the start of each school year. By having more time to prepare, coordinators can schedule their school presentations early, making it easier to get scheduled on the school and teacher calendars.

While the program has gained significant foothold in the first year, one coordinator expressed caution: noting that the program is still laying groundwork in many areas and reported that midstream changes to the program affect the program's credibility. The coordinator gave as an example the disappointed schools she faced when the Kindergarten through First Grade EE Education program planned for year 2 was scaled down from full implementation to a limited pilot program. "*All our people were selling the* [K through 1st] *program, now we have to go back and say, oops it's not going to happen…So many people are trying to use the school venue to deliver their message. Once you get in there, it's very important to proceed cautiously and professionally and not switch up the game once you're in there*." This person noted that it is important to give the program time to work before changes are made that conflict with the descriptions given to teachers and administrators. This person notes that school support can erode if commitments are abandoned by the program.

In the interviews, all of the state coordinators identified one area of improvement that would they report will have the biggest impact on program participation: the use of mass marketing techniques such as news releases, radio, TV and billboard advertisements. They report that Duke Energy has expressed concerns about who is exposed to program marketing information, especially in areas where that information could be seen by non–Duke Energy customers, and has directed Scholastic to market only to 3rd and 4th graders in Duke Energy's service territory. According to the interviewees, this rules out the use of mass media marketing efforts, even in regions where Duke Energy is the primary electric utility. However, because Duke Energy does frequently serve regions that neighbor other utilities' service territories, there may be sensitivities to marketing programs offered by one utility but not by another. For example, neighboring utilities that do not offer a school energy program with free energy efficiency kits may be negatively compared to Duke. Duke Energy may wish to share their specific marketing concerns with the state program coordinators. It would help them better understand reasons behind the marketing restrictions. The interviews report that they are frustrated by the high degree of lost marketing opportunities that have direct impact upon Scholastic's contractual service objectives and obligations.

The program coordinators are Duke Energy's main points of contact with the customers. These coordinators are able to provide feedback that Duke Energy would otherwise never receive. The coordinators have already demonstrated innovative solutions to addressing program barriers. The coordinators may similarly be able to provide innovative solutions to the mass marketing restriction once the parameters of the restriction are fully understood.

Program Metrics

Duke Energy and Scholastic use multiple metrics for tracking the EE Education program achievements. One metric is the survey return rate as measured against projections made at the beginning of the program year. Another metric is the business reply card return rate, measured against projections. Yet another is the number of measures reported on the BRC. The ultimate objective is to demonstrate that customers installed the measures and thus achieved energy savings. Without substantial installations, the program cannot hope to be cost effective.

The survey return rate is tracked on a weekly basis and allows the program coordinators to receive immediate feedback about how effective their past week's presentations have been. The BRC return rate is also tracked on a weekly basis, but the interviewees have inaccurate information regarding how the BRCs are used.

The Duke Energy program manager reports that the energy savings credited to the program are estimated by sampling and tallying measures reported on the returned BRCs. Scholastic has been contracted to achieve a return of 20% of the BRCs sent out. However, it is not clear to some of the interviewees whether the primary metric of program success is the BRC return rate itself or the energy savings attributed to the program. This has led to some concern by Scholastic about how program success is measured. While the program coordinators can work to influence the students, the survey return rate is one step removed from the program coordinator's efforts and parental involvement which is hard to obtain, is usually required. Because the number of BRCs returned is contingent upon the number of surveys returned, the program team has even less influence over each the BRC return rate. Some of the program coordinators believe that the program's energy savings are determined solely by the number of measures reported on the BRCs, and that if the BRCs are not returned, no energy savings would be counted from that household. This misunderstanding has led to some unnecessary stress on the part of the program coordinators: "*I feel strongly that the kits are being used, even if the BRC is not returned.*"

The program staff have been struggling to find other ways to capture the number of energy measures the families actually installed and have made some suggestions to Duke Energy's management. One suggestion is to have an online carbon calculator where students and families could enter the measures they installed and get instant feedback on how much energy or carbon is saved. This would also provide an alternate and highly automated way to convey that information to Duke Energy in addition to the BRC if there is a way to rule out false entries as students consider what-if scenarios to see what the savings would be under installation conditions not yet taken.

Most energy efficiency programs try to provide additional verification of the measures installed, without relying solely on customer self reports. Other ongoing evaluation studies for Duke Energy are finding that on-site examinations found both over- and under-reported installs. That is, some measures reported as installed were actually missing, but some measures had been installed that were not reported. In order to adjust savings for this condition it would be necessary to conduct on-site in-home examinations to confirm or adjust reported installation rates.

It is also important to identify good metrics for evaluating the achievements of the EE Education program's second year. The second year is usually the period in which the benefits of the startup efforts will come to fruition. Because the second year program was scaled down, one of the main first-year activities (the coordinator outreach activities that have been unanimously identified by interviewees as a driver of success,) is critical to be compared against the same standard applied during the first year's achievements. The program management team may already be considering these issues. Because it is difficult to identify a single best metric, the program management may wish to calculate several success metrics and see how well they predict actual success (energy savings). For example, if the program managers are expecting a higher survey return rate in the second year, they may choose to calculate BRC and survey return rate in the first and second years as a function of 1) number of school presentations, 2) number of students who attend the presentations 3) perceived value of the second year incentives versus the perceived value of the first year incentives, 4) number of districts that approve the lesson materials, etc. This diverse toolkit of metrics will also enable Scholastic and Duke Energy to track which components of the program delivery process are most effective, as well as to identify any components that might be improved.

The difficulty in finding appropriate metrics is due in part to the fact that there are several links in the causal chain leading from program activity to BRC response. The program coordinators believe that the program's activities are planting seeds of action for the future generation of decision makers.

Program Successes

The program has had many hard-earned successes and in the interviews the program team members shared their thoughts on what the program's greatest achievements have been, in their own words.

The curriculum is well received by the teachers and is perceived as providing a valuable addition to the school's curriculum:

> *"From an educational point of view, [the lessons] are very well set up. Teachers really like the lessons and activity sheets; they fit well"*
>
> *"Really is a solid curriculum. [It] fits nicely and is very turnkey for teachers to implement. It's in accordance with individual state standards. [Teachers can see] it's legitimate and can use it and see value with it right away."*
>
> *"Even though everything is about going green, it hasn't been taught heavily in school system."*
>
> *"K12 program is being adopted as part of the school strategic plan in Guilford and Charlotte-Mecklenburg districts"*

The program coordinators have identified an effective three-step strategy for gaining access to classrooms and teachers

"Being more strategic in our efforts. We have been able to get district-wide adoption. Our strategic approach is a bit more advanced and that will serve us well going forth."

"Doing well creating network at the administrator level. We're getting good respect for what we're trying to do, getting the message out."

The program team members are passionate about the program's methods and objectives, and are able to relay that enthusiasm to the students and teachers.

"I'm very passionate about this, I'm very committed to making teachers find this interesting and relevant."

"I think it's wonderful that thanks to Duke, students are able to get these free presentations and that families are able to get these tools to save energy…that energy efficiency is in the mailbox and on the radar of every 3rd and 4th grade teacher. It needs to be on the radar of every American but you have to start somewhere."

"I think it's one of the most important things they're doing and I think they should keep doing it."

Summary

In summary, the Energy Efficiency Education Program faced and overcame a number of challenges that are not unusual for a new program's first year of operations. These startup costs have been paid, and the result is that the program has learned valuable lessons that have enabled them to improve the second year's operations. Access to classrooms is critical and the EE Education Program has made significant inroads into the school districts and created a network of schools that have had successes offering the lesson materials to their students. The program team has determined an effective top-down strategy with which to approach new school districts. The survey is a second critical component of the program, as it is the point of access into the families. The program team has successfully targeted student and family concerns with the PER survey and redesigned a new survey to address those concerns.

"The coordinators have a year of knowing what does work and what doesn't. They're now doing the presentations that they know works best."

In the second year, these lessons learned are expected to pay off in more cost-effective program operations and higher participation rates per survey sent out. The program itself is gaining momentum among the educational community.

"I think that the program is on the cusp of taking off. There are a lot of things that are play…awareness is starting to spread."

There will certainly be more challenges in the second year. The in-depth interviews found that the Duke Energy and Scholastic team members have a successful working relationship that allows Scholastic program coordinators to innovate solutions to barriers that they are able to see

day to day. The ability to respond to quickly and flexibly value be one of the program's most valuable assets in resolving any future challenges.

Results from the Interviews with the Teachers

The Interviewed Teachers

Five grade school teachers from North Carolina and three grade school teachers from South Carolina were interviewed about their experience with and use of the Get Energy Smart program. Four of the teachers identified themselves as science teachers, and all eight teach elementary school children in grades 1-5 and utilized the Power in Energy curriculum.

Program Objectives

All eight teachers surveyed agreed with and supported the program's objectives. However, none of the teachers interviewed identified the program objective of cost-effective energy savings. All of the teachers interviewed were not presented with the program objective of cost-effective energy savings or if they were, they did not fully understand these objectives well. Every teacher surveyed identified the objectives of the program as teaching children to conserve energy and resources. Five of the teachers identified the program's lessons as going further than the student and informing the students' parents about energy-saving opportunities. Five of the teachers indicated that the objective was to get students and parents to use the energy efficiency actions and none mentioned the program objective of cost-effective net energy savings specifically. The objectives of the program and the reason the program is funded by Duke Energy is first and foremost to cost-effectively reduce energy consumption in the homes of the students. This goal is to be reached via the educational components of the program. All interviewed teachers expressed an opinion that the primary goals of the program were educational rather than achieving cost-effective energy resources. Three teachers indicated that they felt that Duke Energy's primary goal of energy-efficient savings or behavior was different than the teachers' goal of education, but all three also indicated that these goals were compatible with one another. It is good that the teachers understand the importance of reaching the goals via the educational process, but the education is the route by which the program's goal is to be reached. The program needs to focus on making sure the schoolteachers and administrators understand that the objective is energy savings, while the tool to allow this to occur is through the educational process. The program needs to be sensitive to the objectives of the teachers and focus on the education aspects of the program and not necessarily the program goal of energy savings. However, the teacher should clearly understand that the success of the program and its continued operations is based not on the educational accomplishments of the program, but on the educational processes' ability to produce cost effective savings.

Program Timing

All eight teachers found the program to be useful within their established curriculum and required little adjustment or a reasonable amount of adjustment.

Definition of Success

One of the teachers defined success in the program as having students become aware of energy-saving strategies in their home, and seven teachers said that having students actually use those strategies in real life would define success. All teachers said they thought the school administration would view success in the same way as the teachers.

Communication Between Teachers and Parents

Most communication between teachers and parents was achieved through the students. Teachers who collected the completed surveys from students reported a high rate of participation from the parents in filling out the survey. Five teachers offered an incentive such as candy or gum to students to return the completed surveys.

Communication Between Teachers and Program Administration

Two of the eight teachers reported that they had no or very little interaction with the program's administrator. Three teachers received the program materials from the program's administrative manager, and four others attended a presentation at the school provided by the program administrator. The three teachers that received the program materials directly from the program administrator reported that they had had some level of discussions about the program and the program's goals and procedures with the program administrator.

There is a need to increase the level of interaction between the program's administrator and the teachers responsible for program delivery so that the goals of the program can be shared with the teachers and to obtain stronger support for those goals.

Communication Between Teachers and Duke Energy

Communication between Duke Energy and the teachers was minimal. Six teachers attended program presentations at their school in which Duke representatives were in attendance. However, none of the others had any contact with Duke Energy staff prior to or during the program. All eight of the teachers indicated that the program's objectives and activities were easily understood from the materials provided and no extra training was needed, however, as noted earlier, this exchange was not completely effective at communicating the program's primary goal to the teachers. Three teachers indicated that more communication from Duke Energy may increase teacher participation levels. However, it is not clear that presentations by Duke staff will have an effect on teacher support or participation, or be more effective at causing teachers to better understand the program's goals. What is clear is that there is a need to better communicate the program's goals to the teachers so that the goal may be more effectively focused on by the teachers, and this may be effectively accomplished via the program administrator who is most in contact with the school administrators and teachers.

Participation Levels from Teachers

The interviewed teachers had several suggestions to increase the participation levels. More direct communication with teachers beforehand from the program administrator or the Duke Energy program manager with the school administrators and teachers was the most commonly cited suggestion from the interviewed teachers for ideas that would increase participation. Six of the teachers stated that their school administration's approval and support of the program was essential to their participation.

- *"We can't have a wasted day and we need to know what we are teaching has approval."*
- *"Meeting the state standards is great, but I really look for that rubber stamp from the administration."*

All of the teachers interviewed thought the teacher incentives had a positive effect on participation, but five of the teachers also thought that the incentives could be improved. Several

teachers mentioned that a more flexible classroom incentive in addition to the Scholastic books would be welcome and help increase participation even more. Two teachers mentioned that they had no interest in a trip to New York City and said they would rather add to incentives for all teachers than have a lottery-style contest with a low chance of winning for some of the incentives.

Other suggestions provided by the teachers included:

- *"Update the program materials to today's standards by adding a multi-media element such as a DVD video or online class activities."*
- *"Develop and incorporate a day-to-day educational/activities planner to stretch the impact of the activities out over several days."*
- *"Add more lessons."*
- *"Add a more flexible incentive for teachers to make the effort worthwhile to the teachers who are responsible for success; the incentive can be cash for the class, class activities, or credits for class supplies or other incentives valued by teachers."*
- *"Redesign the website to make it more user-friendly for students and teachers."*

Participation from Families

Teachers were asked about ways to improve energy-saving behaviors in the student's homes as well as increase the installation and use rate of measures in the kits

Four of the eight teachers surveyed were at schools that had received presentations from the Duke Energy representative. All four reported that they were pleased with the added dimension the presentation provided to the program and the enthusiasm it generated for the students.

During the interview, teachers were asked for their ideas that would lead to increased savings through higher measure installation levels and increased application of energy efficient behaviors. The teachers provided the following suggestions:

- *"Add more online content for students to access at home that would focus on increasing key behaviors and measure installations."*
- *"Develop a song that students can sing in the class or at home that sends a behavior and use message."*
- *"Offer a school-day field trip to a power plant and invite families along."*
- *"Include a component in which the students write a report of the use of the kit items and have the program incent the report to make it attractive to students and teachers."*

What Works Well

All eight interviewed teachers said that they enjoyed the program and considered it to be successful. Teachers were asked what worked well about the program and what attracted them to it. The most common response was the inclusion of the CFL and other materials for the students to see.

Responses also included:

- *"The lessons lined up beautifully with my planner."*
- *"Everybody was excited when we opened up the kit."*
- *"Ms. Frizzle is great. More of her, please!"*
- *"Loved plugging in the new light bulb and comparing it to the old one."*

Areas for Potential Improvements

Most responses for improving the program dealt with the design and layout of the activity sheets, adding more multimedia, and associating the lessons more directly with "The Magic School Bus" and the state standards. Three teachers indicated that adding a video component would be a way to improve the curriculum.

Responses included:

- *"The materials need to be designed specifically for the children who are to be exposed to them. The lines of type in some of the materials are too small."*
- *"Make the materials more attractive by using pictures and figures."*
- *"Bring out the integration between the Magic School Bus story and the curriculum's focus and the program's objectives so that they directly support each other."*
- *"Add more multimedia elements – online, songs, videos, presentations."*

Student Family Survey Results: Duke Energy Customers

Surveys were sent to K12 participant families that live in Duke Energy's territory in North and South Carolina. Student families returned a total of 213 surveys from three groups of respondents:

- Group A: 156 surveys were returned by families that received the energy efficiency kit
- Group B: 6 surveys were returned by families that received the energy efficiency kit and an additional 6 CFLs
- Group C: 51 surveys were returned by families that received the Non-Duke Energy customer energy efficiency kit because they did not live in Duke Energy's service territory

The responses to the surveys are provided below. Group A and Group B responses are reported together (n=162) unless noted. The responses from Group B regarding the six additional CFLs they received are reported separately. Group C is reported separately.

Use of the K12 Kit's Measures

CFLs

The CFLs included in the K12 kit were installed by a high percent of recipients. Close to 90% of the recipients installed the 13-watt CFL. Table 4 below shows a summary of the responses to the questions about the 13-watt CFL. Most of the kit recipients replaced a 45-70-watt bulb with the 13-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 5 for the 20-watt CFL.

Table 4. Frequency of Installation: 13-watt CFL

	Carolina Kits (n)	**Carolina Kits** (%)
Installed 13w bulb		
Yes	144	88.9%
No	7	4.3%
Don't Know/Blank	11	7.0%
Wattage of bulb removed		
Less than 44w	6	4.0%
45-70w	105	70.0%
71-99w	28	18.7%
Greater than 100w	11	7.3%
Hours of use per day		
<1	4	2.9%
1-2	27	19.4%
3-4	70	50.4%
5-10	34	24.5%
11-12	1	0.7%
13-24	3	2.2%

Table 5. Frequency of Installation: 20-watt CFL

	Carolina Kits (n)	**Carolina Kits** (%)
Installed 20w bulb		
Yes	134	82.7%

No	17	10.5%
Don't Know/Blank	11	6.8%
Wattage of bulb removed		
Less than 44w	4	2.9%
45-70w	82	59.4%
71-99w	33	23.9%
Greater than 100w	19	13.8%
Hours of use per day		
<1	2	1.6%
1-2	29	23.8%
3-4	61	50.0%
5-10	26	21.3%
11-12	4	3.3%
13-24	-	-

Seventy-three (45.1%) of the respondents have purchased additional CFLs since receiving the kit, with those respondents indicating that they have purchased an additional 5.9 CFLs per household. One person who did not previously have any CFLs installed, and did not plan on buying any CFLs before receiving the K12 kit, noted that they plan to place a CFL in every socket in their house.

CFL Freeridership for Duke Energy Customers

TecMarket Works utilized two questions from the student family survey to estimate CFL freeridership. The first question asked survey respondents whether or not they had installed CFLs prior to participating in the program, and if so, how many they had installed. The second question asked respondents if they had planned on buying any CFLs before participating in the program.

Quantities of pre-installed CFLs range from 1 to 40 among those respondents who indicated having pre-installed CFLs.

Freeridership ratios based on survey responses are assigned using a Bass curve based on diffusion of innovation product adoption concepts. Zero pre-installed CFLs correspond to an assigned freeridership score of zero percent, and fourteen or more CFLs correspond to a freeridership level of 100 percent. This allows higher credit for savings to participants with the lowest pre-existing use of CFLs and lower savings to those with a history of CFLs. The inflection point of the curve is seven CFLs, which is the typical level of CFL penetration among these participants. A graph of this curve is located in Figure 1 with the corresponding freeridership levels by CFL count shown in Table 6. This approach to estimating freeridership is consistent with the field of product adoption and diffusion research and represents a standard approach within the field of product adoption research. It also recognizes that the more CFLs a home has, the less likely the addition of new Duke Energy CFLs will have an impact on product adoption and use behaviors.

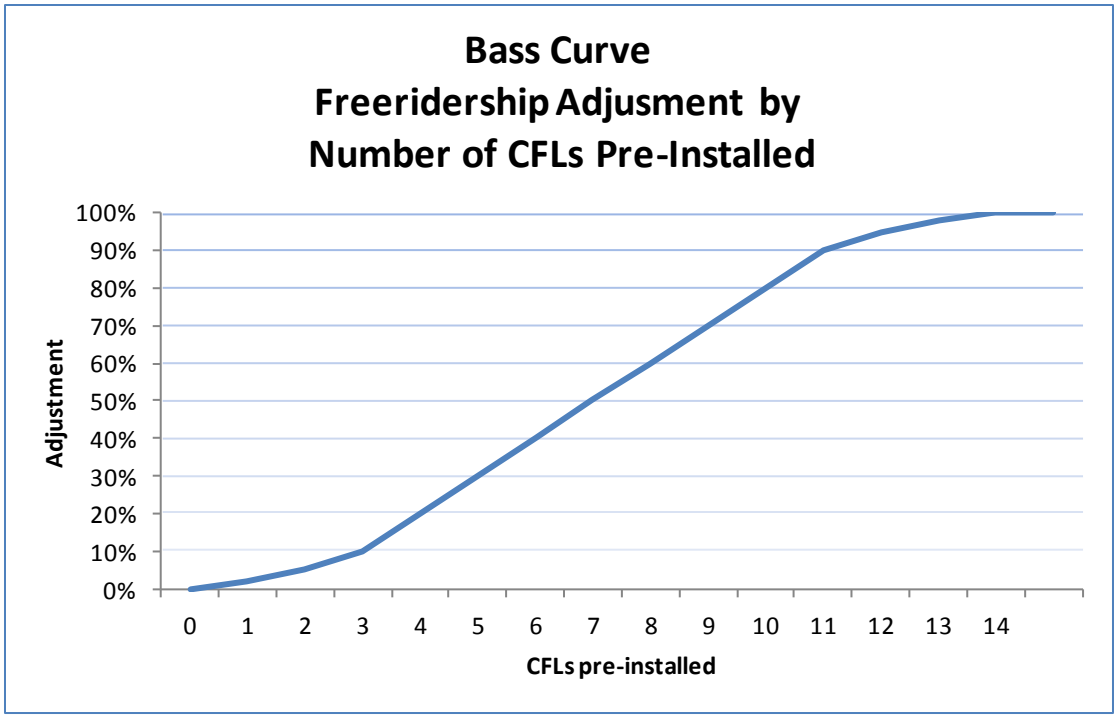


Figure 1. Bass Curve Freeridership Adjustment by Number of CFLs Pre-Installed

Table 6. CFL Freeridership Adjustment Determined by S Curve

Number of CFLs pre-installed	Freeridership Pre-installation adjustment factor	Number of customers with number of pre-installed CFLs
0	0%	62
1	2%	4
2	5%	11
3	10%	8
4	20%	13
5	30%	6
6	40%	9
7	50%	14
8	60%	7
9	70%	1
10	80%	4
11	90%	0
12	95%	0
13	98%	0
14 or more	100%	11

In addition to the pre-installation adjustment factor, TecMarket Works applied a freeridership multiplier based on whether or not respondents indicated they had planned on purchasing measures before receiving the K12 energy efficiency kit. These multipliers are shown in Table 7.

Table 7. Freeridership Multiplier Based on Measure Purchasing Plans

Did you plan on purchasing <measure> before receiving the K12 kit?	Freeridership multiplier
Yes	1.25 (result cannot exceed 100%) (reduces program savings)
Maybe	1
Don't Know	1
No	0.25 (results cannot be lower than 0%) (increases program savings)
No, already installed in all possible places	Automatic 100% freeridership score

Combining Table 6 with Table 7 produces Table 8.

Table 8. Number of Participants Cross-Referenced by Freeridership Adjustment and Multiplier

Number of CFLs pre-installed	Freeridership Pre-installation adjustment factor	Number of Participants per Freeridership Multiplier				
		1.25	1	0.25	Automatic 0%	Automatic 100%
0 (N=62)	0%	NA	NA	NA	62	
1 (N=4)	2%	1	3	0	0	
2 (N=11)	5%	4	5	2	0	
3 (N=8)	10%	5	2	1	0	
4 (N=13)	20%	9	4	0	0	
5 (N=6)	30%	4	1	1	0	
6 (N=9)	40%	5	2	1	0	1
7 (N=14)	50%	8	1	4		1
8 (N=7)	60%	7				
9 (N=1)	70%	1				
10 (N=4)	80%	4				
14 or more (N=11)	100%	7	1			3

TecMarket Works then multiplied the freeridership adjustment factor by the freeridership multiplier for each survey respondent. An average of the resulting freeridership percentage across all 150 respondents produced an average freeridership level of 25.46%.

Low-Flow Showerhead

A sizable percentage of the kit recipients (70.4%) said that they had installed the low-flow showerhead. All but one respondent that installed it indicated that the showerhead was easy to install. Of those that didn't install it, seven said it was not easy to install.

Table 9. Frequency of Installation: Low-Flow Showerhead

	Carolina Kits (n)	Carolina Kits (%)
Installed low-flow showerhead		
Yes	114	70.4%
No	34	21.0%
Don't Know/Blank	14	8.6%
Showers Taken Per Week		

(n=112)		
0-4	4	3.6%
5-10	29	25.9%
11-15	28	25.0%
16-20	24	21.4%
21+	27	24.1%
Flow of Water after install (n=110)		
Less than old showerhead	56	50.9%
About the same	44	40.0%
More than old showerhead	10	9.1%
Used the Teflon tape (n=114)		
Yes	102	89.5%
No	12	10.5%

Low-flow Showerhead Freeridership for Duke Energy Customers
Sixteen percent (18 out of 114) of the respondents who installed the low-flow showerhead indicated that they already had a low-flow showerhead installed in their home before receiving the K12 kit. These customers were identified as 100% freeriders.

The 96 respondents that indicated that they had not previously installed a low-flow showerhead were assigned a freeridership of zero.

Ten of the respondents who indicated that they already had a low-flow showerhead (but not that low-flow showerheads had been installed in all showers) also indicated that they had not been planning to purchase or use another low-flow showerhead before receiving the K12 kit. These respondents were assigned 25% freeridership. The other ten survey respondents who indicated they had pre-installed low-flow showerheads were assigned 100% freeridership.

An average of the resulting freeridership percentages across all 114 respondents with an installed, kit-provided low-flow showerhead produced a freeridership level of 10.09%.

Faucet Aerators

The customers were somewhat less likely to install the faucet aerators included in the K12 kit.

Twenty-one respondents indicated why they did not install one or both of the aerators:

- "I only received one aerator." (n=17)
- "Only received one aerator (n=2)
- "Need a whole new faucet."
- "The kitchen aerator leaked and sprayed everywhere."

Table 10. Frequency of Installation: Bathroom Faucet Aerator

	Carolina Kits (n)	**Carolina Kits** (%)
Installed the bathroom aerator		
Yes	91	56.2%
No	56	34.6%
Don't Know/Blank	15	9.3%

Aerator already installed (n=91)		
Yes	23	25.3%
No	66	72.5%
Don't Know	2	2.2%
Estimate of water flow (n=78)		
Less than the old unit	49	62.8%
About the same as the old unit	25	32.1%
More than the old unit	4	5.1%

One customer that installed the bathroom aerator indicated that the bathroom faucet aerator was not easy to install. Of those that didn't install it, seven said it was not easy to install.

Table 11. Frequency of Installation: Kitchen Faucet Aerator

	Carolina Kits (n)	**Carolina Kits** (%)
Installed the kitchen aerator (n=162)		
Yes	101	61.7%
No	50	30.9%
Don't Know/Blank	11	7.4%
Aerator already installed (n=97)		
Yes	28	28.9%
No	67	69.1%
Don't Know	2	2.1%
Estimate of water flow (n=90)		
Less than the old unit	40	44.4%
About the same as the old unit	34	37.8%
More than the old unit	16	17.8%

Three customers who installed it indicated that the kitchen faucet aerator was not easy to install. Of those that didn't install it, three also said it was not easy to install.

Faucet Aerator Freeridership for Duke Energy Customers

Twenty-four percent (29 out of 122) of the respondents who installed the kitchen or bath aerators indicated that they already had an aerator installed in their home before receiving the K12 kit.

The 93 respondents that indicated that they had not previously installed a faucet aerator were assigned a freeridership of zero.

Twenty-six of the respondents who indicated that they already had an aerator (but not that the aerators had been installed in all faucets) also indicated that they had not been planning to purchase or use another aerator before receiving the K12 kit. These respondents were assigned 25% freeridership. The other three survey respondents who indicated they had pre-installed aerators were assigned 100% freeridership.

An average of the resulting freeridership percentage across all 122 respondents with an installed kit aerator produced a freeridership level of 8.61%.

Outlet and Switch Gaskets

About five out of ten of the recipients installed the outlet and switch gaskets. The kit provided 12 gaskets in total, but unfortunately many of them were installed on interior walls where they do not provide any energy savings.

Table 12. Frequency of Installation: Outlet Gaskets

	Carolina Kits (n)	**Carolina Kits** (%)
Installed the gaskets (n=162)		
Yes	86	53.1%
No	62	38.3%
Don't Know	14	8.6%
Number installed interior wall (n=86)		
1-2	21	24.4%
3-5	21	24.4%
6-8	16	18.6%
9-12	10	11.6%
Don't Know	18	20.9%
Number installed exterior wall (n=86)		
1-2	22	25.6%
3-5	8	9.3%
6-8	12	14.0%
9-12	7	8.1%
Don't Know	37	43.0%

Gasket Freeridership for Duke Energy Customers

Twenty percent (11 out of 55) of the respondents who installed outlet or switch gaskets indicated that they already had gaskets installed in their home before receiving the K12 kit.

The 44 respondents that indicated that they had not previously installed any gaskets were assigned a freeridership of zero.

Five of the respondents who indicated that they already had installed gaskets (but not indicating that gaskets had been installed in all available outlets or switches) also indicated that they had not been planning to purchase or use more gaskets before receiving the K12 kit. These respondents were assigned 25% freeridership. The other six survey respondents who indicated they had pre-installed gaskets were assigned 100% freeridership.

An average of the resulting freeridership percentage across all 55 respondents with installed kit gaskets produced a freeridership level of 11.36%.

Water Flow Meter Bag

Only about 20% of the recipients used the water flow meter bag. Only a small number of people decreased the rate of flow of their water after using the water flow meter bag.

Table 13. Frequency of Use: Water Flow Meter Bag

	Carolina Kits (n)	**Carolina Kits** (%)

Used the Water Meter Bag		
Yes	32	19.8%
No	105	64.8%
Don't Know	25	15.4%
Tested in Shower		**Percent of Those Using the Item**
Hot Water	3	9.4%
Cold Water	5	15.6%
Both	15	46.9%
Adjusted GPM down	2	6.3%
Tested in Kitchen		
Hot Water	2	6.3%
Cold Water	3	9.4%
Both	14	43.8%
Adjusted GPM down	3	9.4%
Tested in Bathroom		
Hot Water	1	3.1%
Cold Water	1	3.1%
Both	10	31.3%
Adjusted GPM down	2	6.3%
Tested in Utility Sink		
Hot Water	-	-
Cold Water	-	-
Both	1	3.1%
Adjusted GPM down	-	-
Tested in Other Area		
Hot Water	-	-
Cold Water	-	-
Both	1	3.1%
Adjusted GPM down	-	-

Water Temperature Gauge Card

About 50% of the recipients used the water temperature gauge card that was included with the kit. Of those that did use it, the most common temperature reading was 120 degrees. Six (7.5%) of those that used it had their water temperature set at 150 degrees or higher, and 18 (22.5%) respondents lowered the temperature setting on their water heater.

Table 14. Frequency of Use: Water Temperature Gauge Card

	Carolina Kits (n)	**Carolina Kits** (%)
Used the Water Temperature Card		
Yes	80	49.4%
No	44	27.2%
Don't Know	38	23.5%
Temperature Reading		**Percent of Those Using the Item**
120	39	48.8%
130	20	25.0%
140	7	8.8%
150+	6	7.5%
Adjusted Water Temperature		

Yes	18	22.5%
No	50	62.5%
Don't Know	12	15.0%

Temperature readings after adjustment for the seventeen respondents that adjusted their water temperature were:

- 120 (n=12)
- 130 (n=3)
- 140

One respondent increased their water temperature from 120 to 130.

LED Night Light

The night light is a very popular item with 81.5% of survey respondents using it. However, only 44.7% of those using this item used it in place of another night light.

Table 15. Frequency of Use: LED Night Light

	Carolina Kits (n)	**Carolina Kits** (%)
Using the Night Light		
Yes	132	81.5%
No	27	16.7%
Don't Know	3	1.9%
Installed		
In a previously empty outlet	62	47.0%
Replaced another light	59	44.7%
Don't Know/Blank	11	8.3%

Magnet

Just under four out of ten of the recipients recalled receiving the magnet. Of the forty-eight people that indicated where they placed it, 91.7% indicated that the magnet is on their refrigerator or elsewhere in the kitchen.

Table 16. Frequency of Use: Magnet

	Carolina Kits (n)	**Carolina Kits** (%)
Recalls Receiving the Magnet		
Yes	60	37.0%
No	62	38.3%
Don't Know	40	24.7%
Placement of Magnet		
Refrigerator/Kitchen	44	91.7%
Cabinet	3	6.3%
Dryer	1	2.1%

Duke Energy Web Site

Survey respondents indicate that there is some confusion about mercury in CFLs. The majority of respondents (44.4%) report that they are not concerned about mercury in CFLs.

	Carolina Kits (n)	**Carolina Kits** (%)
Concerned About Mercury in CFLs		
Yes	45	27.8%
No	72	44.4%
Don't Know	41	25.3%
Blank	4	2.7%
Found Safe Handling Tips on Web		**Percent of Those Going to Web Site**
Yes	19	79.2%
No	2	8.3%
Don't Know	3	12.5%
Didn't Visit Site	124	

The nineteen respondents that did find the CFL safe handling tips were all satisfied with the information provided. Of those that were concerned about mercury, two read the tips on Duke Energy's web site and changed their opinion of CFLs, one did not, and the others were still unsure. One person said that reading the tips made his or her opinion of the CFLs worse.

DOE Energy Savers Booklet

Three quarters of respondents indicated that they read the booklet that was included in the kit, and many of them read it and discussed it with their families or plan to do so.

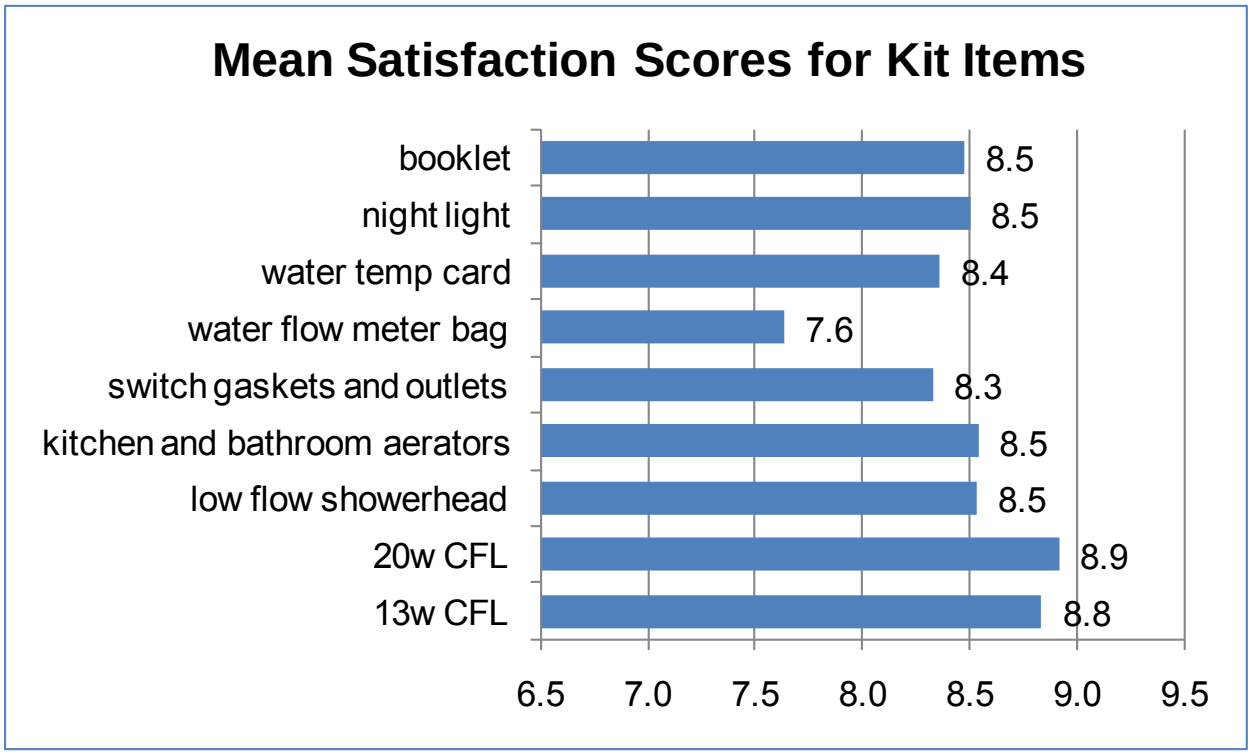
	Carolina Kits (n)	**Carolina Kits** (%)
Read the Booklet		
Yes	122	75.3%
No but will	37	22.8%
Don't Know	3	1.9%
Read the Booklet and Discussed with Family		
Yes	85	52.5%
No but will	29	17.9%
Don't Know	8	4.9%

Satisfaction with Kit Items

Respondents indicate a high level of satisfaction with the kit items. Mean satisfaction scores were highest (8.8 and 8.9 out of 10) with the CFLs. Weighting the mean scores of each of the kit items provides a mean score of 8.50 for the kit as a whole.

	Count	**Minimum Score**	**Maximum Score**	**Mean Score**	**Median Score**
13-watt CFL	159	3	10	8.8	10
20-watt CFL	153	4	10	8.9	10
low flow showerhead	133	1	10	8.5	9

kitchen and bathroom aerators	139	1	10	8.5	9
switch and outlet gaskets	128	1	10	8.3	9
water flow meter bag	77	1	10	7.6	8
water temp card	111	1	10	8.4	9
night light	146	1	10	8.5	10
booklet	126	4	10	8.5	9



Respondents' General Comments

The survey provided an area for the respondents to add their thoughts about the program. Their comments are listed below:

- "Great program!"
- "We are continuing to replace all bulbs with CFLs."
- "Great idea! Everybody wants to do their part - some just need instructions to do so."
- "Thank you very much for your effort and concern to save energy! It is very much appreciated."
- "If you want this program to work give people more incentives to actually take the time to install all of the items in the kit. Say, a gift card if you complete all tasks. Award system? Just a thought."
- "Keep up the good work regarding information to help our environment."
- "It is a very good program and helpful in learning to be energy efficient."
- "Would like to see the same program with LED bulbs."
- "Good program, keep it up."

- "The showerhead that was in the kit did not extend out to the whole bath for the kids who take baths. Just a note for people with kids. That's the only thing, I wish it had a cord extension."
- "Thank you."
- "Excellent to initiate energy efficiency and conservation during home improvement projects."
- "Enjoyed and appreciated."
- "Even though I did not use all the products, I'm in the process of remodeling. As I get to a room, I try to follow the guides and use the most energy smart things that are affordable."
- "Love the program! It gave us as a family great ideas to save energy."
- "I did not receive the GPM to test how many gallons we use."
- "I think this was an excellent and informative program. We have told family and friends about these wonderful free items provided. They had not heard of the program."
- "Please send me more free items."
- "Thank you for your time."
- "I did not take any extra actions in my home because it is an apartment and they may not let me."
- "It's a good program and I plan to implement more from the info in my home."
- "Thank you for all you do for us here in Traphill."
- "Thank you for your help in bringing down our power use."
- "It was a good learning experience for my kids."
- "We enjoyed all of the energy savings products. We plan to purchase more in the future."
- "Grateful for the kit."
- "This was a good program. Very informative and useful. I work for a gas utility but what you all are doing is great. Especially with the free stuff to get people to at least try them."
- "It was a great program, but we had to move. We left the supplies at the old apartment so we need new ones."
- "Thanks for the kit. It was a great reminder."
- "My son and I enjoyed replacing all the items! Thank you."
- "We just built a new house and energy conservation was in my thought process."
- "Good program. I lost my coupon for the free package of light bulbs, but that is my fault. It helped my energy bill. Thanks."
- "Thanks for helping people like me save."
- "I appreciate the info and the products will use both to help save money and resources."
- "The light bulbs are very pricey. The light switch gaskets don't work with our lights."
- "This was a great program and very informative."
- "The program was very helpful and we were able to use most of the products that were given. Thanks, we learned a lot of information."

- “It has been helpful.”
- “I like the program. It is informative and allowed me to share with other family members ways to save on electricity. My mother has purchased the items and my friend’s mother wanted to know how she could sign up.”
- “It is a very good program.”
- “Getting ready to remodel. Haven't bought anything yet. Need everything possible to complete the process.”
- “Good program. Do more like this.”
- “Thanks for the kit!”
- “Thanks.”
- “We loved it! Really impressed! I told all my friends about it.”
- “I switched to CFLs but my energy did not go down. Need instructions for the kit.”
- “Love the program! It was a great awareness program for the whole family.”
- “Loved it.”
- “Duke Energy's 'Get Energy Smart' not only helped me to understand the importance of saving energy but helped my children understand also. Thank you so much for the energy efficiency kit!!”
- “I feel that this was an excellent program. It made me stop and realize how often I was wasting so much energy. I think you should keep it up. I know my bill went down after I installed the stuff you sent and I purchased.”
- “I think it is very important to lower my light bill because it is so high and being on fixed income. I’m retired, so please send more. Thank you.”
- “Thanks for the products.”
- “I believe this program is worthwhile and will encourage people to save energy and money.”
- “Since we did not receive all of the items in the kit it was hard to answer some of these questions. Good program overall.”
- “Great program. Thanks.”
- “Great service, I appreciate the movement for conservation and efficiency.”
- “Very educational. Enjoyable experience.”
- “Very nice!”
- “It was an awesome surprise.”
- “Thanks!”
- “Thank you for the kit. I am a single parent and it was helpful in many ways.”
- “Thanks for the kit, everything was used. You should send out more.”
- “Very helpful on the energy bill.”
- “I think I am saving some on my power and on my water bill. Thanks.”
- “How can other family members receive these kits?”
- “My children really enjoyed and learned when we used the GPM bag! Thank you!”

- "Thank you very much for the free bulbs and showerhead. I love them and my power bill is not as much."
- "Great program. Thanks."
- "Very satisfied with this program and appreciate it."
- "I wish I could get enough for my kids in my classroom for their parents. The kit was awesome."
- "We had cold air coming in around an external outlet and the gaskets fixed the problem. Your kit is very much appreciated. Thank you!"
- "I need another shower head because I can't afford to buy one."
- "It has helped my family."
- "Good program."
- "Everything free came to my home. It is welcome."

Additional CFL Kit

Some of the student families received a kit containing eight CFLs instead of two. 133 surveys were sent to these families in the three states (OH, NC, SC), and Carolinas families returned six surveys.

Survey respondents indicated that their satisfaction with the 13-watt CFLs was 8.9 on a scale of 1 to 10, with 1 meaning they were very dissatisfied and 10 meaning they were very satisfied. Respondents indicated that their satisfaction with the 20-watt CFLs was 9.0 on the same scale.

	Carolinas CFL Kits (n)	**Carolinas CFL Kits** (%)	**Carolinas CFL Kits** (n)	**Carolinas CFL Kits** (%)
Installed 13w bulb #1			**Installed 13w bulb #2**	
Yes	5	83%	5	83%
No	1	17%	1	17%
Don't Know/Blank	-	-	-	-
Wattage of bulb removed				
Less than 44w	-	-	-	-
45-70w	4	66%	5	83%
71-99w	1	17%	-	-
Greater than 100w				
Hours of use per day				
<1	1	17%	1	17%
1-2	2	33%	1	17%
3-4	1	17%	1	17%
5-10	1	17%	1	17%
11-12	-	-	1	17%
13-24	-	-	-	-
Installed 13w bulb #3			**Installed 13w bulb #4**	
Yes	4	67%	4	67%
No	2	33%	2	33%

Don't Know/Blank	-	-	-	-
Wattage of bulb removed				
Less than 44w	1	17%	-	-
45-70w	3	50%	4	67%
71-99w	-	-	-	-
Greater than 100w	-	-	-	-
Hours of use per day				
<1	1	17%	1	17%
1-2	1	17%		
3-4	-	-	1	17%
5-10	2	33%	2	33%
11-12	-	-	-	-
13-24	-	-	-	-

Out of the 24 13-watt CFLs distributed to this group of survey respondents, eighteen of them were installed. This is an installation rate of 75%. For the 20-watt CFLs, 10 of the 24 CFLs were installed, which is an installation rate of 41.7%.

	Carolinas CFL Kits (n)	**Carolinas CFL Kits** (%)	**Carolinas CFL Kits** (n)	**Carolinas CFL Kits** (%)
Installed 20w bulb #1			**Installed 20w bulb #2**	
Yes	4	67%	2	33%
No	1	17%	3	50%
Don't Know/Blank	1	17%	1	17%
Wattage of bulb removed				
Less than 44w	-	-	-	-
45-70w	2	33%	2	33%
71-99w	2	33%	-	-
Greater than 100w	-	-	-	-
Hours of use per day				
<1		-	-	-
1-2	1	17%	-	
3-4	3	50%	2	33%
5-10		-	-	
11-12		-	-	
13-24		-	-	
Installed 20w bulb #3			**Installed 20w bulb #4**	
Yes	2	33%	2	33%
No	3	50%	3	50%
Don't Know/Blank	1	17%	1	17%
Wattage of bulb removed				
Less than 44w	-	-	-	-
45-70w	2	33%	2	33%
71-99w	-	-	-	-
Greater than 100w	-	-	-	-
Hours of use per day				
<1	-	-	-	-
1-2	-	-	-	-

3-4	2	33%	2	33%
5-10	-	-	-	-
11-12	-	-	-	-
13-24	-	-	-	-

The survey asked the families if any of the CFLs were removed, and one family removed one or more bulbs because of a perceived lack of brightness.

Five respondents (83.3%) indicated that they had an average of 4.8 CFLs installed in their homes before receiving the K12 kits. Three (50%) of the respondents were planning on buying CFLs before receiving the kit, one (17%) was not. One (17%) indicated that they were "maybe" planning on buying CFLs before receiving the kit. No respondents from this group had purchased any additional CFLs after receiving the kit.

Kits Sent to Non-Duke Energy Customers

Surveys were sent to Non-Duke Energy customers in the Carolinas, and fifty-one (51) surveys were returned. Non-Duke Energy customers that participated in the K12 program received a kit with the following items:

- 13-watt CFL
- 8 Outlet and light switch insulators
- Bag for testing water flow
- Water temperature card
- DOE booklet

Use of the K12 Kit's Measures

CFL

The CFL included in the K12 kit was installed by all of the Non-Duke Energy participants. Table 17 below shows a summary of the responses to the questions about the 13-watt CFL. Most (75%) of the Kit recipients replaced a 45-70-watt bulb with the 13-watt CFL, and the replacement was done on lights that were usually used 3-4 hours per day on average.

Table 17. Frequency of Installation: 13-watt CFL

	Carolina Kits (n)	**Carolina Kits** (%)
Installed 13w bulb (n=51)		
Yes	44	86.3%
No	4	7.8%
Don't Know/Blank	3	5.9%
Wattage of bulb removed (n=46)		
Less than 44w	4	8.7%
45-70w	33	71.7%
71-99w	3	6.5%
Greater than 100w	6	13.0%
Hours of use per day		

(n=46)		
<1	4	8.7%
1-2	8	17.4%
3-4	19	41.3%
5-10	14	30.4%
11-12	1	2.2%
13-24	-	-

Four respondents (8.7%) indicated that they removed the 13-watt CFL. The reasons given were:

- "Burned out."
- "Too slow to start.
- "Not bright enough.
- "Mercury concerns."

Twenty-three (45%) of the respondents have purchased additional CFLs since receiving the kit, with those respondents indicating that they have purchased a mean of an additional 4.7 CFLs per household.

Previous Use of CFLs

Thirty-seven of the respondents (72.5%) indicated that they had at least one CFL installed in their homes previous to receiving the K12 kit. These families report that they have from one to thirty CFLs installed in their homes, with the average reported number of CFLs being previously installed being 7.3 CFLs per home.

26 of the respondents (51.0%) indicated that they were planning on purchasing CFLs before receiving the kit, and 14 were possibly planning on buying CFLs. Six of them (11.8%) indicated that they did not plan on purchasing CFLs because they had already installed CFLs in all of their household's sockets.

Outlet and Switch Gaskets

Five of the eight respondents installed the outlet and switch gaskets. The kit provided 8 gaskets in total, but unfortunately many of them were installed on interior walls where they do not provide any energy savings.

Table 18. Frequency of Installation: Outlet Gaskets

	Carolina Kits (n)	**Carolina Kits** (%)
Installed the gaskets (n=51)		
Yes	30	58.8%
No	19	37.3%
Don't Know	2	3.9%
Number installed interior wall (n=30)		
1-2	4	13.3%
3-5	10	33.3%
6-8	11	36.7%
Don't Know	2	6.7%
Number installed exterior wall		

(n=30)		
1-2	3	10%
3-5	7	23.3%
6-8	7	23.3%
Don't Know	4	13.3%

Previous Use of Gaskets

Seven of the respondents (87.5%) indicated that they did not have any gaskets installed in their home before receiving the K12 kit.

Three of the respondents (5.9%) indicated that they were planning on purchasing any gaskets before receiving the kit, and six were possibly planning some. Two respondents (3.9%) indicated that they did not plan on purchasing gaskets because they were already installed in all available outlets and switches. Six respondents (11.8%) indicated that they have purchased an additional 21 gaskets since receiving the K12 kit.

Water Flow Meter Bag

About 29% of the recipients used the water flow meter bag. Only one respondent decreased the rate of flow of their water after using the water flow meter bag.

Table 19. Frequency of Use: Water Flow Meter Bag

	Carolina Kits (n)	**Carolina Kits** (%)
Used the Water Meter Bag		
Yes	15	29.4%
No	29	56.9%
Don't Know/blank	7	13.7%
Tested in Shower (n=15)		
Hot Water	2	13.3%
Cold Water	3	20%
Both	8	53.3%
Adjusted GPM down	1	6.7%
Tested in Kitchen (n=15)		
Hot Water	1	6.7%
Cold Water	2	13.3%
Both	6	40%
Adjusted GPM down	1	6.7%
Tested in Bathroom (n=15)		
Hot Water	1	6.7%
Cold Water	1	6.7%
Both	3	20%
Adjusted GPM down	1	6.7%
Tested in Utility Sink (n=15)		
Hot Water	0	-
Cold Water	1	6.7%
Both	0	-
Adjusted GPM down	1	6.7%

DOE Energy Savers Booklet

Forty-five respondents (88.2%) indicated that they read the booklet that was included in the kit, and 25 of them (49%) read it and discussed it with their families.

	Carolina Kits (n)	**Carolina Kits** (%)
Read the Booklet (n-51)		
Yes	45	88.2%
No but will	2	3.9%
Don't Know/blank	4	7.8%
Read the Booklet and Discussed with Family (n=51)		
Yes	25	49%
No but will	12	23.5%
Don't Know/blank	14	27.5%

Satisfaction with Kit Items

Respondents indicate a high level of satisfaction with the kit items. Mean satisfaction scores were highest (8.7 out of 10) with the switch and outlet gaskets. Weighting the mean scores of each of the kit items provides a mean score of 8.33 for the kit as a whole.

	Count	Minimum Score	Maximum Score	Mean Score	Median Score
13-watt CFL	51	3	10	8.9	9
switch and outlet gaskets	46	1	10	8.0	8.5
water flow meter bag	32	5	10	7.5	7
booklet	46	5	10	8.6	9

Respondents' General Comments

The survey provided an area for the respondents to add their thoughts about the program. Their comments are listed below:

- "I think that a plug-in meter would be very educational for most people."
- "We enjoyed being a part of this program. Thanks for the opportunity."
- "Very pleased with items. Thanks."
- "Thanks to Duke for this program and thanks for our reliable and excellent electricity."
- "Enjoyed it."
- "Prompted me to use your energy light bulbs for the first time as well as reducing the flow of water by measuring the usage."
- "This was a great program. Thanks."
- "My daughter was very excited about the program and receiving the mailings."
- "Good program."
- "I enjoyed learning about so much. I enjoyed the free kit. This is a good program for people that are not energy savvy and a good start to learning."

- "The program was awesome. My daughter loved getting the kit and working on items in it with the family."
- "I love this program."
- "Thanks for the coupons and the 4 light bulbs."
- "I would hope that everybody would do things in their home to save power."
- "This program is great!"
- "Thanks for all of the great tips. Those bulbs are expensive."
- "Good program."
- "I thought it was great. The kit should be for 4-8 graders, they are old enough to understand the importance of the information provided and influence their parents to assist them in implementing the kit. I did not use the water bag because our house is newly built with conservation in mind."
- "My family and I are appreciative of this program and the great information to help us conserve energy and cut down our bills."
- "Great informative program."
- "Please include more coupons for CFLs ."
- "The program was informative. If only some people participate and do only a few things a lot of energy could be saved. Keep up the good work."
- "Thank you for this program."
- "Thanks for all of the great info."
- "Great program which has started good conversations in our home."
- "Awareness is KEY."
- "I am energy conscious as is my family most of the time. Thank you for your resources to use when reviewing our energy usage."
- "The booklet was very helpful. Some of the suggestions take time and money."
- "Nice to get the students and families involved and to give books as an incentive. I am a teacher so I also promoted this kit in the classroom."

Impact Evaluation - Billing Analysis

This section of the report presents the results of a billing analysis conducted over the participants in the North and South Carolina K12 program. Billing data was obtained for all participants in the K12 program between July, 2009 and March, 2011 and that had accounts with Duke Energy (after processing, there were a total of 13,754 usable accounts, of which 10,503 were from North Carolina, and 3,251 were from South Carolina).[5] A panel model was used to determine program impacts, where the dependent variable was monthly electricity consumption from January 2009 to March 2011. The results of the billing analysis are presented in Table 20.

Table 20. Estimated Carolina K12 Impacts: Billing Analysis

	kWh	t-value
Per Participant Annual Savings (Gross)	249.2	6.00
Per Participant Annual Savings (Net)	205.2	6.00

This table shows that the K12 produced statistically significant savings for participants in the Carolina. The annual savings per participant is in agreement with the savings found from the engineering analysis (i.e., the engineering estimate of approximately 230 kWh/customer is well within the error band of the estimate from the billing analysis). The remainder of this section discusses the procedure used in the billing analysis.

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.

[5] In order to maximize the use of the data, a single model was estimated over all states (Ohio, North Carolina, South Carolina and Kentucky). Therefore, the actual sample size in the model included 6,271 houses in Ohio and 398 in Kentucky, for a total sample size of 20,423 households.

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*
- *ß* = 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 K12 program is captured by including a variable which is equal to one for all months after the household participated in the program. The coefficient on this variable is the savings associated with the program. In order to account for differences in billing days, the usage was normalized by days in the billing cycle. The estimated electric model is presented in Table **21**.[6]

Table 21. Estimated Savings Model – dependent variable is log (daily kwh usage), June 2008 through March 2011 (savings are negative).

Independent Variable	Coefficient (percentage / 100)	t-value
K12 participation – Ohio	-0.0067	-2.33
K12 participation - Carolina	-0.0125	-6.00
K12 participation - Kentucky	-0.0227	-1.79
Sample Size	478,093 observations (20,423 homes)	
R-Squared	74%	

Note that in this table, the dependent variable is the natural log of the monthly energy use. In this specification, the coefficient represents the savings as a percentage of the participant's

[6] As stated previously, a single model was estimated over participants in all states. Thus, this table presents the impacts for the Ohio and Kentucky in addition to the impacts for the Carolinas.

usage. To derive the kWh savings, the coefficient in the table was multiplied by the average annual usage per participating household in the Carolinas (19,989 kWh/year) to give the 249.2 kWh/year gross savings estimate. To find net savings, the program-wide net to gross percentage found in the engineering analysis of 17.67% was applied to yield the 205.2 kWh/year net savings estimate. The complete estimate model, showing the weather and time factors, is presented in Appendix F: Estimated Statistical Model.

Impact Evaluation - Engineering Estimates

The K12 program required participants to fill out and return a pre-participation questionnaire to Duke Energy before becoming eligible to participate. The K12 program provided an Energy Efficiency Starter Kit to each participant that filled out and returned their questionnaire. Participation was not limited to Duke Energy customers, however, Non-Duke Energy customers received an abbreviated kit containing only one 13-watt CFL and 4 outlet and 4 switch gaskets. A mail-in survey, which can be found in Appendix C: Student Family Surveys, was later mailed to a randomly selected sample of 601 participants, 430 Duke Energy customers and 171 Non-Duke Energy customers. The results of this survey with the associated energy impact estimations for each of the kit items are presented below. Responses were received from 213 of the 430 participants, 162 from Duke Energy customers and 51 from Non-Duke Energy customers. For the purpose of calculating overall savings estimates, the responses and estimated energy savings of these 213 respondents have been extrapolated to the full population of 7,360 participants that received an Energy Efficiency Starter Kit through the K12 program between July 2009 and mid-September 2010. All algorithms used in the calculation of the savings estimates herein can be found in Appendix E: Impact Algorithms. The results are summarized in Table 22 through Table 23Table 25.

Table 22. Gross Program Savings by Measure for Duke Energy Customers

Measure	kWh	kW	therms
CFLs	823,324	62.1	-1,106
Low-Flow Showerheads	684,376	75.0	40,783
Faucet Aerators	104,242	1.3	4,470
Outlet/Switch Gaskets	28,912	11.6	249
Water Temperature Card	37,322	4.3	2,224
Night Light	98	0.0	0
DUKE ENERGY	1,678,273	154	46,621

Table 23. Gross Program Savings by Measure for Non-Duke Energy Customers

Measure	kWh	kW	therms
CFLs	106,688	7.7	-143
Outlet/Switch Gaskets	4,819	1.9	42
NON-DUKE ENERGY	111,508	9.7	-102

Table 24. Net Program Savings by Measure for Duke Energy Customers

Measure	NTG %	kWh	kW	therms
CFLs	25.46%	613,705	46.3	-824
Low-Flow Showerheads	10.09%	615,323	67.4	36,668
Faucet Aerators	8.61%	116,531	1.4	4,997
Outlet/Switch Gaskets	11.36%	25,627	10.3	221
Water Temperature Card	0.00%	39,401	4.5	2,348
Night Light	0.00%	98	0.0	0
DUKE ENERGY	17.19%	1,410,685	130	43,410

Table 25. Net Program Savings by Measure for Non-Duke Energy Customers

Measure	NTG %	kWh	kW	therms
CFLs	25.46%	79,525	5.8	-107
Outlet/Switch Gaskets	11.36%	4,272	1.7	37
NON-DUKE ENERGY	24.85%	83,797	7.5	-70

There were a total of 5,874 kits distributed to Duke Energy customers and 1,486 distributed to Non-Duke Energy customers. A net savings of 1,494,482 kWh was achieved, 1,410,685 kWh by Duke Energy customers and 83,797 kWh by Non-Duke Energy customers. The savings from CFL installations is responsible for the largest percentage (46%) of the total program kWh savings. Low-flow showerheads contribute another 41% and are also the only measure supplying an appreciable amount of therm savings, 84% of the program total. Together, these two measures comprise 88% of the total program kWh savings.

Table 26. Net Program Savings Per Participant by Measure for All Duke Energy and Non-Duke Energy Participants

Measure	kWh	kW	therms
CFLs	94.2	0.0071	-0.1265
Low-Flow Showerheads	105	0.0115	6.2425
Faucet Aerators	19.8	0.0002	0.8508
Outlet/Switch Gaskets	4.06	0.0016	0.0350
Water Temperature Card	6.71	0.0008	0.3997
Night Light	0.02	0.0000	0.0000

The combined net to gross percentage is 17.19% for Duke Energy customers and 24.85% for Non-Duke Energy customers. The comprehensive net to gross percentage is 17.67%. These percentages, along with net program savings, are broken down by measure in Table 24 and Table 25. Program-wide per-participant kWh savings with all Duke Energy and Non-Duke Energy customers combined is 230 kWh, as shown in Table 26.

CFLs

The standard Energy Efficiency Starter Kit included one 13-watt CFL and one 20-watt CFL. The kit received by Non-Duke Energy customers contained just the 13-watt CFL. Duke Energy customers that indicated that they had fewer than seven CFLs currently installed in their home when they filled out their pre-participation questionnaire also received an additional six pack of CFLs containing three 13-watt CFLs and three 20-watt CFLs; 133 such kits were given away. Non-Duke Energy customers were ineligible to receive this supplement.

A total of 157 13-watt CFLs and 140 20-watt CFLs were installed by 150 Duke Energy customers, an install rate of 87% and 83%, respectively. A total of 12,546 CFLs were given away, 6,273 each of 13 and 20-watt CFLs to Duke Energy customers, and 1,486 13-watt CFLs to Non-Duke Energy customers. As presented in Table 27, a total of 5,465 13-watt and 5,234 20-watt CFLs were installed by Duke Energy customers. Another 1,287 13-watt CFLs were installed by Non-Duke Energy customers. To avoid inaccuracy due to insufficient sample size, the install rate for Duke Energy customers, 87%, was carried over to the non-customers.

Table 27. Total number of CFLs Installed with Gross Savings Estimates

	Total Installed	Install Rate	kWh	kW	therms
13W CFL	5,465	87%	452,902	32.8	-608
20W CFL	5,234	83%	370,421	29.3	-498
NON-DUKE ENERGY	1,287	87%	106,688	7.7	-143
TOTAL	11,986	78%	930,012	69.8	-1,249

From the mail-in survey, it was determined that, on average, participants use the 13-watt CFL to replace a 64-watt incandescent bulb and the 20-watt CFL to replace a 68-watt incandescent bulb. On average, these bulbs are operated for 4.41 and 4.04 hours per day, respectively. The savings from installing each wattage of CFL are presented in Table 27**.** Extrapolating the data collected from the survey to the full population of program participants, K12 participants reduced their gross annual kWh consumption by 930,012 kWh, or 126 kWh per person per year. Mean values are shown in Table 28. Of the total savings, 559,590 kWh (60%) is from 13-watt CFLs and the other 370,421 kWh (40%) comes from 20-watt CFLs. This results in gross per-installation savings achievements of 82.9 kWh and 70.8 kWh, respectively. The slight increase in therm consumption occurs because incandescent bulbs burn much hotter than CFLs and consequently, homeowners must use a little more gas heating their homes in the winter.

Table 28. Mean Gross Savings Estimates per Participant from Participants Installing CFLs

	kWh	kW	therms
13W CFL	86	0.006	-0.115
20W CFL	71	0.006	-0.095
COMBINED	142	0.011	-0.191

Outlet and Switch Gaskets

The standard Energy Efficiency Starter Kit contained 12 gaskets. The kit received by Non-Duke Energy customers contained only eight gaskets. Fifty-Five out of the 162 Duke Energy customers surveyed combined to install a total of 259 outlet and/or switch gaskets out of the 1,944 provided to them in the kit (13%) into exterior walls. Applying the same implementation rate to the Non-Duke Energy customers yields another 81 gaskets installed. Gasket installations in interior walls will realize zero savings and are therefore not counted. Projecting these numbers onto the entire participant base yields 9,370 gaskets installed by Duke Energy customers and 1,562 installations by Non-Duke Energy customers. Table 29 shows this installation information along with the savings estimates. From Table 30, each Duke Energy participant installed an average of 4.82 gaskets and each Non-Duke Energy participant installed an average of 3.83 gaskets in exterior walls. The outlet and switch gaskets installed by Duke Energy customers provided gross energy savings of 28,912 kWh, for an average of 14.9 kWh per participant per year. Non-Duke Energy customers saved 4,819 kWh, an average of 11.8 kWh per participant per year.

Table 29. Total Gaskets Installed in Exterior Walls with Gross Savings Estimates

	Total Installed	Install Rate	kWh	kW	therms
DUKE ENERGY	9,370	13%	28,912	11.6	249

NON-DUKE ENERGY	1,562	13%	4,819	1.9	42
TOTAL	10,932	13%	33,731	13.5	291

Table 30. Mean Gaskets Installed in Exterior Walls with Mean Gross Savings Estimates

	Average Installed	kWh	kW	therms
DUKE ENERGY	4.82	14.9	0.006	0.13
NON-DUKE ENERGY	3.83	11.8	0.005	0.10
TOTAL	4.65	14.3	0.006	0.12

Low-Flow Showerheads

A total of 114 out of 162 (70%) low-flow showerheads were installed from the kits. Given that 70% of the participant population has installed their showerheads, it can be assumed that 4,127 have been installed in total. Low-flow showerheads were not provided to Non-Duke Energy customers. Participants that installed the showerhead lowered their daily hot water consumption for showers from 20.2 gallons before the installation to 9.8 gallons after the installation. Table 31 shows the installation figures along with estimates of their savings. An estimated gross 684,376 kWh and 40,783 therms are saved, an average of 165 kWh and 9.9 therms per installation per year, as seen in Table 32.

Table 31. Total Low-Flow Showerheads Installed with Gross Savings Estimates

Total Installed	Install Rate	kWh	kW	therms
4,127	70%	684,376	75	40,783

Table 32. Mean Gross Savings Estimates for Installed Low-Flow Showerheads

kWh	kW	therms
165	0.018	9.9

Faucet Aerators

One kitchen and one bathroom faucet aerator were given out in each kit. A total of 192 aerators were installed by 123 people with a 59% installation rate. Extrapolating this data to fit the participant population, 6,950 aerators are estimated to be installed. Faucet aerators were not provided to Non-Duke Energy customers. Table 33 shows that the aerators provided by the kit have saved 127,509 gross kWh. In Table 34, it is shown that per installation, this is about 18.35 kWh annually.

Table 33. Total Faucet Aerators Installed with Gross Savings Estimates

Total Installed	Install Rate	kWh	kW	therms
6,950	59%	127,509	1.5	5,468

Table 34. Mean Gross Savings Estimates for Installed Faucet Aerators

kWh	kW	therms

18.35	0.0002	.787

Water Temperature Cards

A total of 80 out of the 162 participants (49%) reported using their water temperature card. However, only 18 of these 80 people (23%) changed their water heater temperature based on the card's result. This means that approximately 11% of people have adjusted their water heater. Applying this number to the full population returns 659 adjustments made. Water temperature cards were not provided to Non-Duke Energy customers. For participants that made an adjustment, their average hot water temperature went from 135 degrees before the change to 124 degrees after the change. As shown in Table 35, an estimated 39,401 kWh per year was saved as a result of these changes, an average of 59.8 kWh per participant per year, as seen in Table 36.

Table 35. Total Water Temperature Cards Used with Savings Estimates for Adjustments

Total Adjustments	Usage Rate	kWh	kW	therms
659	11%	39,401	4.5	2,348

Table 36. Mean Savings Estimates for Water Temperature Adjustments

kWh	kW	therms
59.8	0.007	3.57

LED Night Lights

Out of the 162 participants, 132 installed the LED night light, an installation rate of 81%. Just under half of these night lights (49%) replaced an existing night light, meaning that the other 51% were used in a socket where there was previously no night light, this subtracts a small amount of savings from the measure. In all, there were 2,322 replacement night lights and 2,450 new night lights. Table 37 shows a total savings of 98 kWh per year. There were no kW or therm savings, and the LED night lights were not provided to Non-Duke Energy customers.

Table 37. Total LED Night Lights installed with Savings Estimates

Total Installed	Install Rate	kWh
4,772	81%	98

Appendix A: Teacher Interview Instrument

Name: _____

School: _____

We are conducting this interview to obtain your opinions about and experiences with the Get Energy Smart Program. We'll talk about the Get Energy Smart Program and its objectives, your thoughts on improving the program, and the materials and support provided to the teachers. The interview will take about 20-30 minutes to complete.

1. Please describe your program-associated role and scope of responsibility. What is it that you are responsible for as it relates to this program?

Program Objectives

2. Please describe your understanding of the Get Energy Smart Program's current objectives.

3. Are these the right objectives or would you change them in any way? If yes, what would you change? How do you think this change would affect how the program is operated or managed?

4. In your opinion, which objectives do you think are best being met or will be met?

5. How would you define success for this program? What has to occur for you to consider this program successful? Is this different than how your school administration would describe success? How?

6. What is it about this program that makes it attractive to you personally? What about it does your school's administration like?

Operational Efficiency

7. Please review with us how the program operates relative to your duties, that is, please walk us through the processes and procedures and key events that allow you do currently fulfill your duties.

8. Have any recent changes been made to your duties? If so, please tell us what changes were made and why they were made. What are the results of the change?

9. Describe the evolution of the Get Energy Smart Program. How has the program changed since you first became a partnering teacher? How well have these changes worked for you, and for your school?

10. Do you have suggestions for improvements to the program that would increase participation rates or interest levels from the teachers?

11. Do you have suggestions for improving or increasing energy impacts gained through the student's families?

12. Do you have suggestion for making the program operate more smoothly or effectively?

Program Design & Implementation

13. *(If not captured earlier)* Please explain how the communications and interactions between the teachers, families, and Get Energy Smart management team work. Do you think these interactions or means of communication should be changed in any way? If so, how and why?

14. What are your thoughts on how the Program is presented to teachers? How effective is this approach? Do you have suggestions for improving the presentation approach? How about the school, is the program presented to the school administration in an effective way? Any issues you see in this or are there any changes you would make?

15. Do you utilize the full curriculum provided, or do you skip some sections of the curriculum? *If skipping some,* Which components are you skipping and why? Can they be improved in some way that would make them more valuable?

16. Do you feel that you are getting adequate program or program concept training and program information? What can be done that could help improve your and other teachers' effectiveness?

17. Overall, what about the program works well and why?

18. What doesn't work well and why? Do you think this discourages participation or teacher interests?

19. In what ways can the program operations or operational efficiencies be improved?

20. Should the program be focusing effort on attracting more participating schools or teachers? *If yes,* How should the program do this?

21. The key aspect of this program that makes it worthwhile for utility companies is the amount of energy savings achieved. What can Duke Energy do to achieve higher installation rates of the kit items?

22. What can be done to encourage higher levels of energy efficient behaviors in the student's homes?

23. Thinking about all aspects of the program, If you could change anything about the program, what would you change and why?

24. Are there any other issues or topics you think we should know about and discuss for this evaluation?

Appendix B: Program Manager Interview Protocol

Name: _____

Title: _____

We are conducting this interview to obtain your opinions about and experiences with the K12 Curriculum program, which I will refer to as the K12 program. We'll talk about the K12 Program and its objectives, your thoughts on improving the program, and the materials and support provided to the teachers. The interview will take about 40-60 minutes to complete. May we begin?

1. Please describe your role and scope of responsibility in detail. What is it that you are responsible for as it relates to this program?

Program Objectives

2. Please describe your understanding of the K12 Program's current objectives.

3. Are these the right objectives or would you change them in any way? If yes, what would you change? How do you think this change would affect how the program is operated or managed?

4. In your opinion, which objectives do you think are best being met or will be met?

5. Is there any kind of selection criteria that schools are required to meet in order to participate? What are these and how do you implement these selection criteria?

6. Is there a target number of schools or teachers that Duke Energy would like to see participate? If so, how many? Has this goal been reached?

7. How do you define success for this program? What has to occur for you to consider this program successful?

Operational Efficiency

8. Please review with us how the K12 operates relative to your duties, that is, please walk us through the processes and procedures and key events that allow you do currently fulfill your duties.

9. Have any recent changes been made to your duties? If so, please tell us what changes were made and why they were made. What are the results of the change?

10. Describe the evolution of the K12 Program. How has the program changed since it was it first planned?

11. Do you have suggestions for improvements to the program that would increase participation rates or interest levels from the teachers?

12. Do you have suggestions for improving or increasing energy impacts gained through the student's families?

13. Do you have suggestion for making the program operate more smoothly or effectively?

Program Design & Implementation

14. *(If not captured earlier)* Please explain how the communications and interactions between the teachers, families, and K12 management team work. Do you think these interactions or means of communication should be changed in any way? If so, how and why?

15. How do you market the program to teachers? How effective is this approach? What other approaches have you considered?

16. How do you select which schools or school districts to target? Is there anything that should be changed about this selection process?

17. Describe your tracking process with the schools and teachers/classes, and number of students.

18. How do you determine what measures or behavior change suggestions should be included in the program's push efforts? Are key industry experts, trade professionals or peers used for assessing what the technologies or behavioral suggestions should be included in the program? If so, how does this work?

19. What kinds of measures or behaviors have you considered but have elected not to include? Why did you not include them?

20. Are key industry experts and trade professionals used in other advisory roles? If so how does this work and what kinds of support are obtained?

21. Describe the K12 training and development approach. Are teachers getting adequate program training and program information? What can be done that could help improve teachers' effectiveness? Can we obtain training materials that are being used?

22. How are the training materials developed? Who is involved in this and what are their roles?

23. What educational system associated market information, research or market assessments are you using to determine the best target schools or school systems on which to focus program efforts?

24. What school system market information, research or assessments are you using to identify key systematic barriers to the program or to participation to develop more effective delivery mechanisms?

25. Overall, what about the K12 program works well and why?

26. What doesn't work well and why? Do you think this discourages participation or teacher interests?

27. Can you identify any kind of Duke Energy-associated, school system associated, or other operational barriers that impede a more efficient program design or operation?

28. In what ways can the program operations or operational efficiencies be improved?

29. Should the program be focusing effort on attracting more participating schools or teachers? If yes, in what ways can the program attract more participating schools or teachers?

30. What should the program do to encourage higher installation rates of the kit items?

31. What can be done to encourage higher levels of energy efficient behaviors in the student's homes?

32. What do you do to make sure that the best information and practices are being used in K12 operations? What should you or Duke Energy be doing to improve the program?

33. Thinking about all aspects of the program, If you could change anything about the program, what would you change and why?

34. Are there any other issues or topics you think we should know about and discuss for this evaluation?

Appendix C: Student Family Surveys

The surveys sent to student families are embedded below.

Survey mailed to Duke Energy customers:

K12 Student Family Participant Survey Du

Survey mailed to Duke Energy customers that received six additional CFLs:

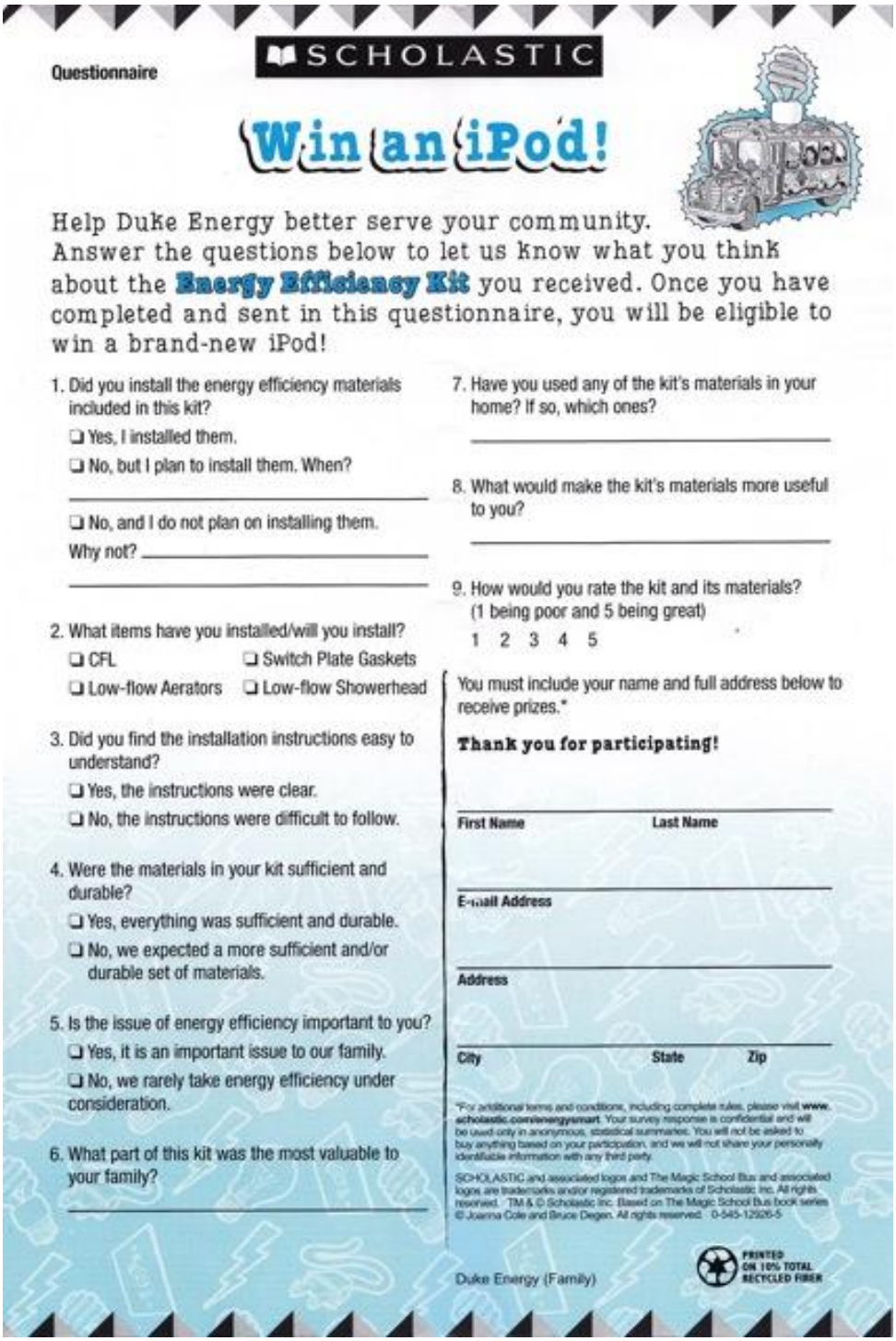
K12 Student Family Participant Survey ex

Survey mailed to Non-Duke Energy customers:

K12 Student Family Participant Survey for

Appendix D: Program Collateral

Out of 345 students returning the survey, Duke Energy was able to match 304 to their teacher. Of those 304, 17 were in a classroom where the teacher handed out the notification flyer. That is 5%. The following images are examples of advance notifications of the program:



Questionnaire

SCHOLASTIC

Win an iPod!

Help Duke Energy better serve your community. Answer the questions below to let us know what you think about the **Energy Efficiency Kit** you received. Once you have completed and sent in this questionnaire, you will be eligible to win a brand-new iPod!

1. Did you install the energy efficiency materials included in this kit?
   - ❑ Yes, I installed them.
   - ❑ No, but I plan to install them. When? _____
   - ❑ No, and I do not plan on installing them.
   - Why not? _____
2. What items have you installed/will you install?
   - ❑ CFL ❑ Switch Plate Gaskets
   - ❑ Low-flow Aerators ❑ Low-flow Showerhead
3. Did you find the installation instructions easy to understand?
   - ❑ Yes, the instructions were clear.
   - ❑ No, the instructions were difficult to follow.
4. Were the materials in your kit sufficient and durable?
   - ❑ Yes, everything was sufficient and durable.
   - ❑ No, we expected a more sufficient and/or durable set of materials.
5. Is the issue of energy efficiency important to you?
   - ❑ Yes, it is an important issue to our family.
   - ❑ No, we rarely take energy efficiency under consideration.
6. What part of this kit was the most valuable to your family? _____
7. Have you used any of the kit's materials in your home? If so, which ones? _____
8. What would make the kit's materials more useful to you? _____
9. How would you rate the kit and its materials? (1 being poor and 5 being great)
   1 2 3 4 5

You must include your name and full address below to receive prizes.*

Thank you for participating!

First Name Last Name

E-mail Address

Address

City State Zip

*For additional terms and conditions, including complete rules, please visit **www.scholastic.com/energysmart**. Your survey response is confidential and will be used only in anonymous, statistical summaries. You will not be asked to buy anything based on your participation, and we will not share your personally identifiable information with any third party.

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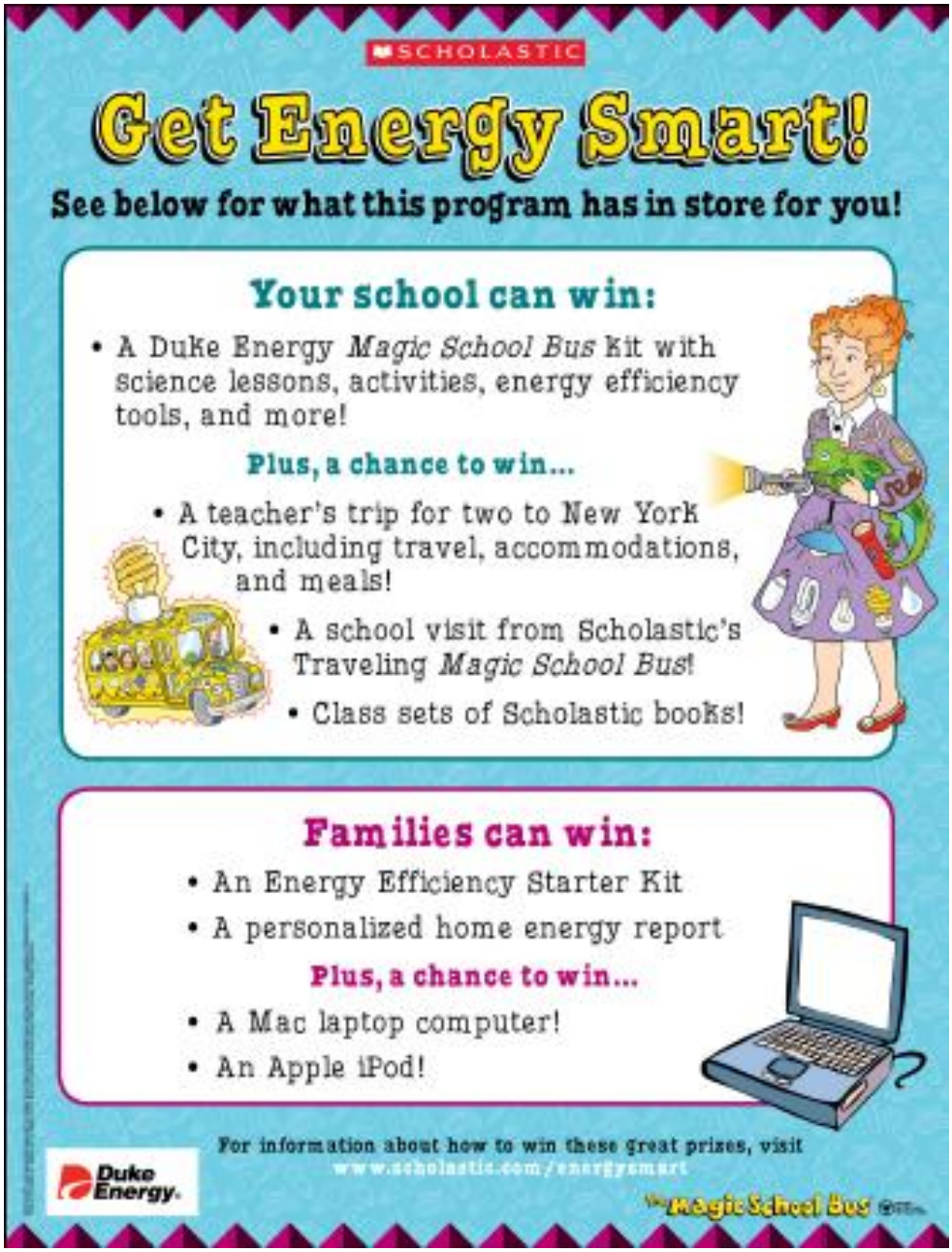
Duke Energy (Family)

PRINTED ON 10% TOTAL RECYCLED FIBER

SCHOLASTIC
Get Energy Smart
at your school!
Saving energy is easy to do!
I can save energy every day!
Look for this great program coming to your school!
This FREE program teaches students all about energy... and meets your state's education standards!
Duke Energy.

page 1 of 1


SCHOLASTIC
Get Energy Smart!
See below for what this program has in store for you!
Your school can win:
• A Duke Energy Magic School Bus kit with science lessons, activities, energy efficiency tools, and more!
Plus, a chance to win...
• A teacher's trip for two to New York City, including travel, accommodations, and meals!
• A school visit from Scholastic's Traveling Magic School Bus!
• Class sets of Scholastic books!
Families can win:
• An Energy Efficiency Starter Kit
• A personalized home energy report
Plus, a chance to win...
• A Mac laptop computer!
• An Apple iPod!
For information about how to win these great prizes, visit
www.scholastic.com/energysmart
Duke Energy.
The Magic School Bus

page 1 of 1

page 1 of 2

page 2 of 2

SCHOLASTIC

Dear Principal,

We want to let you know about an exciting **FREE program** that will be arriving in your school in September. This program has been created by Duke Energy and Scholastic to help your teachers educate their students about energy efficiency.

Your school will receive several Get Energy Smart kits, which include interactive lessons and hands-on activities for your 3rd- and 4th-grade classrooms. These lessons and activities are aligned to meet your state's standards in math, science, and language arts. Please share Get Energy Smart with all of your 3rd- and 4th-grade teachers.

Get Energy Smart will encourage your staff and students to think about what they can do to reduce energy costs at school and at home. Students will even become Energy Investigators and look for ways your school can be more energy efficient. To help spread the word about the program, we have created the following tools that are included in this packet.

- **Informational teacher handouts (with a reproducible family letter on the back)**
- **Announcement posters (to hang in the Main Office)**
- **Incentive Posters (to display in the school hallways)**

In addition to the easy-to-implement lessons and activities, the Get Energy Smart program also offers opportunities for free science assemblies and workshops for your school. For more details about these events and other program information, please visit **www.scholastic.com/energysmart** or call **1-800-349-8301**. Find out what else Duke Energy is doing for your community at **www.duke-energy.com/kidswithenergy.com**.

Sincerely,
Duke Energy
and Scholastic

Keep an eye out for this great program featuring *The Magic School Bus*

Duke Energy.

page 1 of 1

The following images are examples of program promotional materials:

ENERGY EFFICIENCY EDUCATION PROGRAM FOR THE CAROLINAS

JUNE 2009

Duke Energy.

What are the goals of this program?

- Educate students on energy efficiency and encourage them to think about energy usage at school and at home.
- Encourage their families to complete energy audit surveys, and use the results to make their homes more energy efficient.
- Provide free energy efficiency kits and items such as compact fluorescent light bulbs (CFLs) to students, and encourage their use in the home.

How does it work?

- Duke Energy is partnering with Scholastic Inc. (leading provider of educational materials) and a teacher advisory board to provide learning activities and resource materials for use in the classroom.
- The core of the program is the co-developed "Get Energy Smart" curriculum, which includes both online (www.scholastic.com/energysmart) and printed materials to supplement the schools' science and math curriculum.
- Duke Energy's "Kids with Energy" Web site, a companion to the "Get Energy Smart" site, provides more energy efficiency information and resources (www.duke-energy.com/kidswithenergy).
- Duke Energy provides Home Energy Audit Survey materials for students to take home and complete with their parents/guardians.

Who can participate?

- Currently the program is designed for students in grades 3 and 4. Eventually it will extend to other K-12 grade levels.
- The program is offered to public and private schools within Duke Energy's service area in North Carolina and South Carolina, starting in August 2009.

[over]

page 1 of 2

What are the benefits to the schools, students and their families?

- The "Get Energy Smart" materials meet North Carolina and South Carolina academic content standards.
- The program can help schools reduce energy consumption at their facilities through:
  - Greater overall awareness of energy efficiency in the school community
  - Use of energy efficiency education kits, tools and good practices on site.
- Energy efficiency lesson plans, learning activities and kits are provided at no cost.
- Teachers receive training in workshops conducted by Scholastic, as well as Continuing Education Units.
- Students learn about energy use and efficiency, and take that knowledge and energy efficiency tools home to their families to assist in lowering energy costs.
- Classrooms receive incentive awards, based on their degree of participation (such as certificates, classroom science books or class field trips).

What are the program costs?

- "Get Energy Smart" is part of Duke Energy's energy efficiency program portfolio that was approved by the Public Service Commission of South Carolina and the North Carolina Utilities Commission. There is no direct cost to administrators, teachers, parents, or students for the program curriculum, activities or participation incentives.

When is the program available?

- The curriculum is available throughout the school year, beginning in August 2009.
- Teacher workshops, planning and evaluation meetings for teachers will occur during the school year, as well as the summer months.

What kind of support is available for teachers?

- A Duke Energy/Scholastic regional program coordinator will provide teacher workshops, develop volunteers, handle local operations and serve as a central point of contact for schools.
- Educators may contact their North Carolina state coordinator at energysmartNC@scholastic.com or their South Carolina state coordinator at energysmartSC@scholastic.com.
- Scholastic provides weekday support via a toll-free phone number: 1-800-347-8301, Monday through Friday.

Where can we find more information on the "Get Energy Smart" Program?

- Visit us today at www.scholastic.com/energysmart and www.duke-energy.com/kidswithenergy.
- Call Scholastic toll free at 1-800-347-8301.
- Or contact your Duke Energy business relations manager.

What other programs are available?

- You can arrange for Energy Assessments for your school facilities – online, by phone or on site. Learn more at our Web site. For North Carolina, visit http://www.duke-energy.com/north-carolina-large-business/energy-efficiency/energy-assessments.asp. For South Carolina, visit http://www.duke-energy.com/south-carolina-large-business/energy-efficiency/energy-assessments.asp.
- Schools are also eligible for Duke Energy Smart $aver™ incentives, which can help offset upfront costs, reduce payback time for energy efficiency measures and accelerate energy savings. Please visit Duke Energy's Web site for further details about the Smart $aver program. For North Carolina, visit http://www.duke-energy.com/north-carolina-business/energy-management/energy-efficiency-incentives.asp. For South Carolina, visit http://www.duke-energy.com/south-carolina-business/energy-management/energy-efficiency-incentives.asp.
- For more information, contact your Duke Energy business relations manager, or visit us online at www.duke-energy.com.

Get Energy Smart!

Duke Energy.

page 2 of 2

Attention

3rd- and 4th-Grade Teachers and Administrators!

Hello! My name is Michelle White, and I want to share with you a great new educational program from Duke Energy and Scholastic. The **Get Energy Smart** program has been created especially for teachers in the southern Ohio area. As part of the program, every 3rd- and 4th-grade teacher within the Duke Energy service area will receive a free educational kit created by Scholastic. These kits, which feature Ms. Frizzle and *The Magic School Bus*, are being sent directly to your school. Read on to find out how you can get the most out of this great new program or visit **scholastic.com/energysmart** for more details.

1. Keep an eye out for a big box with the Magic School Bus on it and **open it right away!**
2. Complete the lessons inside with your students. These lessons and activities will help your class learn about energy efficiency. Best of all, the lessons are correlated to **Ohio Academic Content Standards** in science, language arts, and social studies. You don't need to wait until you are "teaching science" to get to these lessons.
3. Send the family materials home with your students. These valuable materials contain tips on energy efficiency, at-home activities, and a **Home Energy Survey**. By completing this survey, your students' families will learn how to save money and help the environment. The survey comes in a prepaid envelope so all families need to do is complete it and drop it in the mail. Families can also find details about completing the survey online at **scholastic.com/energysmart**. Families who fill out the survey will:
   - Receive a free **ENERGY EFFICIENCY KIT** with CFLs, aerators, outlet insulators, and a fun toy!
   - Receive a free energy report with suggestions on how to reduce energy bills!
   - Be entered to win one of two free laptop computers!

If you have any questions about this program, please feel free to contact me, your Ohio Program Coordinator for Get Energy Smart at **energysmartOH@scholastic.com** or call 1-800-347-8301. I would be happy to answer any questions you have or even schedule a visit to your school to show you how to best use these materials in your classroom. I look forward to helping you and your students Get Energy Smart!

Sincerely,

Michelle White

Prizes for the Classroom

If at least five of your students' families return their surveys, you will automatically receive a set of 15 books to add to your classroom library. Plus you will be eligible to win a class visit from Ms. Frizzle and *The Magic School Bus* or a trip for two to New York City!

For complete rules, visit www.scholastic.com/energysmart

Duke Energy. SCHOLASTIC The Magic School Bus

page 1 of 2

Start getting energy smart now with this fun word search!

S	S	A	N	E	A	R	T	H	T
M	V	W	O	I	N	T	A	E	H
A	T	C	I	R	T	C	E	L	E
G	R	G	T	T	L	F	C	E	R
I	A	N	A	P	C	E	R	G	M
C	M	B	L	O	O	H	C	S	O
Y	S	A	U	I	S	W	P	O	S
W	M	E	S	S	R	F	E	U	T
P	L	E	N	E	R	G	Y	R	A
E	F	F	I	C	I	E	N	T	T

BUS	ENERGY	POWER
CFL	HEAT	SCHOOL
EARTH	INSULATION	SMART
EFFICIENT	LAMP	SWITCH
ELECTRIC	MAGIC	THERMOSTAT

Once you have circled all of the words in the list above, write down the remaining letters in order. These remaining letters will spell out a secret message from Ms. Frizzle!

_____

_____

Visit www.scholastic.com/energysmart for more games and activities, as well as energy-efficiency tips for home and school!

page 2 of 2

SCHOLASTIC

Duke Energy.

Attention, 3rd and 4th Grade Teachers:

Welcome to **Get Energy Smart!** Join your 3rd- and 4th-grade students on a journey through the science of energy with Ms. Frizzle and *The Magic School Bus*. The program's academic standards-based lessons and worksheets teach students the value of conserving energy while reinforcing important science, math, and language arts skills.

PLUS! In addition to the FREE kit delivered to your classroom, you will have a chance to win these great prizes:

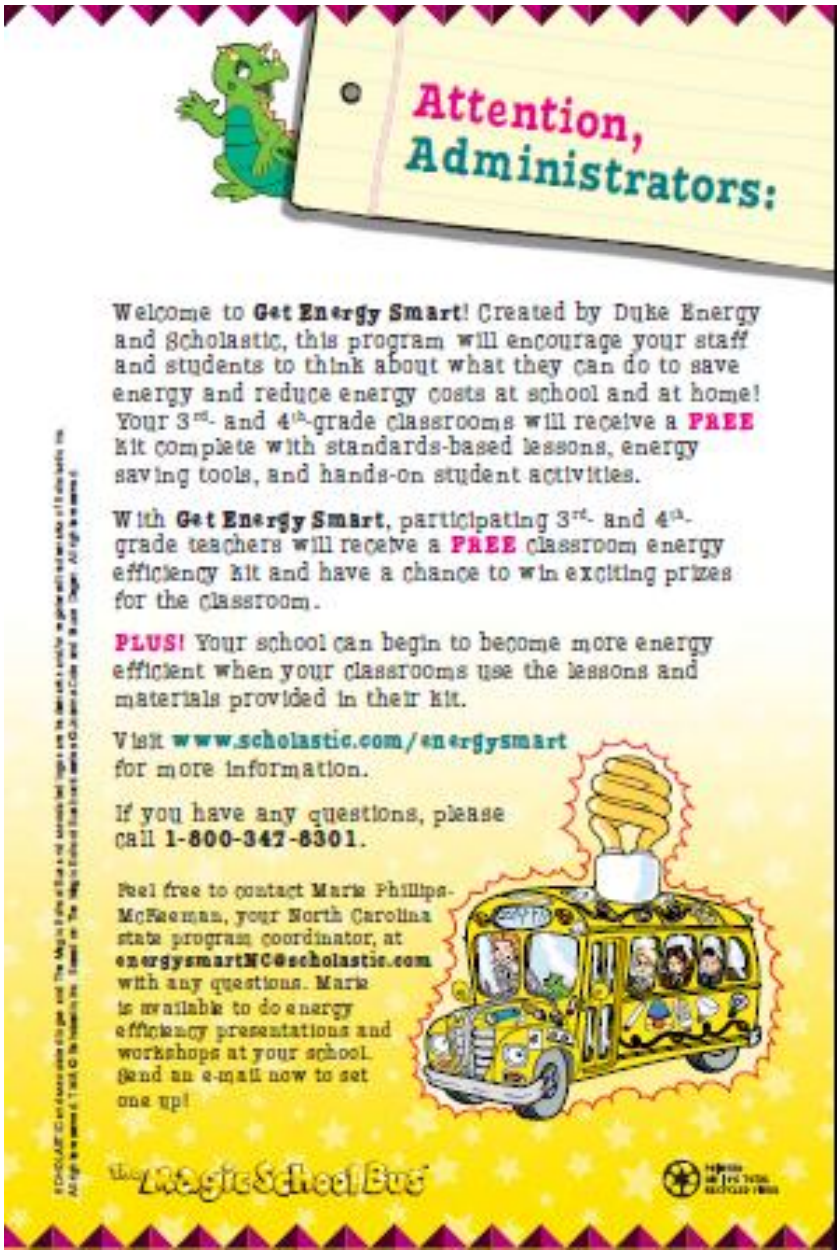
- **a trip for two to New York City, including a shopping trip to the Scholastic store and museum passes**
- **a classroom visit from *The Magic School Bus***
- **a class set of books from Scholastic**

Find out how you could win by visiting **www.scholastic.com/energysmart** for more information.

The program's easy energy conservation ideas can lead to lower energy use and a cleaner environment! We hope this helps your students **Get Energy Smart!**

Feel free to contact Marie Phillips-McKeeman, your North Carolina state program coordinator, at **energysmartNC@scholastic.com** with any questions. Marie is available to do energy efficiency presentations and workshops at your school. Send an e-mail now to set one up!

page 1 of 1



Attention, Administrators:

Welcome to **Get Energy Smart**! Created by Duke Energy and Scholastic, this program will encourage your staff and students to think about what they can do to save energy and reduce energy costs at school and at home! Your 3rd- and 4th-grade classrooms will receive a **FREE** kit complete with standards-based lessons, energy saving tools, and hands-on student activities.

With **Get Energy Smart**, participating 3rd- and 4th-grade teachers will receive a **FREE** classroom energy efficiency kit and have a chance to win exciting prizes for the classroom.

PLUS! Your school can begin to become more energy efficient when your classrooms use the lessons and materials provided in their kit.

Visit **www.scholastic.com/energysmart** for more information.

If you have any questions, please call **1-800-347-8301**.

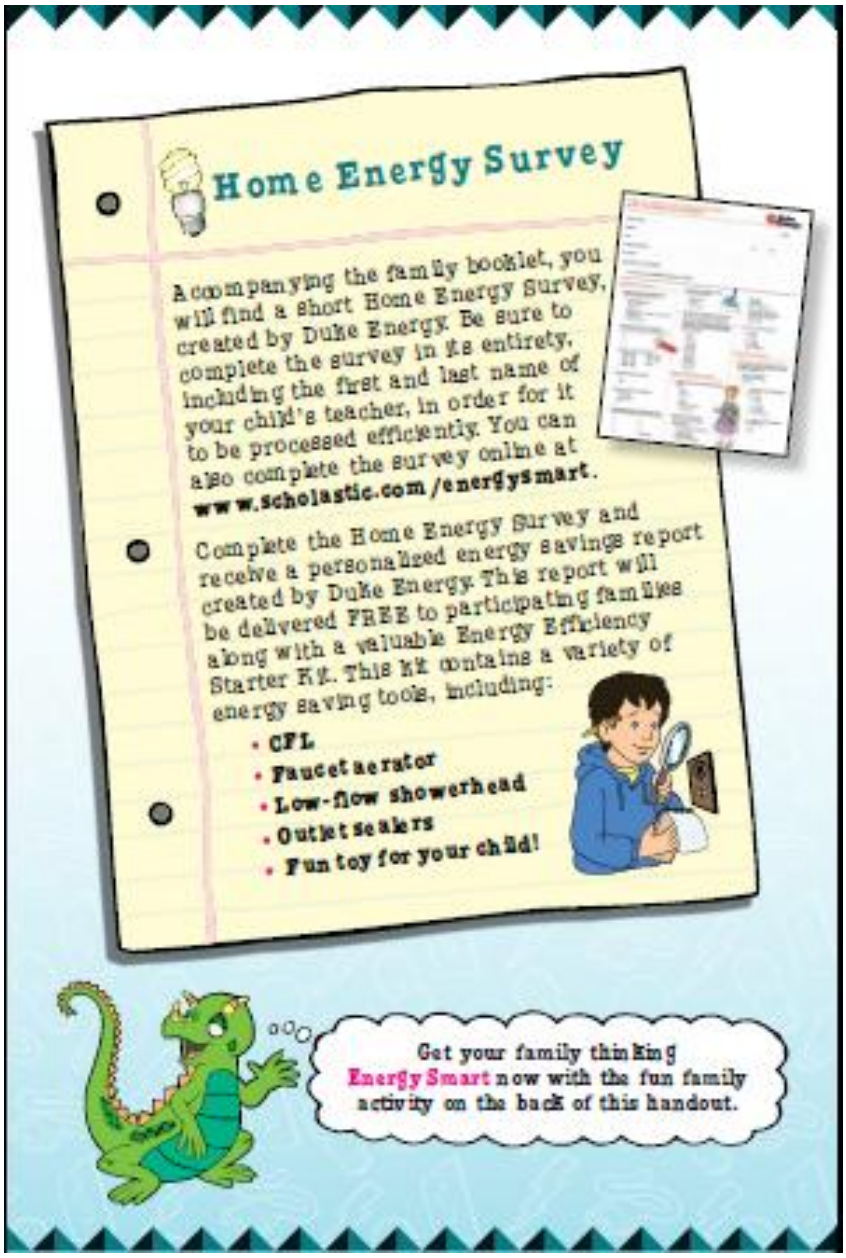
Feel free to contact Marie Phillips-McFeeman, your North Carolina state program coordinator, at **energysmartNC@scholastic.com** with any questions. Marie is available to do energy efficiency presentations and workshops at your school. Send an e-mail now to set one up!

The Magic School Bus

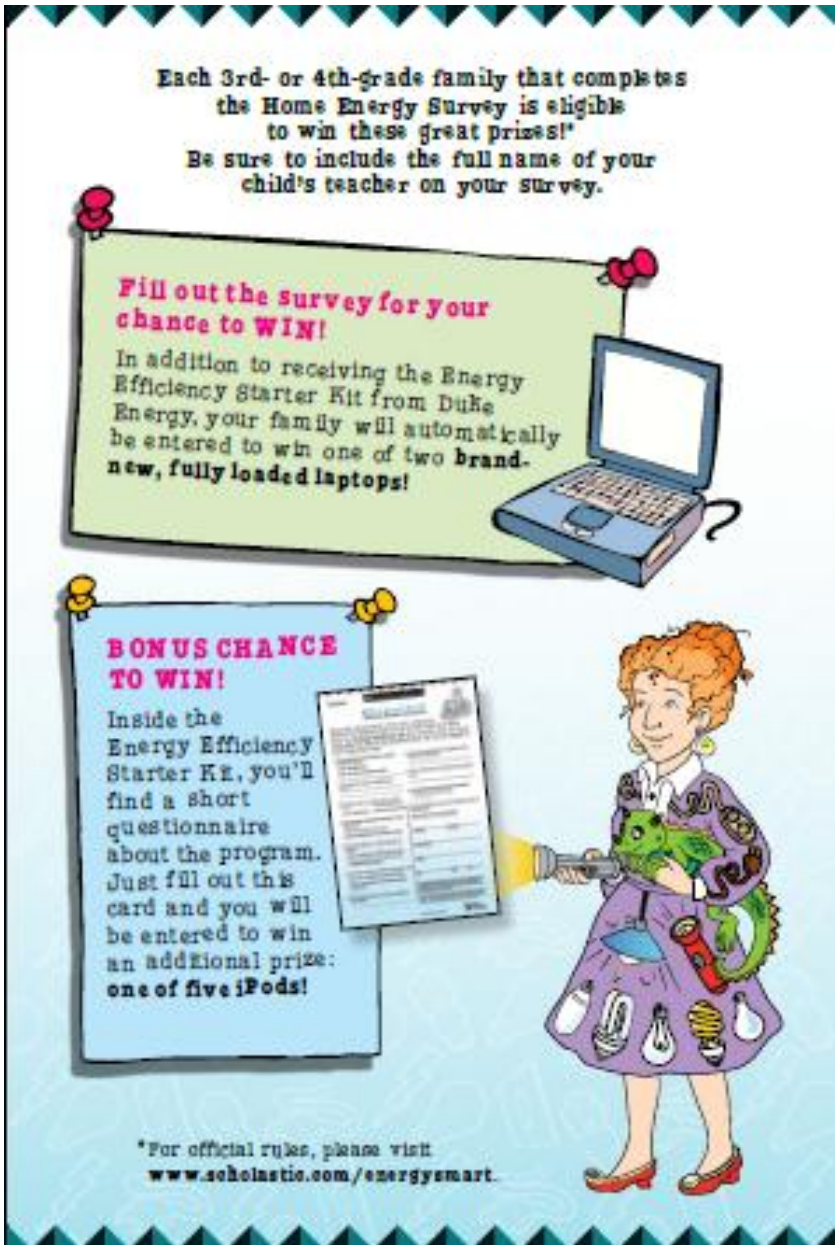
page 1 of 1

SCHOLASTIC
Welcome to
Get Energy Smart!
Created by Scholastic and Duke Energy, Get Energy Smart teaches your child about energy efficiency and shows that saving energy can be easy and fun!
Your 3rd- or 4th-grader should be bringing home this booklet. The tips inside can help your family save money on energy bills and contribute to a cleaner environment.
Get Energy Smart now. Look inside for details!
Duke Energy.
The Magic School Bus

page 1 of 4

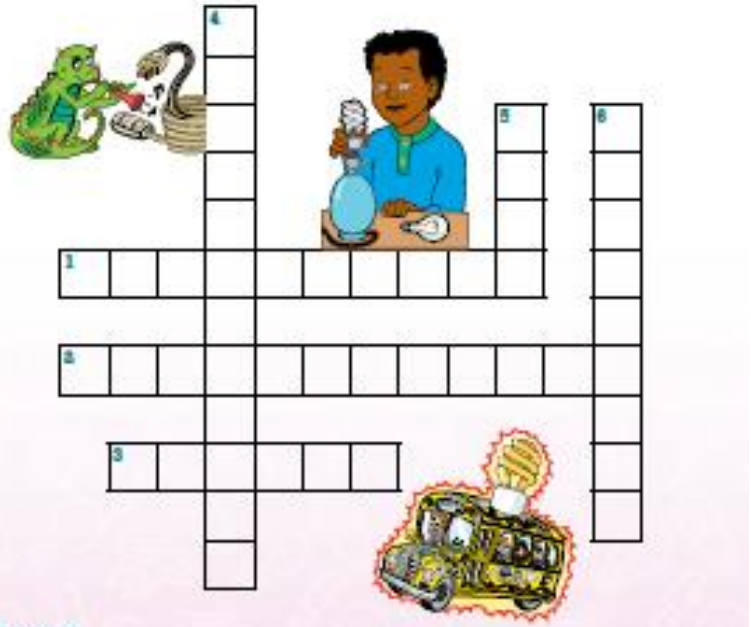

Home Energy Survey
Accompanying the family booklet, you will find a short Home Energy Survey, created by Duke Energy. Be sure to complete the survey in its entirety, including the first and last name of your child's teacher, in order for it to be processed efficiently. You can also complete the survey online at www.scholastic.com/energysmart.
Complete the Home Energy Survey and receive a personalized energy savings report created by Duke Energy. This report will be delivered FREE to participating families along with a valuable Energy Efficiency Starter Kit. This kit contains a variety of energy saving tools, including:
• CFL
• Faucet aerator
• Low-flow showerhead
• Outlet sealers
• Fun toy for your child!
Get your family thinking Energy Smart now with the fun family activity on the back of this handout.

page 2 of 4


Each 3rd- or 4th-grade family that completes the Home Energy Survey is eligible to win these great prizes!*
Be sure to include the full name of your child's teacher on your survey.
Fill out the survey for your chance to WIN!
In addition to receiving the Energy Efficiency Starter Kit from Duke Energy, your family will automatically be entered to win one of two brand-new, fully loaded laptops!
BONUS CHANCE TO WIN!
Inside the Energy Efficiency Starter Kit, you'll find a short questionnaire about the program. Just fill out this card and you will be entered to win an additional prize: one of five iPods!
*For official rules, please visit www.scholastic.com/energysmart.

page 3 of 4

Get Energy Smart with this fun, family-friendly game.



ACROSS

1. You can use this to control the temperature in your home
2. This kind of light bulb gets pretty hot and uses a lot of energy
3. This smart scientist invented the light bulb

DOWN

4. Using energy responsibly, not wasting it
5. A unit of measure of electric power
6. Energy efficiency is one way to reduce _____.

For more games and activities, visit
www.scholastic.com/energysmart

page 4 of 4

SCHOLASTIC
DE-sm
Energy Efficiency Education
in K-12 Schools
Ebony Pitts, Marketing Specialist
Duke Energy
April 2009
Confidential and Proprietary
1

Energy Efficiency Education

DE-sm

Duke Energy Introduces a New Energy Efficiency School Program

- A program that…
  - delivers Energy Efficiency education across Duke Energy's five jurisdictions
  - is engaging to administrators, teachers, students and parents
  - results in reduction of energy use for the participants and can be tracked at the household level
- Student population K - 12
  - NC = 336,000
  - SC = 248,000
  - OH = 261,000
  - KY = 62,000
  - IN = 483,000

Duke Energy Service Territory

Service Territory_.jpg

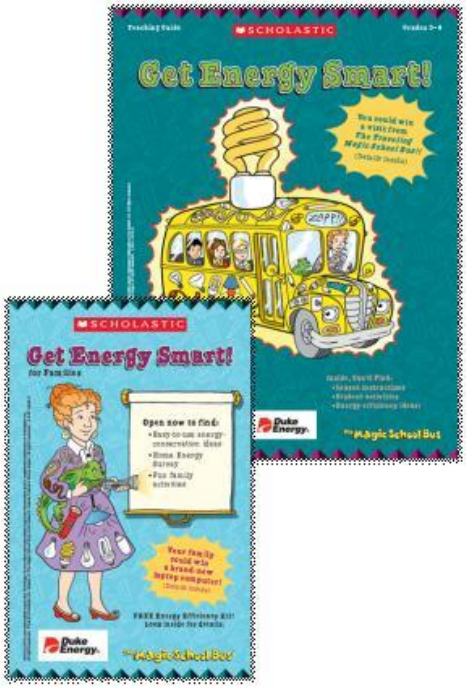
2

Energy Efficiency Education

DE-sm

About the **Get Energy Smart** Program

- Co-developed with Scholastic
- **Get Energy Smart** Teaching Materials:
  - Targets grades 3-4
  - Focuses on the value of saving energy
  - Based on *The Magic School Bus* science book series
  - Features lessons & activities that meet state academic standards
- **Get Energy Smart** Family Materials:
  - Family Booklet with energy efficiency related activities and information
  - **Home Energy Survey** for families



3

Energy Efficiency Education

DE-sm

Additional **Get Energy Smart** Kit Components

- Box turns into "pop-out" *Magic School Bus,* Ms. Frizzle, and other series characters for display in the classroom.
- Classroom poster featuring energy efficiency messaging and an image of a CFL bulb that turns on and off..

- **Hands-on energy-saving sampler:**

- CFL
- Low-Flow Aerator
- Outlet Sealer
- Light Switch sealer

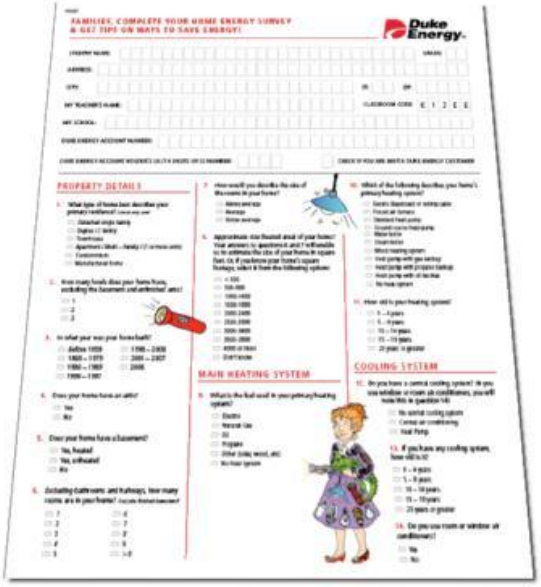
4

Energy Efficiency Education

DE-sm

Get Energy Smart Family Materials:

- 8-page Family Booklets for students to bring home
- **Home Energy Survey** for families to complete and return to Duke Energy
- Incentives for family participation, including:
  - Laptop Computers
  - iPods



5

Energy Efficiency Education

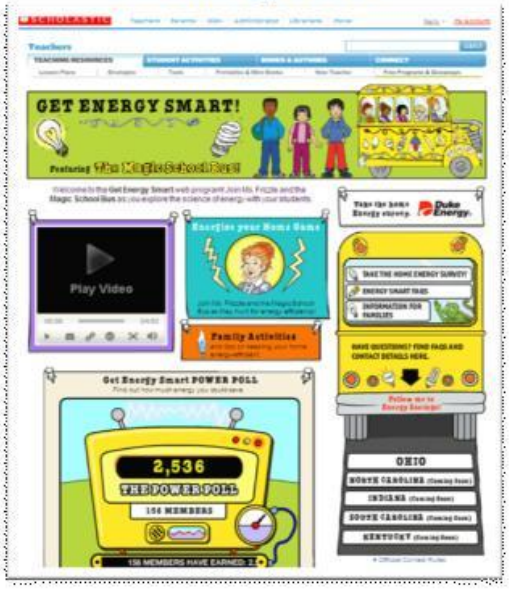
DE-sm

Get Energy Smart

Supporting co-branded Web sites offer online communities, free downloadable materials and other resources for teachers and family.

Kids with Energy

Get Energy Smart!



6

Energy Efficiency Education

DE-sm

How Do Teachers and Administrators Benefit?

- Free, professional lessons and activities
- Training Workshops
- Continuing Education Units
- Classroom incentives
  - **Magic School Bus science kit**
  - Eligible for educational trip to visit Scholastic offices in New York
  - Visit from Miss Frizzle and the traveling **Magic School Bus**!

7

Energy Efficiency Education

DE-sm

How Do Students and Families Benefit?

- Participating families become eligible for a free **Efficiency Kit and Family Report**!
- The kit contains:
  - Items to help families lower energy costs.
- Family Report:
  - Useful tips to help manage energy use.

Energy Efficiency Education

DE-sm

How to Learn More about **Get Energy Smart** ?

Ebony Pitts, K12 Program Manager
Duke Energy
Phone: 704-382-0882
E-mail: epitts@duke-energy.com

Tricia MacGill, Project Manager
Scholastic, Inc.
Phone: 212-343-6852
E-mail: tmacgill@scholastic.com

Resources:

- www.scholastic.com/energysmart
- www.duke-energy.com/kidswithenergy
- Call Scholastic toll free at 1-800-347-8301 / Email State Coord.
- Or contact your Duke Energy Business Relations manager

9

Appendix E: Impact Algorithms

CFLs

General Algorithm

Gross Summer Coincident Demand Savings

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

Gross Annual Energy Savings

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

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

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 = 0.00148
$HVAC_d$	= HVAC system interaction factor for demand = 0.16738
$HVAC_g$	= HVAC system interaction factor for annual gas consumption = -0.0013

13 W CFL Measure

$Watts_{ee}$ = 13, which is the input power of program supplied CFL

$Watts_{base}$ - calculated from survey responses as shown below = 64.41718

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: = 1609.382 for 13-watt bulb, 1473.233 For the 20-watt bulb.

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.

Charlotte, NC

Heating Fuel	Heating System	Cooling System	HVACc	HVACg
Other	Any except Heat Pump	Any except Heat Pump	0	0
Any	Heat Pump	Heat Pump	-0.10	0
Gas Propane Oil	Central Furnace	None	0	-0.0021
		Room/Window	0.069	-0.0021
		Central AC	0.069	-0.0021
	Other	None	0	-0.0021
		Room/Window	0.079	-0.0021
		Central AC	0.079	-0.0021
Electricity	Central furnace	None	-0.43	0
		Room/Window	-0.31	0
		Central AC	-0.31	0
	Electric baseboard	None	-0.43	0
		Room/Window	-0.31	0

		Central AC	-0.31	0
	Other	None	-0.43	0
		Room/Window	-0.31	0
		Central AC	-0.31	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.

Charlotte, NC

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: = 67.96552

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

Outlet Gaskets

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 = 0.00276
kWh/cfm	= electricity savings per unit cfm reduction = 5.50976
therm/cfm	= gas savings per unit cfm reduction = 0.04753

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)
Charlotte	60	8	19	1.57

Measure ELA impact and cfm reductions are as follows:

Measure	Unit	ELA change (in^2/unit)	ΔCfm/unit (NC)
Outlet gaskets	Each	0.357	0.56
Weather strip	Foot	0.089	0.14

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	2.48	0.00248	0
Any	Heat Pump	Heat Pump	10.37	0.00248	0
Gas Propane Oil	Central Furnace	None	0	0	0.0743
		Room/Window	2.48	0.00248	0.0743
		Central AC	2.48	0.00248	0.0743
	Other	None	0	0	0.0743
		Room/Window	2.48	0.00248	0.0743
		Central AC	2.48	0.00248	0.0743
Electricity	Central furnace	None	17.01	0.00990	0.000
		Room/Window	18.54	0.01485	0.000
		Central AC	18.54	0.01485	0.000
	Electric baseboard	None	17.01	0.00990	0.000
		Room/Window	18.54	0.01485	0.000
		Central AC	18.54	0.01485	0.000
	Other	None	17.01	0.00990	0.000
		Room/Window	18.54	0.01485	0.000
		Central AC	18.54	0.01485	0.000

Low-Flow Showerhead

Gross Summer Coincident Demand Savings

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

Gross Annual Energy Savings

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

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

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
Charlotte	60.3 °F	100°F	39.7°F

Water heater efficiency

Combustion efficiency for residential gas water heater = 0.70

Demand diversity factor = 0.1

Coincidence factor = 0.4

Showers/week = 9.16

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

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
Charlotte	60.3 °F	100°F	39.7°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.

Water Temperature Card

Gross Summer Coincident Demand Savings

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

Gross Annual Energy Savings

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

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

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) =4.6817
UA_{ee}	= overall heat transfer coefficient of improved water heater (Btu/hr-°F) =1.9217
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.

LED Night Lights

$Watts_{ee}$ = 0.6
$Watts_{base}$ = 4
Daily Operating Hours = 24

$\Delta kWh = units \times (Watts_{base} - Watts_{ee}) / (1000 \times DailyOH) \times 365$

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 2.

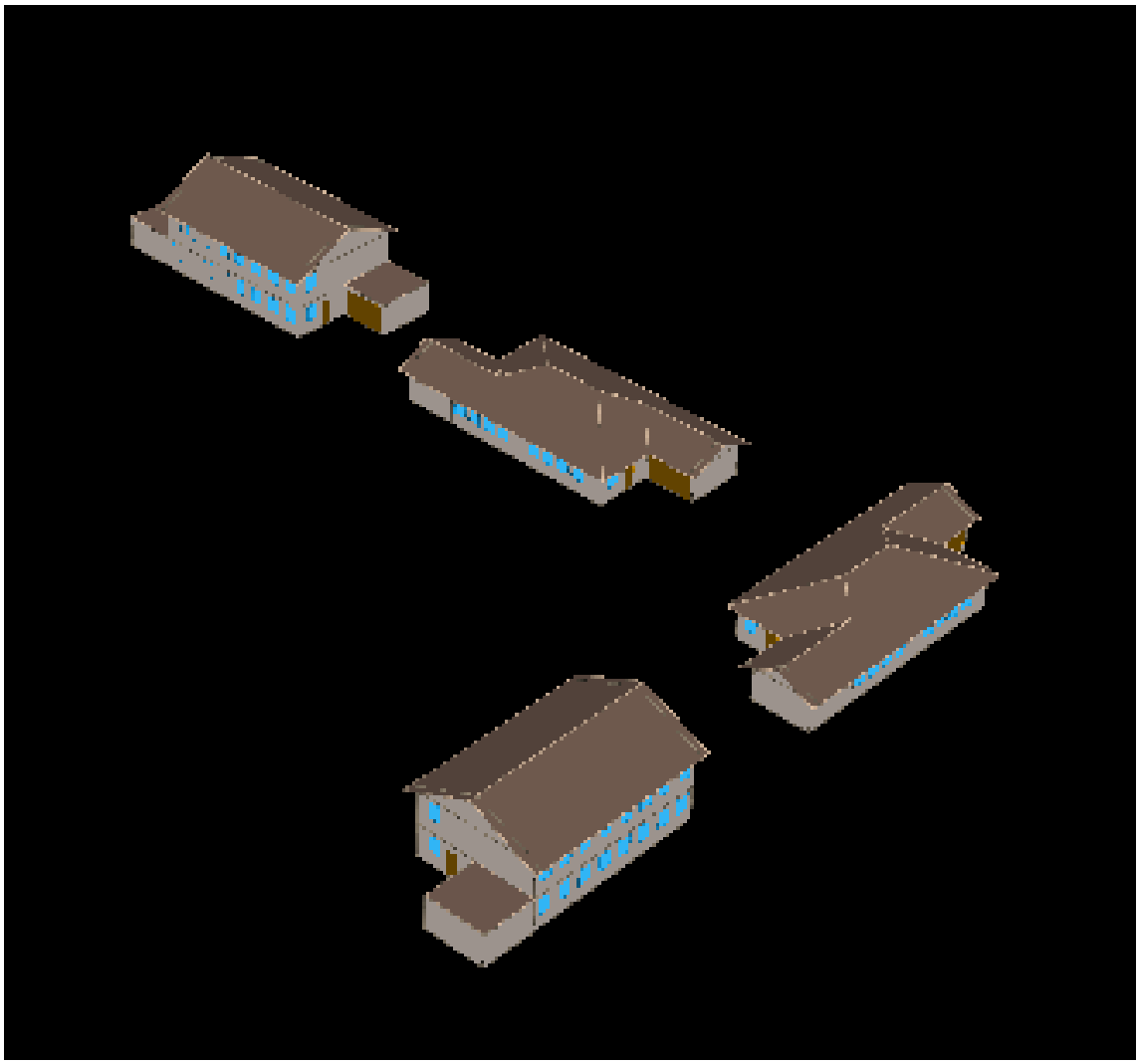


Figure 2. Computer Rendering of Residential Building Prototype Model

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
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

Characteristic	Value
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

ASHRAE, 2001. ASHRAE Handbook of Fundamentals, American Society of Heating, Refrigeration and Airconditioning Engineers, Atlanta, GA, 2001.

Efficiency Vermont, 2003. Technical Reference Manual, Master Manual Number 4, Measure Savings Algorithms and Cost Assumptions, Efficiency Vermont, Burlington, VT. 2003.

EPRI, 1993. Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2: Fundamental Equations for Residential and Commercial End-Uses, EPRI TR-100984 V2., Electric Power Research Institute, Palo Alto, CA. 1993.

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 F: Estimated Statistical Model

This appendix show the complete model estimated for the billing analysis. The model includes indicators for each month (the yearmonth variable), temperature, the state the participant resides, and the participation variables.

Variable	Coefficient	Std. Err.	t-value	P>|t|	[95% Conf.	Interval]
Ohio Part	-.0067198	.00289	-2.33	0.020	-.0123841	-.0010555
Carolina Part	-.0124677	.0020794	-6.00	0.000	-.0165433	-.0083921
Kentucky Part	-.0227276	.0126868	-1.79	0.073	-.0475933	.0021381
yearmonth (time variables)						
200902	-.052312	.033756	-1.55	0.121	-.1184726	.0138487
200903	-.0715763	.0421097	-1.70	0.089	-.1541099	.0109574
200904	-.1556293	.0601211	-2.59	0.010	-.2734648	-.0377938
200905	-1.063964	.0581443	-18.30	0.000	-1.177925	-.9500025
200906	-3.438992	.0869149	-39.57	0.000	-3.609343	-3.268641
200907	-3.606707	.1163904	-30.99	0.000	-3.834829	-3.378586
200908	-3.965954	.1196231	-33.15	0.000	-4.200411	-3.731496
200909	-2.858674	.0768451	-37.20	0.000	-3.009288	-2.708059
200910	-1.481454	.0436092	-33.97	0.000	-1.566927	-1.395982
200911	-.3275281	.0653933	-5.01	0.000	-.455697	-.1993592
200912	.1987411	.033256	5.98	0.000	.1335604	.2639217
201001	.1349608	.0392585	3.44	0.001	.0580153	.2119063
201002	.1203595	.0412687	2.92	0.004	.0394741	.2012449
201003	.5782756	.0409695	14.11	0.000	.4979767	.6585745
201004	.1993842	.0500427	3.98	0.000	.1013021	.2974663
201005	-2.783248	.0815696	-34.12	0.000	-2.943122	-2.623374
201006	-3.55006	.0763178	-46.52	0.000	-3.699641	-3.40048
201007	-4.569939	.1307381	-34.95	0.000	-4.826182	-4.313697
201008	-3.825948	.1096061	-34.91	0.000	-4.040772	-3.611123
201009	-2.843417	.0753555	-37.73	0.000	-2.991111	-2.695722
201010	-2.341425	.0447405	-52.33	0.000	-2.429115	-2.253735
201011	-.0632438	.044417	-1.42	0.154	-.1502997	.0238121
201012	.1765302	.029746	5.93	0.000	.118229	.2348314
201101	.2212299	.0471835	4.69	0.000	.1287518	.313708
201102	.555201	.0426248	13.03	0.000	.4716578	.6387442
201103	.5683593	.047679	11.92	0.000	.47491	.6618087
temperature interacted with monthly indicator						
200901	-.0138686	.0007626	-18.19	0.000	-.0153632	-.0123739
200902	-.0143049	.0007527	-19.00	0.000	-.0157802	-.0128296
200903	-.0135311	.0007972	-16.97	0.000	-.0150937	-.0119686
200904	-.0127076	.0010832	-11.73	0.000	-.0148307	-.0105844
200905	.0039433	.0008611	4.58	0.000	.0022555	.0056311
200906	.0410536	.0011429	35.92	0.000	.0388135	.0432937
200907	.0456421	.0016258	28.07	0.000	.0424556	.0488285
200908	.0485673	.0016261	29.87	0.000	.0453803	.0517543
200909	.0363371	.0010932	33.24	0.000	.0341945	.0384798
200910	.0143571	.0006964	20.61	0.000	.0129921	.0157221
200911	-.0096781	.0012833	-7.54	0.000	-.0121934	-.0071629
200912	-.0224782	.0006526	-34.45	0.000	-.0237572	-.0211991
201001	-.0170185	.0011085	-15.35	0.000	-.019191	-.014846
201002	-.0198193	.0012126	-16.34	0.000	-.0221959	-.0174426
201003	-.0270605	.0006987	-38.73	0.000	-.0284299	-.0256911
201004	-.0167514	.0007344	-22.81	0.000	-.0181907	-.0153121
201005	.0289119	.0011713	24.68	0.000	.0266162	.0312077
201006	.0417506	.000957	43.63	0.000	.0398749	.0436262
201007	.0565541	.001666	33.95	0.000	.0532889	.0598194
201008	.0473564	.0013879	34.12	0.000	.0446361	.0500767
201009	.0368167	.0010226	36.00	0.000	.0348125	.038821
201010	.0286051	.0006504	43.98	0.000	.0273304	.0298798
201011	-.0166427	.0008261	-20.15	0.000	-.0182618	-.0150236
201012	-.0249429	.0005702	-43.75	0.000	-.0260605	-.0238254
201101	-.0209974	.0014676	-14.31	0.000	-.0238737	-.018121
201102	-.0273321	.0009304	-29.38	0.000	-.0291557	-.0255085
201103	-.0281919	.0008984	-31.38	0.000	-.0299527	-.0264311
state interacted with monthly indicator						
2 200901	.2404777	.0146982	16.36	0.000	.2116695	.2692858

2	200902	.3097867	.0141364	21.91	0.000	.2820798	.3374936
2	200903	.2506665	.0114111	21.97	0.000	.228301	.273032
2	200904	.1930738	.0116537	16.57	0.000	.1702328	.2159147
2	200905	.1268657	.011327	11.20	0.000	.104665	.1490663
2	200907	-.200628	.0153021	-13.11	0.000	-.2306198	-.1706363
2	200908	-.1056397	.0147499	-7.16	0.000	-.134549	-.0767304
2	200909	-.246503	.0145415	-16.95	0.000	-.2750039	-.2180021
2	200910	-.1033328	.0149927	-6.89	0.000	-.132718	-.0739476
2	200911	.1851111	.0165659	11.17	0.000	.1526424	.2175797
2	200912	.4145755	.014596	28.40	0.000	.3859679	.4431832
2	201001	.304861	.0152787	19.95	0.000	.2749152	.3348068
2	201002	.4098067	.0175765	23.32	0.000	.3753573	.4442562
2	201003	.2172948	.011091	19.59	0.000	.1955568	.2390328
2	201004	.1113218	.0107755	10.33	0.000	.0902021	.1324416
2	201005	.2296814	.0108011	21.26	0.000	.2085116	.2508512
2	201006	.055609	.0108398	5.13	0.000	.0343633	.0768547
2	201007	-.1511093	.012124	-12.46	0.000	-.174872	-.1273467
2	201008	-.1792477	.0123959	-14.46	0.000	-.2035433	-.1549521
2	201009	-.2885355	.0135805	-21.25	0.000	-.3151528	-.2619181
2	201010	-.2003509	.0132729	-15.09	0.000	-.2263653	-.1743364
2	201011	.3172147	.015395	20.61	0.000	.287041	.3473884
2	201012	.5328833	.0148749	35.82	0.000	.5037289	.5620377
2	201101	.3508014	.0162304	21.61	0.000	.3189903	.3826126
2	201102	.2363542	.0114875	20.57	0.000	.2138391	.2588694
2	201103	.2976398	.0121518	24.49	0.000	.2738228	.3214569
3	200901	-.0335729	.0287799	-1.17	0.243	-.0899807	.0228348
3	200902	.0026508	.0297882	0.09	0.929	-.0557332	.0610348
3	200903	-.0168359	.029722	-0.57	0.571	-.0750901	.0414184
3	200904	-.0211797	.0283686	-0.75	0.455	-.0767813	.0344219
3	200905	-.1413398	.0286474	-4.93	0.000	-.1974879	-.0851918
3	200907	-.0015518	.0282434	-0.05	0.956	-.0569081	.0538044
3	200908	.0572144	.0280412	2.04	0.041	.0022546	.1121742
3	200909	-.0861749	.0279939	-3.08	0.002	-.1410422	-.0313077
3	200910	-.0843118	.0279604	-3.02	0.003	-.1391133	-.0295103
3	200911	-.0351205	.0280048	-1.25	0.210	-.090009	.0197681
3	200912	.0872507	.0281925	3.09	0.002	.0319942	.1425072
3	201001	-.0360286	.0285158	-1.26	0.206	-.0919187	.0198614
3	201002	.0130815	.0287192	0.46	0.649	-.0432074	.0693703
3	201003	-.0435733	.0286941	-1.52	0.129	-.0998129	.0126662
3	201004	-.0587561	.0284881	-2.06	0.039	-.114592	-.0029202
3	201005	.0058591	.029481	0.20	0.842	-.0519228	.0636409
3	201006	.1033168	.0295559	3.50	0.000	.0453882	.1612453
3	201007	.0270181	.0294907	0.92	0.360	-.0307827	.0848188
3	201008	.0084112	.0295064	0.29	0.776	-.0494203	.0662427
3	201009	-.0501598	.0295561	-1.70	0.090	-.1080889	.0077693
3	201010	-.0750878	.0309838	-2.42	0.015	-.135815	-.0143606
3	201011	.0130509	.0310657	0.42	0.674	-.0478369	.0739386
3	201012	.1036032	.0310394	3.34	0.001	.042767	.1644394
3	201101	-.0131601	.0311165	-0.42	0.672	-.0741474	.0478272
3	201102	-.0180948	.0312241	-0.58	0.562	-.0792932	.0431035
3	201103	-.0268983	.0311963	-0.86	0.389	-.0880421	.0342456

Appendix G: Early Feedback Report of 9/11/09

Executive Summary

About This Report

This report presents the early feedback findings for the evaluation of the "Get Energy Smart" Program, also known as the K12 Curriculum Program. For this early feedback report, we interviewed ten participating teachers, the program manager, and the program implementation manager from Scholastic.

According to the program information:

> "The "Get Energy Smart" program goal is to educate children and their families about wise energy usage in their homes and personal choices they can make to save money, protect the environment and address climate change. The curriculum was designed to allow teachers to incorporate the materials into their existing math/science instructional schedules with supplemental activities on the Web.
>
> The lessons are short, but relevant, and create opportunities for interactive, hands-on learning. Students and families can perform an on-line energy audit of their own homes, which creates an energy report for each participating family. After students perform the audit, they receive a free energy efficiency starter kit containing information and the following items:
>
> - Earth Massage Showerhead, 1.5 GPM
> - Kitchen Aerator with Swivel & Flip Valve, 1.5 GPM
> - Water Flow Meter Bag
> - Hot Water Temperature Gauge Card
> - 13 watt CFL (60 watt equivalent) Energy Star Approved
> - 20 watt CFL (75 watt equivalent) Energy Star Approved
> - Bathroom Faucet Aerator, 1.0 GPM Needle Spray
> - Combination Pack of Switch / Outlet Gasket Insulators (12 per pack)
> - Energy Efficient Limelight Style Night Light
> - Duke Energy Labeled DOE Energy Savers Booklet
> - Small Roll of Teflon Tape
> - Duke Energy Supplied Product Info / Instruction Sheet
> - Duke Energy Supplied CFL Magnet
> - Duke Energy Supplied Kit Label

Since the Ohio K12 program started in March of 2009, Duke Energy has had approximately 1,200 participants that were able to receive EE Kits with 2,400 CFLs. In addition, another 794 CFLs were distributed.

Summary of Findings and Recommendations

An overview of the key findings and recommendations identified through this evaluation is presented below.

Evaluation Contractor's Recommendations for Duke Energy to Consider

The following program recommendations are provided by TMW, the evaluation contactor. The recommendations are provided to allow Duke Energy to review them with the program manager and the lead administrator so that each recommendation can be accepted, rejected or modified according to the best judgment of the program design professionals.

1. Duke Energy should restructure the program so that the delivery of the energy saving actions information collected from students and parents is the one of the criteria for receipt of program incentives. Duke should establish a minimum survey return rate for identifying behaviors and actions taken, and set incentives so that the higher the survey return rate achieved from the program administrator and the school, the larger the incentive received. Duke should also consider an incentive structure based on the level of energy actions taken and reported in the collected surveys. Duke should identify a set of behavior change and actions taken metrics and use these metrics as one of the key criteria for assessing the performance of the program and the delivery of that program by the program administrator. Consider adding a stronger focus in school/teacher presentations and discussions that focuses on the need for high survey response rates.

2. While some students attend a school located within Duke Energy's territory, yet live in a home outside of that territory, the savings from that student's home should be counted as a Duke Energy program accomplishment. TecMarket Works recommends that savings from the program be tracked as a function of school location and participant's actions rather than the address of the participating student's home. This is consistent with current practice. This recommendation is provided to encourage the continuation of this approach rather than developing a program accounting system that allocates savings to utilities based on the address of the parent. A conversion to a participant address-based energy savings tracking system would increase costs without substantially improving the reliability of the savings estimates. Consider modifying the program screening efforts to allow all students in a participating class to receive the program kits, regardless of the location of their home. Work with the Commission to allow savings from schools operating in multiple utility territories to be credited to the sponsoring utility so that territorial issues do not impact program energy credits.

3. Examine if inexpensive mass media efforts such as public service announcements, interest stories in local newspapers, and topic specific public interest discussion programming can be employed to increase program knowledge, public acceptance, market pull, and help create a pre-existing receptive atmosphere from administrators, teachers and the communities that can increase enrollment efficiency.

4. Schedule the program's field efforts to be carefully integrated into the individual school's pre-established curriculum and teacher workload so that the efforts are not placed in competition for teacher's time at key bottlenecks and can be more efficiently integrated into the curriculum.

5. Assess if the energy saving actions induced by the program are impacted by the flexibility of the school's curriculum to see if the program is more cost effective when

integrated into schools that have a more flexible curriculum. Then target or prioritize targeting and field efforts to achieve the highest level of energy actions taken while maintaining support and teacher/administrator/student learning and satisfaction.

6. Work more directly with the teachers, through the school administrators, to coordinate the program's field efforts, stress the program's primary objectives, clarify the efforts and information needed to document and count the savings, achieve teacher support, and arrange for follow-up information gathering for evaluation needs.

7. If not already accomplished, assess the relationship between students, teachers and parents to identify the grade levels at which the program-provided energy technologies are installed and used, the recommended behavior changes are taken and the system-level carbon reductions are achieved and focus the program's efforts on these grades.

8. Increase the attention given to helping teachers understand that the goal of the program, and the primary criteria on which program decisions are based, that is achieved installations of the program-provided technologies, the adoption of program-recommended behavior changes, and the level of achieved carbon emission reductions, rather than a more general goal of educating children. Education is not the primary goal of the program, but the vehicle by which the program's objectives are reached.

9. Consider requiring a presentation by the program administrator attended by at least 70% or 80% of the participating teachers (or some other level) as a condition of program participation. If well-executed this presentation can help convey the program's importance and goals to the teachers, obtain added support, increase teacher satisfaction, increase the percentage of surveys received and provide a vehicle for teachers to exchange ideas and discuss possible/successful educational approach scenarios with other teachers and the program administrator.

10. Duke should drop the requirement for the parents of students to provide a part of their social security number (last four digits) on the participant survey. Requiring parents to report the last four digits of their social security number is viewed as an identity-theft security risk to some of the parents, thereby reducing the ability of the program to document results. Removing this requirement will increase survey response and improve the ability of the program to document program impacts.

11. A number of comments received from the teachers focused on the need to reexamine the program materials and potentially have them redesigned. This process evaluation excluded the assessment of the program materials to determine their appropriateness for each of the targeted grade levels. Duke should consider having a skilled grade-level-specific materials design expert examine the program materials to make sure that they are structured to match the ability of the teachers to present them effectively for each of the targeted grades and for the children within those grades. The assessment should focus on delivering educational content in a way that leads to increased actions (behaviors and measure installs) and the associated energy savings.

Teacher-Provided Recommendations for Duke Energy To Consider

In addition to the recommendations provided by the evaluation contactor, several teachers provided recommendations that can be considered by the program design professionals. TecMarket Works presents these recommendations from the interviewed teachers, but does not elevate these recommendations to be included with the recommendations from the evaluation contactor. The evaluation contractor recommendations are those that TecMarket Works suggest be implemented into the program (above). The teacher recommendations are provided without judgment as to their appropriateness for the K12 program. These including the following:

12. Arrange to have the timing of the program's field efforts to not coincide with the annual Ohio Achievement tests, as this was a challenge for some of the 4th grade teachers by making it difficult for them to fit the Get Energy Smart curriculum into their lesson plans.

13. Increase the level of direct communication between teachers, school administrators, the program administrator and Duke Energy in order to increase program support and teacher participation.

14. Consider adding a work booklet to the course materials for students to take home that would add focus to the energy saving behaviors that need to be implemented. This can also focus on kit measure use and emphasize the benefits to the family, the utility and the world.

15. Consider adding an online content component for students to access at home that would focus on increasing key behaviors and measure installations.

16. Consider developing a simple game for the students to play with their family that would reinforce the behaviors needed and encourage the installation of measures.

17. Include a magnet in the package that can be used to send a use or behavior message. "It never hurts to have a magnet in there."

18. Schedule a parents' night at the school for a Duke Energy presentation so that the parents and the school can work as a team with the program.

19. Include a component in which the students write a report of the use of the kit items and have the program incent the report to make it attractive to students and teachers.

20. Arrange to have the energy kits distributed earlier, more closely to the Christmas break to compensate for the need to focus on the Ohio Achievement tests in the spring.
21. Increase the level of educational and results-related program promotions (flyers, brochures, school examples, etc.) provided to the teachers and school administrators in time to be effectively used.

22. Have the program administrator and Duke Energy host a workshop for teachers on the program early in the contact phase. Include presentations hosted by Duke Energy.

23. Redesign the materials and activities to make them more teaching-friendly and student friendly by using larger size print and including more pictures.

24. Update the program materials to today's standards by adding a multi-media element such as a DVD video or online activity.

25. Develop and incorporate a day-to-day educational/activities planner to stretch the impact of the activities out over several days.

26. Add an incentive for teachers to make the effort worthwhile to the teachers who are responsible for success "because teachers like incentives, too"; the incentive can be cash for the class, class activities, or credits for class supplies or other incentives valued by teachers.

27. Redesign the web site to make it more user-friendly for students and teachers so that it can be integrated into the teaching environment.

28. Add a booklet to the course materials for students to take home to work with that would add focus to the behaviors that need to be implemented. This can also focus on measure use and emphasize the benefits to the family, the utility and the world.

29. Develop a song that students can sing in the class or at home that sends a behavior and use message. "My students respond well to little songs and ditties. We made our own little songs about how to save energy."

30. The materials need to be designed specifically for the children who are to be exposed to them. "The lines of type in some of the materials were too small. I had to re-type the sheets and split up the questions 1-4 on the front and 5-8 on the back" so that the children could better comprehend them.

31. Make the materials more attractive by using pictures and figures; "Clip art (with Mrs. Frizzle, etc.) is important" for this grade level.

32. Better incorporate the Magic School Bus into the curriculum and the focus of the program so that the message is clear and integrated; "I put the Magic School Bus together and there didn't seem to be a connection…having a book or story written specifically for it would be helpful."

33. Need to more effectively structure the program's focus and materials so that it integrates smoothly with the school curriculum that we must follow; "It has to go with the curriculum. I don't have time for experiments. Maybe have lessons that are coordinated with and support the state standards."

34. Develop a rainy day program video to use as a supplemental program tool; "A 20-minute assembly, or even a video sent out to the schools; we have plenty of rainy and snowy days."

Teacher Comments

The teachers also provided additional comments on the program and its operations. These comments are summarized below.

- "The materials were very eye-catching and got my interest right away."
- "The program materials were all put together and ready to go."
- "The lesson plan was just about right for our class."
- "We found we could tie the lessons in with several other subjects. We used math to calculate energy savings over a period of time and also talked about energy's relationship to natural resources in science class."
- "The packet of supplies was great. Children love being able to touch and hold things."
- "The Magic School Bus holds a high level of interest for children."
- "One of my favorite parts was passing the program materials out to the kids and seeing their faces light up. It was a really good thing for me to see."

Introduction

This report presents the findings for the evaluation of the Get Energy Smart Program. The Get Energy Smart Program provides energy efficiency informational and educational support and resources to 3rd and 4th grade teachers for them to incorporate into their lesson plans. The goal of the program is to use students as an information route to achieve cost effective savings in the homes of the children using the support and assistance of the parents.

The evaluation was comprised of interviews with 10 out of the 58 teachers that participated in the program last semester (spring 2009). The objective of the interviews was to determine program satisfaction, and to gather feedback on the curriculum and any suggested changes or improvements.

Methodology

This study consisted of reviews of program materials to understand the focus and scope of the program, process evaluation interviews with Duke Energy program managers, Scholastic program administrators and schoolteachers implementing the program. The interviews focused on methods of operation and implementation, experiences and perspective associated with program design, approaches and results, and levels of satisfaction with the program's materials, communications, and delivery components. The interviews with the teachers also assessed process issues including the ease of signing up for the program, the quality and completeness of the curriculum, the value of the energy recommendations provided and other subjects. The purpose of these examinations and interviews is to provide Duke Energy with an early feedback report assessing the program's operations early enough to be used to guide program design efforts for the second phase of the program's multi-state rollout.

Evaluation Findings

Program Design and Operations

Overall we have found this program to be very well designed, operated and managed. The Duke Program Manager is well informed and has an expert level of knowledge about the program and its operational environment. The Duke Program Manager is focused on the program and remains active in her search for ways to improve the program. Likewise, we found the Scholastic program manager to be well informed and have an expert level of knowledge about the program and its day-to-day activities. The design and operations of the program is impressive and reflects a level of dedication by both Duke Energy and Scholastic.

The interviewees were able to address all of the evaluation topics explored during the interviews, indicating not only an expert level of knowledge about their program, but demonstrating a history of focusing on the program, the operation of the program, and a high level of individual understanding of the objectives of the program. There is a concerted effort on the part of both of these key individuals to make this program a showcase for these types of programs.

The responsibility for overall program design and operation, as well as the overall responsibility for implementation, rests with the Duke Program Evaluation Manager. The Duke Manager is also responsible for program performance, tracking and reporting performance progress to the Duke Energy senior portfolio managers, contracting and contract management, and for the overall success of the program. The Duke Manager in conjunction with other Duke managers is also responsible for strategic program planning and integrating the program into the Duke energy efficiency program portfolio. The responsibility for the in-field day-to-day operations of the program rests with the Scholastic Program Manager. Scholastic is responsible for the successful implementation of the program and the acquisition of net cost effective energy savings obtained via the delivery of program services into the targeted schools and classrooms. The detailed implementation efforts at the school level rests with the Scholastic Program Manager who is supported by Scholastic's field management staff who, together with the Program Manager, works with the school administrators and teachers to implement the program. The development and delivery of educational materials and in-class approaches to achieve the energy saving objective is the responsibility of the Scholastic team. The responsibility for educational training, and therefore the acquisition of energy savings, ultimately rests in the relationship skills, teaching skills, management skills of the teachers who must bring the program to the key participants, who are the parents of the students that must make sure the actions that save energy are taken. The Duke Program Managers also support key field efforts via personal appearances during key presentations and discussions with Scholastic staff, school administrators and teachers. The larger school districts and schools that have an assigned Duke Energy Business Relations Manager will support the program's efforts to engage school administrators and senior management personal within the school system to help obtain and build support and participation. School districts and schools without an assigned Business Relations Manager will be approached by the Scholastic Manager and in several cases by the Duke Program Manager to gain participation and support.

This is an effective structure with responsibility for performance embedded in positions that can effectively implement the program in a way that the program's objectives can be accomplished.

TecMarket Works provides no recommendations for changes to this overall structure and approach. It is a well designed and effective integrated operational and management approach.

With the move toward programs that are viewed as generation assets the K-12 program has gone through some refinements in presentation and focus. According to the program manager, the program has been recreated to be more focused on delivering a curriculum that meets the educational objectives of the teachers and school administrators, but also meets the energy action objectives on which the program is now based. According to the interviews with both the Duke Energy and Scholastic managers, they have trimmed some of the "bells and whistles" that were more general education and activity-focused and realigned the curriculum to focus more on the things that can lead to energy savings. According to the interviewees, this has led to a win-win situation in that the education is still provided, but that real savings are coming from that education. TecMarket Works did not conduct an assessment of these approaches as part of this early feedback evaluation. As a result, we are unable to confirm that the new curriculum focuses on teaching those things that lead to household energy savings; however, a review of teacher comments presented later in this report suggests the teachers were very satisfied with the education materials provided and their ability to use them effectively. While there are several suggestions from teachers calling for change, these changes are more presentation, operational and coordination changes rather than subject matter changes. However, the focus of the teachers is not on achieving savings, but in providing an energy education. Likewise, the focus of the Scholastic program objectives is also on the educational aspects of the program rather than on the energy savings requirements. As a result, TecMarket Works is unable to provide an assessment determining if the program's materials and approaches are now more focused on energy savings and what students and parents can do in their homes. TMW does agree with the Duke Energy Program Manager that the program is in competition with a required curriculum and that the Duke message is not required. As a result, this program must prepare its materials and messages to satisfy the school administrators and the teachers who are responsible to an approved curriculum. As noted by the program manager, "we are up against mandated curriculums that are required, we are not required, so we are operating in competition with what is required." This statement accurately captures Duke's position within the educational field. Duke Energy must provide a program that causes actions to be taken, yet it must do that within an administrative environment that is focused on a broader energy education. If the program moves too far toward teaching only household energy savings actions, it will erode the support of the educational community. If the program moves toward a broader energy education, it will erode the net savings that can be achieved. The program design function must operate in this dual-purpose framework and balance the program's needs with the needs of the educational community and the state educational curriculum. The Duke Program Manager is keenly aware of this balancing act and the need to be successful within this dual-purpose framework.

Interviews with the Scholastic Program Manager indicate that they are very familiar with the state standards for curriculums and curriculum development and have developed the program materials to integrate into the state's educational curriculum. However, information from the teachers suggest that schools that have stricter curriculum requirements that tend to not permit deviation from the approved curriculum, or teachers with less flexibility on what they teach and how they teach report less success in integrating the program materials into their lesson plans.

Teachers with more flexibility in their lesson plans report more successful integration of the programs materials (see teacher survey results section of this report).

Ultimately, the success of this program rests on the ability of the Scholastic team, working with Duke Energy, to have teachers engaged with their students in a way that convinces parents to work with their children to implement energy saving actions in their homes. From this perspective, the program is not an educational program for children, but is a parent motivation program. The success of the program depends not on the educational ability of teachers to convey energy concepts and control actions to students, but on the ability to move the student-parents combination to action by motivating those students to act as the communications conduit to parents. The role of the energy education is essentially the approach for implementing a call-to-action to both the students and their parents while meeting the general energy education needs of the schools and teachers. This message needs to be conveyed to the Scholastic team and to the school administrators and teachers. While the message is there to a limited degree, it does not seem to be clearly articulated to the extent that this condition drives key program interaction and operational systems. At this time, educating students about energy concepts in general appears to be the single most important objective of the program beyond the Duke Energy offices.

Need for Communication of Program Objectives

The program has a number of objectives. These objectives reflect the overall mission of the energy efficiency portfolio as well as the educational efforts designed to achieve the measure installations, behavior changes and carbon reduction objectives. According to the Duke Program Manager, the program's objectives include:

1. Acquiring $4 million in earnings before taxes (EBT) via a cost recovery mechanism under which recovery is based on documented energy savings.
2. Delivering net energy savings via an educational program / approach via young children.
3. Acquiring non-energy benefits in the form of carbon reductions and avoided plant construction.
4. Acquire a positive impact on customer satisfaction rates within Dukes markets.
5. Influence and modify customer energy management behavior to be more energy efficient.

These objectives appear to be well-grounded within the regulatory objectives associated with Duke Energy's energy efficiency program portfolio. These objectives are to acquire cost effective energy resources for Duke Energy's service territory. According to the Program Manager, these are the right objectives because they merge the energy acquisition framework with the educational framework for acquiring the energy objectives. TecMarket Works agrees with this assessment. We recommend no changes to these program objectives.

However, we found a significant disconnect between the Duke Program Manager's program objectives and the objectives of the Scholastic Program Manager. Essentially the two managers are focused on different key objectives for the same program. According to Scholastic, the primary objectives of the program are:

1. To educate consumers about energy efficiency via a "children-as-ambassadors-to-the-family" approach.
2. Meeting program reporting criteria at a state level.
3. Achieve lifeline / lifestyle behaviors that save energy.

The Scholastic Program Manager had not heard that there was a power supply objective for the program and was unfamiliar with the EBT concept for specific levels of energy efficiency obtained through the program. The Program Manager has also not heard that there is a measure installation objective needed to acquire the energy savings. For the Scholastic part of the contracted service, the objectives appear to be more education-focused, reporting-focused, and lastly, behavior change-focused without a specific quantifiable or documented energy or installation-related objective.

This difference is not new to these types of programs and is often present in educational programs that find themselves operating within two different corporate missions associated with the organizations for which they are employed. Essentially, Duke Energy is a regulated utility that is responsible for cost effectively saving energy within a regulated structure defining cost effectiveness. As a result, Duke Energy is focused on the documented net energy saving objectives for the energy efficiency portfolio within which this program must operate. Within the regulatory paradigm the key metric is cost effective energy savings achieved via installed technologies or implemented behavior changes. This means that the program must provide, as its primary deliverable, actions that cause energy savings that are less expensive than what it costs to provide that energy via conventional means. That is, it is an alternative energy supply program that must operate with the cost caps associated with conventional supplies. Within this structure, all other objectives are secondary to this primary objective. Duke Energy's program objectives are consistent with this paradigm. This is also the focus of the Duke Program Manager and the reason for offering this program within the Duke portfolio. The Scholastic Program Manager operates from a different framework and is focused on the educational impacts of the program and the ability to integrate the program into established curriculums. As a result, the Scholastic Program Manager's primary objective is to educate participating children, and have that education carried to the parents via an ambassador approach. In this paradigm, the focus is on education transfer.

These paradigms are somewhat in conflict because in the eyes of the Scholastic Program Manager, educational transfer is the primary end objective of the program, diluting the focus from the primary regulatory objective of the program. This disjoint has led to a program that is not tailored to the need to obtain energy impact behavior change information from the participating students or their parents, preventing Duke from accurately monitoring program progress or effectiveness. The program is essentially structured to be an educational program that has the potential to produce savings, but documenting that potential or setting management, progress or financial benchmarks necessary to track savings are not placed at a level of importance necessary for an energy saving program. Within a regulatory environment, utility energy efficiency portfolio structures that focus resources on efforts that provide least-cost, cost effective energy supplies equitably across multiple market sectors, all programs should be established in a way that allows Duke to maintain an accurate understanding of the program's energy impacts. As a result, this program's operational environment and supportive tracking

mechanisms needs to be adjusted so that the focus of the program, particularly in the eyes of the people responsible for delivering on those objectives, is on obtaining installed actions and achieved behavior changes providing cost effective energy resources via an educational framework. At the same time the program should maintain an educational focus associated with meeting the educational objectives of the program administrators who approve the program, the teachers responsible for supporting and fielding the program, and the student's need for a high quality energy education.

We do not suggest that this is an easy objective. TecMarket Works understands that the more the program pushes the educational community toward obtaining installed actions or behavior changes, potentially the less support the program will enjoy from that community. The program must, after all, work within an educational community in which education is the primary objective. We do not suggest that the educational community will implement the program so that Duke Energy can accomplish its regulatory-focused EBT objectives. Such a concept would not be received well within the educational community. Nor do we suggest that the educational community will agree to produce specific levels of energy savings within the homes of their students. However, we do recommend that the program implementers understand that the program inclusion within the Duke Energy portfolio is dependent on acquiring net cost effective energy savings when compared to the program's cost. While educating children about energy in general and specify about how to become more energy efficient is an admirable objective, and is one supported by Duke Energy and the educational community, this objective falls short of being the program's primary objective. Thus there is a need to have not only Duke Energy focus on the primary program objective, but also have the program contractor also focus on that objective and established program designs and operational practices that place this objective as the primary objective, and incorporate program progress and monitoring systems that are both reliable and allow both Scholastic and Duke Energy to monitor monthly or quarterly progress toward that objective.

The program is not far from this objective now, and requires only a few modifications to move the installation and behavior change objective up to be the primary objective. However, we are not suggesting that this program adjustment is an easy one, or that it has yet to be explored by the Duke Program Manager. The Duke Program Manager is already keenly aware of the need for the program to be cost effective and provide new net energy resources within the Duke portfolio. However, interviews with the Scholastic Program Manager suggested a struggle with this objective and a need to compromise with schools and teachers so that the program has the appearance of supporting the educational objective more than the installation and behavior change objective. This is understandable in view of the different organization objectives between Duke Energy, Scholastic and the school districts targeted by the program.

However, in examining the program's operations, TecMarket Works found the single most important effort associated with the program's ability to track and document actions taken (the survey of actions taken by students and parents) and achieved savings to be one of the least important efforts for the schools and the teachers responsible for obtaining that information and delivering it to Duke Energy. As a result, Duke should restructure the program so that the delivery of the energy action information collected from students and parents is one of the key operational performance criteria on which receipt of the payments to the program administer is

based and is one of the key criteria on which incentives to schools and teachers is structured. This can be established as an operational reward for meeting the threshold rather than a penalty for non-performance. Duke should establish a minimum survey return rate for identifying behaviors and actions taken, and then set incentives to reward high-performance so that the higher the survey return rate achieved, the larger the program payments and incentive received. TecMarket Works suggests that the survey return goal be set at 80% of households to receive full incentive, with a 50 percent return rate for receipt of a survey return incentive.

These incentives should also be calibrated so that the program is cost effective, with higher payments conditional on energy implementation actions taken by impacted customers. Duke Energy should identify a set of survey response and behavior change and actions taken metrics and use these metrics as one of the key criteria for assessing the performance of the program and the delivery of that program by the program administrator. The success of the program rests on net energy savings acquired. The actions that are needed to deliver on this objective should be the key monthly or quarterly performance success indicator for both Duke Energy and Scholastic.

Successful Program Roll Out

From the program information reviewed by TecMarket Works, the interviews with the Duke Energy and Scholastic Managers, as well as the surveys with participating teachers, the program is being effectively organized, fielded and operated, and is well received by the schools and teachers. There appears to be a well-structured operational approach that has successfully rolled out the Ohio program in March of this year, and a program service delivery that has already begun to acquire energy savings. This is a significant accomplishment and reflects well on Duke Energy, Scholastic, and the ability of the service providers to design and launch services within an environment from which change in structured curriculums typically take substantial amounts of time to acquire. The elementary school educational system is one that is guided by standardized curriculums developed, reviewed and modified over the course of several years. Designing, embedding, and delivering services successfully within this environment in such a short period of time reflects well on all parties involved. The surveys with the teachers indicates that the program's materials were designed in a way that they could be integrated into the curriculum and into the teacher's individual approaches within their ability to tailor that approach. While several teachers noted that they would like to see changes in the materials and in the interactive approach (see teacher and TecMarket Works recommendations in this report) the program's materials and approach was successfully implemented. The focus of management's efforts can now turn to fine-tuning the program's operations, improving the interaction with teachers and schools, adjusting program materials to focus more on program objectives, developing end-result incentives and compensation structures and developing a progress tracking system that focuses on key metrics.

Targeting and Enrollment of Schools and School Districts

The program targets all schools within Duke's territory. The two targeting criteria are:

1. Location of the school(s) within Duke's Energy's service territory.
2. The school(s) has to have an account with Duke Energy.

However, Duke Energy and Scholastic have structured the outreach and enrollment efforts more strategically than these two criteria suggest. Early in the program development process, the schools and schools systems operating in Duke Energy's territory were prioritized, placing the largest districts and schools at the top of the list. The outreach and enrollment efforts then focused on the largest schools, many of which were large enough that they had assigned Business Relationship Managers. These Business Relationship Managers were effectively used to help gain access to school administrators who must approve of the program's integration within the grade-level curriculum associated with each school. As contact was established with the larger schools, successful enrollments began to be captured. The program then moves down the priority list, taking into account location and effective time-use considerations, and begins working to contact the rest of the schools. This allowed Scholastic and the Duke team to contact schools first targeting the size of the school but not bypassing smaller schools that were easily reached within this targeting approach. This is a good strategy and this process is continuing.

In addition to these efforts, Scholastic provides direct mail pieces to the teachers within the district presenting the program and the program materials. TecMarket Works does not recommend mass marketing approaches aimed at convincing schools to come to the program for voluntary enrollment. However, the use of limited mass marketing might be effective at making parents, teachers and school administrators aware of the program and to help establish a market pull component in addition to the current market push initiates currently used. Mass marketing is expensive; however, radio and TV stations have a public service obligation that makes it possible for short spots to be developed inexpensively. Radio and TV stations also air public interest stories and conversations when they think there is some level of interest for that information. In addition, newspapers, especially local newspapers, often desire local stories to add to their papers. With the keen public interest on climate change and carbon reduction, and public interest in controlling utility costs and plant construction, it may be possible to inexpensively provide a coordinated set of mass market efforts that can be used as market pull strategies that work in conjunction with the program's direct personal contact with the schools and targeted follow-up communications and relying only on the teachers to reach the students and their parents.

Under a well-structured program design that is supported by the schools and teachers, the students themselves can be effective at reaching their parents to inform them about the program. The use of mass media, to the extent possible within program resources, can amplify the student-parent efforts and act as market pull initiatives to pre-dispose school administrators and teachers to the program prior to program contact. The program must be effective at reaching parents and gaining their support and participation for the program to be cost effective from an energy savings perspective. However, the design of the program must engage the child-parent relationship in a way that makes energy efficiency communications and behavior change possible. The examination of the program materials and communication strategies and systems is beyond the scope of this evaluation. However, TecMarket Works encourages Duke Energy and Scholastic to make sure that the communications systems between the teacher, the student and the parent are expertly incorporated into the materials, presentations and operations of the program. The program's strategy to reach 70,000 households via the teacher-student-parent relationship is aggressive. However, according to the Duke Program Manager, this objective is based on the need for a specific level of energy savings needed to support the program's costs. TecMarket Works makes no specific recommendations for these teacher-student-parent

communication strategies at this time. However, TecMarket Works finds that the targeting approach used to prioritize and contact schools and school districts to be an effective approach. TecMarket Works provides no recommendations for changes to this approach. Further, TecMarket Works agrees with the expressed opinion of the Duke Program Manager that the ability of the program to rapidly and effectively reach key school and school system decision makers and gain their support is critical to the success of the program. The targeting approach used by Duke Energy and Scholastic is structured to maximize that contact.

Duke Energy has set a goal of gaining program participation from at least 50 percent of the schools in their service territory within the programs initial offerings. In view of the need to independently and sequentially convince each district and school to participate, and incorporate the program's messages within the teaching schedule, this is an aggressive goal. The evaluation did not include assessing the pace of the enrollment process or the number of homes included in current efforts or homes capable of moving through the participation pipeline during the initial offering. However, Duke Energy is monitoring progress toward this objective.

Defining and Tracking Success

As noted earlier in this report, the program's goal is to gain participation from 50 percent of the schools, reaching 70,000 homes during the initial offering. Also, as noted earlier, there is a lack of an approach for tracking actions taken or behaviors modified as a result of the program. These are the most important outcomes of the program that lead to energy savings, but these issues are covered in other sections of this report and do not need to be repeated here. However, TecMarket Works suggests that the most important indicator of success must not be the percent of schools reached or the number of households represented, but the amount of energy projected to be saved as a result of the actions and behavior caused by the program. TecMarket Works recommends establishing a per student energy savings objective based on the anticipated actions taken and behaviors influenced by the program, and set monthly or quarterly ex post energy saving objectives and plot program performance against those objectives. The primary method of tracking progress can be the surveys of actions taken provided by the students and parents. These data can be entered into a progress-tracking database so that ongoing energy impact performance can be monitored.

In tracking progress, it is not necessary to adjust saving projections based on the address of the impacted household. While some student's homes may not have a Duke Energy Account and attend a school that does, the savings from these homes should not be subtracted from the projected savings achieved by the Duke program. In the opinion of TecMarket Works, these savings should be fully credited to the Duke Energy Program. The reasons for this recommendation is that as the state moves toward a more comprehensive energy efficiency framework, covering all parts of the state, the spillover savings that are observed in a Non-Duke Energy territory home will be offset by savings caused by other programmatic efforts outside of Duke Energy's territory that do spillover into Duke's territory. The net difference as a result of these adjustments will be minimal, yet the efforts needed to track each student's address to adjust savings based on the position of that address within Duke's territory will increase both program costs and evaluation costs with little net savings impacts to justify these expenses. TecMarket Works recommends that savings from the program be tracked as a function of participant's actions rather than the address of the participating student's home.

Teacher Training Support

The program has developed a multi-step teacher-training program to help assure that the program materials are well understood and that the program is effectively presented. This training approach includes:

1. Presentations and discussions by Scholastic personnel, a training kit sent to each teacher with training materials and presentation information, coupled with a website that presents the program and describes what it does and how it works.
2. A teacher workshop that goes over and discusses all materials and approaches.
3. In-school presentations during which live demonstrations of the materials are presented and discussed.
4. Program customer service support line that teachers can call to obtain added support and information for specific issues.

In addition to these training services, the Scholastic team maintains e-message boards and e-mail support to the teachers and attends many of the teachers meetings and school meetings in which the programs is discussed. Scholastic also makes their four program coordinators available to the teachers and the schools to address any issues or questions that arise across the implementation process. These coordinators report their actions and contacts to the Scholastic Program Manager each week.

From the perspective of the Duke Energy and Scholastic program managers, these tools work well and meet the majority of training needs. Scholastic is responsible for the development of the training and training materials and coordinates with the Duke call center to help Duke train the call center staff so that they can address issues that are bought to the call center. If the call center cannot address an issue, they refer the caller to the program manager for assistance. This training seems to function well with teachers reporting that they appreciate the training and assistance provided.

Monthly Budgeting and Reporting Requirements

One of the programmatic conditions identified during the process evaluation was the number of budgets under which the program operates. According to the results of the management interviews, the program is operating under multiple sets of operational and reporting budgets that must be tracked and updated each month. It appears that the program operates under 10 different budgets across the Duke territories. Questions to the Scholastic Program Manager confirmed that they have two budgets per year for each state, totaling 10 operational budgets that must be tracked and updated each month. TecMarket Works inquired into the amount of management time that was spent tracking the 10 different budgets each month. The manager was not sure of the total amount of time spent tracking the 10 budgets, but did indicate that a significant amount of program resources are spent tracking the 10 monthly budgets and reporting line item expenditures and changes to those budgets. TecMarket Works did not examine these budgets or assess the need for the maintenance of 10 different budgets each month and is not in a position to determine the need for or adequacy of these processes within an early feedback process evaluation. However, TecMarket Works recommends that Duke Energy review their budgeting, budget tracking, and reporting requirements to see if the process can be streamlined without impacting management monitoring, cost control, or oversight responsibilities. The regulatory

process often requires a state-specific, program-specific monthly accounting and reporting effort, and utility companies have an obligation to provide adequate oversight for their programs. These conditions set the requirements for monthly expenditure tracking and progress reporting. However, we agree that the process needs to be as streamlined as much as possible while meeting the regulatory and management requirements of energy efficiency programs.

Results from the Interviews with the Teachers

The Interviewed Teachers

Ten grade school teachers were interviewed about their experience with and use of the Get Energy Smart program. Six of the teachers identified themselves as science teachers, and all ten teach elementary school children in grades 1-5 and utilized the Get Energy Smart curriculum.

Program Objectives

All ten teachers surveyed agreed with and supported the program's objectives. However, none of the teachers interviewed were presented with the program objective of cost-effective energy savings; or if they were, they did not fully understand these objectives well. Every teacher surveyed identified the objectives of the program as teaching children to conserve energy and resources, and six of the teachers identified the program's lessons as going further than the student and informing the students' parents about energy-saving opportunities. Five of the teachers (half) indicated that the objective was to get students and parents to use the energy efficiency actions. This is probably the closest to the actual goal of the program, but still misses the primary program goal – cost effective net energy savings. The objectives of the program and the reason the program is funded by Duke Energy is first and foremost to cost effectively reduce energy consumption in the homes of the students. This goal is to be reached via the educational components of the program. All interviewed teachers expressed an opinion that the goals of the program were educational rather than achieving cost effective energy resources. It is good that the teachers understand the importance of reaching the goals via the educational process, but the education is the route by which the program's goal is to be reached. The program needs to focus on making sure the schoolteachers and administrators understand that the objective is energy savings, while the tool to allow this to occur is through the educational process. The program needs to be sensitive to the objectives of the teachers and focus on the education aspects of the program and not necessarily the program goal of energy savings. However, the teacher should clearly understand that the success of the program and its continued operations is based not on the educational accomplishments of the program, but on the educational processes' ability to produce cost effective savings.

Program Timing

Teachers who have a more flexible curriculum and greater autonomy in their classroom found the program to be useful within their established curriculum, however, those without a flexible curriculum found the Get Energy Smart Program difficult to integrate into the state's certified curriculum. In addition, the timing of the program near the Ohio Achievement tests was a challenge for some teachers.

Definition of Success

Half (5) of the teachers defined success in the program as having students become aware of energy-saving strategies in their home, and four teachers said that having students actually use those strategies in real life would define success. One teacher defined success as having the families of her class fill out the form and return them to Duke Energy. Nine out of ten teachers said they thought the school administration would view success in the same way as they did as teachers. One teacher said that the school administration would have a different definition of success than the teachers. In that case, the teacher's definition was based on real world use while

the administration's definition would be based on test results. None of the teachers or administrators interviewed identified the production of net cost effective energy savings as a program goal.

Communication Between Teachers and Parents

Most communication between teachers and parents was achieved through the students. Teachers who collected the completed surveys from students reported a high rate of participation from the parents in filling out the survey. Three teachers offered an incentive such as candy or gum to students to return the completed surveys. One suggestion from a teacher who did not collect completed surveys was for Duke to include envelopes or even stamps with the energy survey so that the families could easily return them at no cost.

Communication Between Teachers and School Administration

Six of the ten teachers reported that they had no or very little interaction with the program's administrator. One teacher received the program materials from the program's administrative manager, and three others attended a presentation at the school provided by the program administrator. Only one teacher that had received the program materials directly from the program administrator reported that they had had some level of discussions about the program and the program's goals and procedures with the program administrator. There is a need to increase the level of interaction between the program's administrator and the teachers responsible for program delivery so that the goals of the program can be shared with the teachers and to obtain stronger support for those goals.

Communication Between Teachers and Duke Energy

Communication between Duke Energy and the teachers was minimal. Three teachers attended program presentations at their school in which Duke representatives were in attendance. However, none of the others had any contact with Duke Energy staff prior to or during the program. All ten of the teachers indicated that the program's objectives and activities were easily understood from the materials provided and no extra training was needed, however, as noted earlier, this exchange was not effective at communicating the program's primary goal to the teachers. Several teachers indicated that more communication from Duke Energy may increase teacher participation levels. However, it is not clear that presentations by Duke staff will have an effect on teacher support or participation, or be more effective at causing teachers to better understand the program's goals. What is clear is that there is a need to better communicate the programs goals to the teachers so that the goal may be more effectively focused on by the teachers, and this may be effectively accomplished via the program administrator who is most in contact with the school administrators and teachers.

Participation Levels from Teachers

The interviewed teachers had several suggestions to increase the participation levels. Three teachers said that *"a box just showed up at my room,"* indicating that they were expected to assess the package materials, buy into and support the program's objectives, and effectively implement the educational efforts designed to achieve the net energy resource goal. This is probably asking too much from a teacher already pressed by an inflexible curriculum and may be too much to ask of teachers in general. Two of those teachers also noted that they saw several unused program boxes at their schools and were unsure of their function or purpose. More direct

communication with teachers beforehand from the program administrator or the Duke Energy program manager with the school administrators and teachers was the most commonly cited suggestion from the interviewed teachers for ideas that would increase participation. The amount of time available to the teachers for the program's educational message was cited three times as an impediment to teacher participation. These teachers reported that they could not fit the curriculum into their lesson plans because of the Ohio Achievement tests (for 4th graders) competed for the same time block. Other teachers reported that the program's curriculum came to them too late in the year to be effectively integrated into the class schedule. Other suggestions provided by the teachers included:

- Integrating the program more closely with the state's educational standards.
- Arrange to have the energy kits distributed earlier, more closely to the Christmas break to compensate for the need to focus on the Ohio Achievement tests in the spring.
- Increase the level of educational and results-related program promotions (flyers, brochures, school examples, etc.) provided to the teachers and school administrators in time to be effectively used.
- Have the program administrator and Duke Energy host a workshop for teachers on the program early in the contact phase. Include presentations hosted by Duke Energy.
- Redesign the materials and activities to make them more teaching-friendly and student friendly by using larger size print and including more pictures.
- Update the program materials to today's standards by adding a multi-media element such as a DVD video or online activity.
- Develop and incorporate a day-to-day educational/activities planner to stretch the impact of the activities out over several days
- Add an incentive for teachers to make the effort worthwhile to the teachers who are responsible for success "because teachers like incentives, too"; the incentive can be cash for the class, class activities, or credits for class supplies or other incentives valued by teachers
- Redesign the website to make it more user-friendly for students and teachers.

Participation from Families

Teachers were asked about ways to improve energy-saving behaviors in the student's homes as well as increase the installation and use rate of measures in the kits. One teacher noted that several of her students' families were alienated by the program's operations by being asked to include their social security number and Duke customer number on their survey. According to this teacher, this requirement substantially limits the number surveys that can be returned. Inclusion of this data on the survey essentially converts the survey from being a program feedback tool, to a financial risk and privacy invasion activity for some of the families being asked to complete them.

One 5th grade teacher reported that she had students who filled out the survey only to receive a letter from the program indicating that they did not qualify for the kit. This was disheartening for the both the teacher and the students who were selectively excluded from the program.

Four of the ten teachers surveyed were at schools that had received presentations from the Duke Energy representative. All four reported that they were pleased with the added dimension the

presentation provided to the program and the enthusiasm it generated for the students. One teacher noted that many of her students showed up for an optional day of school solely to see presenter Michelle White for a second time. While this indicates a strong demand for the presentation, it also suggests that the presentation may not have been scheduled at the best time for the students who did not have to attend the optional day.

During the interview, teachers were asked for their ideas that would lead to increased savings through higher measure installation levels and increased application of energy efficient behaviors. The teachers provided the following suggestions:

- Add a booklet to the course materials for students to take home to work with that would add focus to the behaviors that need to be implemented. This can also focus on measure use and emphasize the benefits to the family, the utility and the world.
- Add an online content component for students to access at home that would focus on increasing key behaviors and measure installations.
- Develop a simple game for the students to play with their family that would reinforce the behaviors needed and the installation of measures.
- Develop a song that students can sing in the class or at home that sends a behavior and use message. "My students respond well to little songs and ditties. We made our own little songs about how to save energy."
- Include a magnet in the package that can be used to send a use or behavior message. "It never hurts to have a magnet in there."
- Schedule a parents' night at the school for a Duke Energy presentation so that the parents and the school can work as a team with the program.
- Include a component in which the students write a report of the use of the kit items and have the program incent the report to make it attractive to students and teachers.

What Works Well

All ten interviewed teachers said that they enjoyed the program and considered it to be successful. Teachers were asked what worked well about the program and what attracted them to it. The most common response was the inclusion of the CFL and other materials for the students to see.

Responses also included:

- "The program materials were very eye-catching and got my interest right away."
- "The programs materials were all put together and ready to go."
- "The lesson plan was just about the right length and ability-level for our class."
- "We found we could tie the lessons in with several subjects. We used math to calculate energy savings over a period of time and also talked about energy's relationship to natural resources in science class."
- "The packet of materials was great. Children love being able to touch and hold things."
- "The lessons were brought down to the right level for my class, and "The Magic School Bus" holds a high level of interest for children."
- "One of my favorite parts was passing the program materials out to the kids and seeing their faces light up. It was a really good thing for me to see."

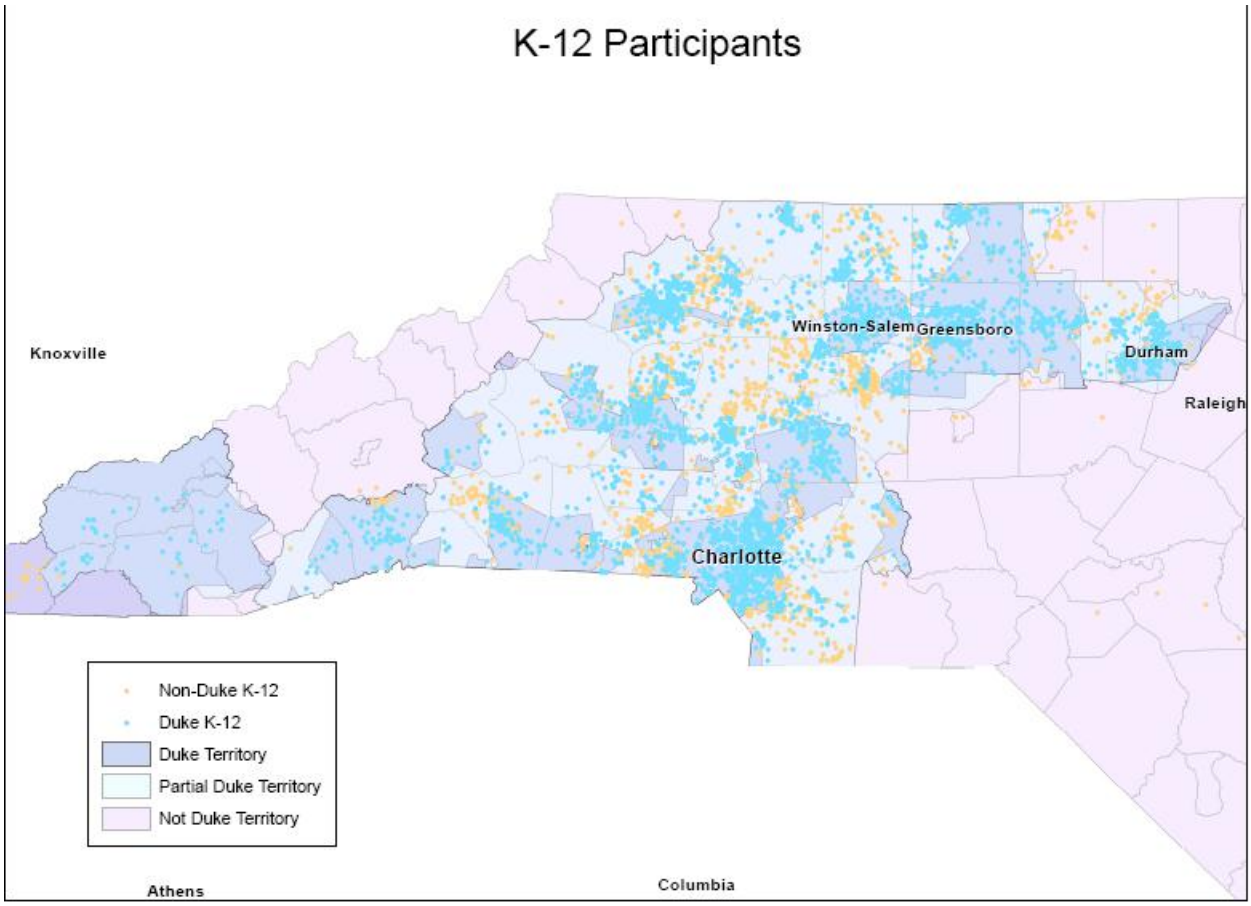
Areas for Potential Improvements

Most responses for improving the program dealt with the design and layout of the activity sheets, adding more multimedia, and associating the lessons more directly with "The Magic School Bus" and the state standards. Three teachers indicated that adding a video component would be a way to improve the curriculum.

Responses included:

- The materials need to be designed specifically for the children who are to be exposed to them. "The lines of type in some of the materials are too small.
- Make the materials more attractive by using pictures and figures
- Bring out the integration between the Magic School Bus story and the curriculum's focus and the program's objectives so that they directly support each other.
- Need to more effectively structure the program's focus and materials so that it integrates smoothly with the school curriculum that we must follow.
- Develop a 20-minute rainy day program video to use as a supplemental program tool.

Appendix H: Boundary File with Schools



Appendix I: DSMore Table

SAE:

Per Measure Impacts Summary for K-12 Carolinas

Impacts ⇨ / Technology ⇩	Product code	State	EM&V gross savings (kWh/unit)	EM&V gross kW (customer peak/unit)	EM&V gross kW (coincident peak/unit)	Unit of measure	Combined spillover less freeridership adjustment	EM&V net savings (kWh/unit)	EM&V net kW (customer peak/unit)	EM&V net kW (coincident peak/unit)	EM&V load shape (yes/no)	EUL (whole number)
CFLs		Carolinas	59.5	0.0445	0.0044	lamp	17.67%	49.0	0.0366	0.0037	no	5
Low-Flow Showerheads		Carolinas	127.2	0.0349	0.0140	head	17.67%	104.7	0.0287	0.0115	no	10
Faucet Aerators		Carolinas	14.0	0.0004	0.0002	aerator	17.67%	11.6	0.0003	0.0001	no	10
Outlet/Switch Gaskets		Carolinas	2.4	0.0009	0.0009	gasket	17.67%	2.0	0.0008	0.0008	no	20
Water Temperature Card		Carolinas	45.9	0.0052	0.0052	card	17.67%	37.8	0.0043	0.0043	no	3
Night Light		Carolinas	0.016	0.0000	0.0000	light	17.67%	0.013	0.0000	0.0000	no	16
Program wide			**249**	**0.0859**	**0.0247**			**205**	**0.0707**	**0.0203**		**8**

Process and Energy Impact Evaluation of the Power Manager® Program in North and South Carolina

Final Report

Prepared for
Duke Energy

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Summary of Findings

Customer Satisfaction

- Satisfaction with the Power Manager program is high with over 70 percent of the survey respondents rating their satisfaction at a 9 or 10 on a 10-point scale for all program aspects: Overall program, program enrollment, and program information.

Motivating Factors

- More than half (61.8%) of the surveyed North Carolina participants were able to recall any benefits promoted by the program. In South Carolina, 53.5% were able to recall at least one benefit promoted by the program. The surveyed participants that did recall program benefits were able to provide 63 benefits that they recalled being promoted by the program. Of the 63 benefits recalled by these participants, 75% of them mentioned money either by recalling the bill credits or financial incentives for participating in the Power Manager program.

- Most participants rate environmental issues as important or very important to them. However, a small number of them (about 7%) are a member of an organization with an environmental mission.

- More than half of the participants in both states do not know when control events occur, or even notice the bill credits on their bill. However, the bill credits are the most commonly cited reason for their participation in the program.

Recommendations

- **Process Recommendation**: Bring on additional staff to help answer phone calls and email during events, and to assist with the administrative needs. Although the interviewees state that Duke Energy's management is aware of the need for more staffing, it is worth emphasizing this need. Demand response programs usually only a have a few opportunities each year in which they are visible to the customer and it is critical to ensure that program operations run efficiently in the eyes of the participant during those times, and that all customer concerns during events are addressed promptly. While the Power Manager® team has succeeded with their existing staffing, interviewees express concern that their ability to respond to customer concerns during events may affect their ability to provide technical oversight of the event once it's initiated.

- **Process Recommendation:** Events may be called for economic or emergency reasons. In the Carolinas, the Duke Energy's System Operations Group

determines emergency situations. Duke Energy's RED determines when economic events are called. Economic events are to prevent the market's energy cost fluctuations from negatively affecting customers. In program planning, continue to balance the number of economic events with the possibility of emergency events. Duke Energy also needs to carefully balance customer satisfaction with both emergency and economic events. Where emergency events increase, customer dissatisfaction needs to be mitigated through increased communication, and possible media coverage.

- **Process Recommendation**: Consider leapfrogging the Cannon switch technology in favor of a switch that allows two-way communication, or one that can be integrated with a Smart Grid. Switch upgrades are underway and will be completed in two or more years, but Duke Energy program staff is aware that in that time, the upgraded switches themselves may be outdated as state-of-the-art developments continue to occur with equipment or Smart Grid infrastructure. Duke Energy staff has expressed a need for two-way communications in order to achieve effective program management and savings acquisition.

- **Impact Recommendation**: A potential alternative approach for future impact evaluations is to use the data from the M&V and the operability sample to directly estimate impacts via statistical models. This data can be used to develop a statistical model that estimates the actual load impacts during previous events as well as the providing and estimated of peak weather impacts. In spirit, this approach is similar to the duty cycle approach, but the impact estimates are obtained directly from observed data, rather than simulated from data on non-event days.

Introduction

This document presents the evaluation report for Duke Energy's Power Manager® Program as it was administered in North and South Carolina.

The evaluation was conducted by TecMarket Works with assistance from Integral Analytics and Yinsight. The survey instruments were developed by TecMarket Works. The survey was administered by TecMarket Works. Integral Analytics reviewed the energy impact estimates conducted by Duke Energy. Yinsight (a TecMarket Works subcontractor) conducted the in-depth interviews with program management.

Methodology

This section presents the approach for conducting this assessment.

Participant Surveys

TecMarket Works developed a customer survey for the Power Manager® Program participants, which was implemented in November 2010 after they experienced control events over the summer of 2010.

TecMarket Works conducted telephone surveys with 106 randomly selected program participants in the states of North Carolina (n=76) and South Carolina (n=30). The survey instrument can be found in Appendix B: Participant Survey Instrument.

Program Impact Estimation

The impact evaluation for the Power Manager program was conducted by Duke Energy Staff working with and reviewed by Integral Analytics staff. The impact evaluation developed an AC duty cycle model based on information from a sample of Power Manager participants in Ohio, the Carolinas, and Kentucky. This duty cycle was then used to simulate the connect load during the Power Manager® event days under peak normal weather conditions for different PM program options and load control technologies to produce estimates of the potential load reduction. These estimates were then de-rated by the results of the 2010 operability study to give estimates of the realized load reductions. Table 1 below summarizes the resulting estimated actual and the peak normal weather load impacts at the switch level for customers in the Carolinas.

Table 1. North and South Carolina Load Impacts

Control Strategy	2010 Impacts	Peak Normal Weather Impacts
Target Cycle (TC) 1.3	1.18	1.10
Fixed Cycle (FC) 67%	1.41	0.56

This general approach is well established in the industry and the actual analysis was very thorough and well thought out. There is little reason to doubt that the resulting impact estimates are reasonable and accurate. A potential alternative approach for future impact evaluations is to use the data from the M&Vand the operability sample to directly estimate impacts via statistical models. This approach could use a time-series, cross-sectional analysis where the dependent variable is the actual AC load (or run time), and the independent variables include weather conditions, time of day, day of week, and the Power Manager® control event. In essence, this would produce an overall duty-cycle model, and the coefficient on the Power Manager® control event variable(s) would estimate the actual load impacts during those events.

Section 1: Impact Analysis

M&V Samples

The Duke Energy Staff included participant samples from their Southeast and Midwest states in the analysis for the 2010 Power Manager® (PM) program. The 2010 PM M&V sample in the Midwest consists of 129 households with 143 air-conditioner (AC) units. This includes 42 households from Ohio, 18 households from Kentucky, and 69 households from Indiana, closely reflecting the relative numbers of PM participants in each state in February, 2010. The 2010 Midwest M&V sample has 27 new households randomly selected from the PM population in February, 2010, and 102 holdovers from the 2009 M&V sample that were randomly selected in either 2008 or 2009.

The PM M&V sample in the Southeast consists of 122 households with 153 air-conditioner (AC) units. This includes 88 households from North Carolina and 34 households from South Carolina, closely reflecting the relative numbers of households with Cannon or Comverge load control devices. Households with PLC load control devices were not included in the PM target population since they did not participate in PM cycling events. There are 31 holdovers from the 2009 M&V sample which was only in South Carolina. The 91 new households in the 2010 M&V sample were randomly selected from the group of North and South Carolina load research customers with PM load control devices.

PM M&V samples are stratified into high and low groups according to premise monthly kWh usage from the previous summer. The Dalenius-Hodges technique for selecting strata boundaries and the Neyman method for optimum sample allocation were employed to achieve reduced sample variance of load reduction estimates. Stratification analysis was performed separately for the Midwest and Southeast PM populations. The resulting stratification of PM M&V samples is shown in Table 2.

Table 2. M&V Sample Stratification

	Midwest		Southeast	
	High	Low	High	Low
Sample allocation	63	66	61	61
Population weight	33.3%	66.7%	35.4%	64.6%

M&V Data Collection

Hourly run-time of AC units in the M&V samples was collected during 2010 summer months (May through September). This was accomplished with Cannon load control devices, which record hourly run-time (in minutes) of the AC unit to which they are attached. At households selected for the M&V sample, any older load control device was replaced by a Cannon load control device for this purpose. The purpose of this study is to determine the load reduction achieved when the load control device functions as expected, so this device replacement does not introduce bias into our results. Completely separate operability studies are conducted to determine deviation from expected

performance (the de-rating factor) for each load control technology. Two rounds of data collection from M&V Cannon devices were conducted in July and October. In addition to hourly run-time, the Cannon device scan data includes hourly shed minutes and the contents of many device registers. Information about the AC unit is also recorded, including amp ratings (RLA and FLA).

Households in the M&V samples were equipped with load research interval meters, and 15-minute premise interval usage (kWh) was collected for 2010 summer months. Households in the M&V samples were requested to complete a brief survey on characteristics related to AC usage and overall premise energy consumption; 75% in the Midwest and 69% in the Southeast completed the surveys.

Validation of AC Duty Cycle Data

Hourly AC run-time collected from Cannon M&V devices is compared to corresponding premise interval kWh to verify that it accurately reflects operation of the attached AC unit. The validation process is accomplished through a sequence of computer programs that: 1) convert the hourly A/C run-time data into hourly duty cycle; 2) display time series plots of premise kWh and duty cycle with control over time resolution enabling visual comparison of plot detail; 3) calculate cross-correlation between hourly kWh and hourly duty cycle and display cross-plots of kWh vs. duty cycle. Each run-time data file collected for an AC in the 2010 M&V sample is reviewed in this fashion, and the AC duty cycle is added to the model database when hourly premise kWh provides adequate confirmation.

For 5 AC in the Midwest sample and 5 AC in the Southeast sample, Duke Energy could not obtain the 2010 data needed to apply validation procedures. Reasons for this include customers leaving the PM program (3), no interval KWH (3), unable to retrieve scan data (3), and Cannon device not installed (1). In the validation process, run-time data was rejected for 11 AC in the Midwest sample and 9 AC in the Southeast sample. These cases appear to be due to sensitivity issues, where the AC is reported to have no run-time or to be always running. The remaining sample is statistically significant and provides better insight into AC usage profiles. Overall, 2010 hourly duty cycle data was added to the model database for 127 AC from the Midwest sample, and 134 AC from the Southeast sample. Table 3 summarizes the 2010 M&V sample.

Table 3. M&V Sample

	Midwest			Southeast	
	Ohio	Indiana	Kentucky	North Carolina	South Carolina
Households	42	69	18	88	34
Total AC Units	143			153	
Missing data	5			5	
Invalid Data	11			9	
Final AC Sample	127			139	
Duty Cycle Models (see below)	125			115	

AC Duty Cycle Models

Impact estimates during PM load control periods are based upon models developed for the natural duty cycle of M&VAC units. These models are developed from 2010 duty cycle data described above, and similar duty cycle data from the two prior summers (2008, 2009) for AC units that are holdovers from previous M&V samples. Weekends and holidays are not used in the models, and hours during load control and for the remainder of the day are not used. Duke Energy's staff was able to develop duty cycle models for AC units at 125 households in the Midwest M&V sample, and for AC units at 115 households in the Southeast M&V sample. These are the relevant sample sizes for our load impact results.

Natural duty cycle models are specified and estimated individually for M&V AC units to better capture the unique dependence of duty cycle on temperature and humidity characteristic of each AC unit. A limited dependent variable model specification is adopted for hourly duty cycle, the independent variable in the models. Candidate specifications for dependent variables in the models include temperature averaged over the prior 2-hour, 4-hour, and 6-hour intervals, and a weighted temperature average with declining weights over the previous six hours. Candidate specifications also include similar sets of averages based on temperature-humidity index (THI) and heat index (16-element polynomial). Models are estimated with the SAS procedure QLIM. The dependent variable specification selected for an AC unit is based on fit diagnostics from hourly model fits over the typical load control hours, 2:00–6:00 PM. For the selected model, distinct parameters are estimated in each hour of interest, resulting in a set of hourly natural duty cycle fits for each M&V AC. Model specifications selected for M&V AC units and associated t-values for typical load control hours are listed in Appendix C: Duty Cycle Models for M&V Units.

PM Load Control Strategies

The PM program employs two generic types of load control devices which require somewhat different treatment for load impact evaluation. The newer switch type - Cannon LCR 4700 in OH, KY, NC, and SC, and Cannon LCR 5200 in IN - operates with an adaptive control strategy called Target Cycle. For each hour of load control, the Target Cycle switch calculates a unique shed time (or percentage) based on characteristics of the attached AC unit. The older switch type – CSE in IN and KY and Comverge in NC and SC - uses traditional fixed cycling control, where all devices on the same program shed the same amount of time during the control period. In the Midwest, the principal PM program options are 1.5 kW and 1.0 kW, and Target Cycle switches are configured with these load reduction targets. Fixed cycling devices in the Midwest limit the AC run time to 7.5 minutes (1.5 kW) or 15 minutes (1.0 kW) of each 30-minute control period. Equivalently, PM CSE devices in the Midwest are operated with fixed cycling percentages of 75% (FC 75%) for 1.5 kW, or 50% (FC 50%) for 1.0 kW. Different program options are not offered in the Southeast. Cannon devices in NC and SC are configured with a load reduction target of 1.3 kW (TC 1.3), and Comverge fixed cycling devices limit the AC run-time to 5 minutes of each 15-minute control period. Equivalently, PM Comverge devices in the Southeast are operated with a fixed cycling

percentage of 67% (FC 67%). Table 4 summarizes PM load control technology and strategy used in different states.

Table 4. PM Load Control Devices and Strategies

Device		Strategy				
	Period	OH		IN / KY		NC / SC
	(min)	1.5 kW	1.0 kW	1.5 kW	1.0 kW	
Cannon	30	TC 1.5	TC 1.0	TC 1.5	TC 1.0	TC 1.3
CSE	30			FC 75%	FC 50%	
Comverge	15					FC 67%

Target cycle control puts more functionality in the switch itself. Rated amps of the attached AC unit is entered into the switch at installation, and used to determine connected load for the unit. The switch also records hourly duty cycle of attached AC unit and builds a profile (historical profile) of the expected hourly duty cycle under weather conditions typical for load control. The historical profile can be scaled (globally) by adjusters included in the commands sent to switches for load control. The connected load and adjusted historical profile are used to calculate hourly cycling percentages for the attached AC unit expected to achieve the appropriate load reduction target (1.5 kW, 1.3 kW or 1.0 kW).

Factors that determine Target Cycle shed percentages for M&V AC units during 2010 control periods are known, except for contents of the historical profile registers on those days. Values in these registers started the season at 100%, and were updated frequently by storing run-time for days with weather conditions similar to a load control day. Historical profiles are available in the scan data collected from M&V devices in July and October. Historical profiles on 2010 control days are determined from the profiles obtained in these data collections, adjusted to reflect the stored days (if any) between the data collection and the control day.

AC Connected Load

Connected load is the average power demand (kW) of a running AC unit over a full cycle. It determines the load reduction (kWh) achieved when AC run time is reduced. Connected load is specified for M&V AC units through the basic engineering formulas,

*Apparent Power (kVA) = (Compressor Amps + Fan Amps) * 230 Volts / 1000*

*Connected Load (kW) = Power Factor * Apparent Power*

Rated amps for the compressor (FLA) and fan (RLA) are typically listed on the AC faceplate.

Power factor in this formula is actually different for different AC units, and even varies somewhat for different cycles of the same unit, increasing at high temperature and humidity. Duke Energy analyzed synchronous AC run time and premise interval kWh collected for the M&V samples to determine an appropriate overall power factor within

each sample. Results are 0.82 for the Midwest M&V sample, and 0.81 for the Southeast M&V sample. These power factor values are used to calculate connected loads for impact evaluation. The connected loads determined for M&V AC units are given in Appendix D: Connected Loads for M&V Units.

Simulation Method for PM Impact Evaluation

Simulation with M&V natural duty cycle models is used to determine average load reduction per household within high and low M&V strata during each hour of load control and for each PM cycling strategy. These strata results are combined with the population weights given in Table 2 to estimate average load reduction per household in the PM population (Midwest or Southeast). The potential load impacts estimated in this manner represent the load reduction which would be achieved if all switches controlled as expected. Impact results for PM load control in the Midwest are obtained by simulation with the Midwest M&V sample, and impact results for the PM load control in the Southeast are obtained by simulation with the Southeast M&V sample.

The simulation procedure is very similar for the two basic PM control strategies, Target Cycle and fixed cycling. In a fixed cycling simulation, the same specified shed percentage is applied to all AC. At the start of a target cycle simulation, a shed percentage for the specified hour (and day) of load control is calculated for each AC from information specific to that unit and the load reduction target (1.5 kW or 1 kW). These shed percentages remain the same throughout the simulation. Other than this, the simulation procedure is the same for Target Cycle and fixed cycling.

A single realization in the simulation is generated by a random draw of residuals for each of the M&V natural duty cycle model fits, which are evaluated at the temperature and humidity of the control hour (and day). This gives a set of simulated natural duty cycles appropriate for the control hour. Load reduction for each M&V AC is calculated as follows:

Duty cycle reduction = MAX[Duty cycle - (1 – Shed percentage), 0]

*Load reduction = Connected load * Duty cycle reduction*

For households with multiple AC, realized load reduction is aggregated to the household level by summing load reduction from all household AC. These realized load reductions are averaged within the strata, to produce single realizations of average load reduction per household within both high and low strata. These two sample averages constitute the result from one pass through the simulation corresponding to one draw of model residuals.

Several thousand passes through the simulation are performed to adequately capture the variation in average load reduction within strata that is consistent with our duty cycle models and M&V sample sizes. The results accumulate into distributions of sample averages for both high and low strata. The grand means of these distributions are the most significant output from a simulation run. They are the estimates of average load reduction per household in the high and low strata for the specified control hour and cycling strategy. The spread of these distributions (e.g., variance) characterizes the

uncertainty in the load reduction estimates, and is very much affected by our M&V sample sizes.

Load Impact Results

Load impacts described in this section are computed with population estimates of load reduction per switch, rather than load reduction per household. Simulation results are converted to load reduction per switch using the factors 1.090 switches per household for Midwest results, and 1.189 switches per household for Southeast results. Population estimates of load reduction per household are divided by these factors to get corresponding population estimates of load reduction per switch. The estimates of switches per household are determined from the Midwest and Southeast M&V samples.

Table 5 through Table 7 illustrate the calculation of load reduction load reduction on a PM event day in a state with 3 different load control technologies. Load impact from CSE devices are developed in Table 5, load impact from Cannon devices are developed in Table 6, and Table 7 gives the total PM load impact in the state. In Table 5, columns labeled shed kW/switch are the results of simulation runs, scaled as described above, for both 75% cycling (1.5 kW program) and 50% cycling (1.0 kW program) and for hours 16-18 on July 7, 2010. Potential load impacts for CSE devices (next to last column) are calculated from switch counts for each program option in the state on the event day. De-rated load impacts in the last column of Table 5 are the product of the potential impact with the de-rating factor (54.1%) applicable to Kentucky CSE devices. The appropriate de-rating factors for each switch technology are determined by separate operability studies. Table 6 for Cannon devices is structured in the same way as Table 5. The columns with shedKW/switch in Table 6 contain results from Target Cycle simulations, and the higher de-rating factor appropriate for Cannon devices (93.1%) is used to calculate de-rated impacts. Table 7 shows the PM hourly impact results in KY on July 7, 2010, which are obtained by adding corresponding hours in the last columns of Table 5 and Table 6.

PM load control devices do not start shedding load in unison at the top of the first control hour. Instead, each load control device computes a random time delay which determines when the first shed period begins for that device. For the population as a whole, this reduces the shed minutes in the first hour of a load control event by a factor that depends on the load control technology and program option. For CSE devices, these loss factors are 0.1875 for the 1.5 kW program with 75% shed percentage, and 0.125 for the 1.0 kW program with 50% shed percentage. Potential and de-rated impacts for hour 16 in Table 5 are reduced accordingly. Duke Energy approximated the reduction in shed minutes for Target Cycle 1.5 kW and 1.0 kW programs with these same factors, and the potential and de-rated impacts for hour 16 in Table 6 are similarly reduced.

Table 5. KY CSE Impact Results on 7/7/2010

									De-rate
									54.1%
		Option 1.5 kW			Option 1.0 kW			Total	
Date	Hour	shed kW/switch: FC 75%	Switch Count	Potential Impact (MW)	shed kW/switch: FC 50%	Switch Count	Potential Impact (MW)	Potential Impact (MW)	De-rated Impact (MW)
			3553			3086			
7/7/2010	16	1.57		4.5	0.89		2.4	6.9	3.8
3-6 pm	17	1.66		5.9	0.96		3.0	8.9	4.8
(EDT)	18	1.69		6.0	0.99		3.1	9.1	4.9

Table 6. KY Cannon Impact Results on 7/7/2010

									De-rate
									93.1%
		Option 1.5 kW			Option 1.0 kW			Total	
Date	Hour	shed kW/switch: TC 1.5	Switch Count	Potential Impact (MW)	shed kW/switch: TC 1.0	Switch Count	Potential Impact (MW)	Potential Impact (MW)	De-rated Impact (MW)
			954			2150			
7/7/2010	16	1.37		1.1	0.98		1.8	2.9	2.7
3-6 pm	17	1.37		1.3	0.97		2.1	3.4	3.2
(EDT)	18	1.35		1.3	0.96		2.1	3.4	3.1

Table 7. KY PM Impact Results on 7/7/2010

Date	Hour	De-rated Impact (MW)
7/7/2010	16	6.5
3-6 pm	17	8.0
(EDT)	18	8.0

PM hourly impact results have been computed as illustrated by Table 5 through Table 7 for all 2010 load control days in all states. Results for OH, KY, and IN are given in Table 9 and results for NC and SC are given in Table 10. Both Cannon and CSE load control devices are also installed in IN, so load impact results there are computed in the same way as for KY. Only Cannon devices are installed in OH, so these load impact results are computed similarly to Table 6 above. In NC and SC, older fixed cycling Comverge switches are installed along with newer Cannon devices, so load impact results are computed similarly to Table 5 through Table 7. But PM offers a single program in

NC and SC, with fixed cycling at 67% and a Target Cycle load reduction target of 1.3 kW, so the calculations corresponding to Table 5 and Table 6 are simplified.

Table 8 shows de-rating factors used for 2010 impact evaluation. The factors for Cannon and Comverge were determined by operability studies conducted in 2010. The CSE factor in IN was also determined by an operability study conducted in 2010, and the CSE factor in KY was determined by an operability study conducted in 2009.

Table 8. De-rating Factors for Impact Evaluation

Switch Type	OH	KY	IN	NC / SC
Cannon	0.931	0.931	0.931	0.931
CSE		0.541	0.396	
Comverge				0.399

Table 9. 2010 PM Impact Results for OH, KY and IN

		PM Impact (MW)			
Event Date	Hour	OH	KY	IN	Midwest Total
	15	20.0	6.4	24.4	50.9
6/23/2010	16	21.4	7.7	30.9	60.1
	17	21.4	8.0	31.4	60.8
	18	21.4	8.0	31.5	60.9
	16	19.3	6.5	24.5	50.3
7/7/2010	17	22.2	8.0	29.9	60.1
	18	21.9	8.0	29.8	59.8
	16	20.9	6.8		27.7
7/8/2010	17	24.6	8.5		33.1
	18	24.1	8.5		32.6
	16	19.8	6.9	31.8	58.5
7/23/2010	17	23.4	8.6	38.8	70.7
	18	23.8	8.8	38.9	71.6
	15	22.5	7.8	17.5	47.8
8/4/2010	16	25.6	9.5	22.2	57.4
	17	25.2	9.6	23.3	58.1
	14	18.4	6.2	28.1	52.8
8/10/2010	15	23.9	8.3	35.1	67.2
	16	24.6	8.7	37.0	70.3
	14	20.5	6.2	24.9	51.7
8/13/2010	15	23.4	7.7	32.4	63.5
	16	22.8	7.9	34.8	65.5
	16	17.4	5.2		22.6
8/31/2010	17	20.2	6.6		26.9
	18	21.2	6.9		28.1

PM load control was activated in OH and KY on 8 days during the summer of 2010, including both CSE and Cannon devices in KY on all days. PM load control was activated in IN on 6 days during summer 2010, including CSE devices on all days and Cannon device on all days except for August 4. Table 9 gives hourly impact results in OH, KY, and IN for each control day. The last column of Table 9 gives total PM impact in the Midwest. The highest hourly impact in the Midwest was 71.6 MW in hour 18 (5:00 – 6:00 pm EDT) on July 23.

Table 10. PM Impact Results for NC and SC

		PM Impact (MW)		
Event Date	**Hour**	**NC**	**SC**	**Southeast Total**
6/14/2010	16	14.0	29.0	43.0
	17	16.2	33.0	49.2
	14	34.2		34.2
6/15/2010	15	43.6		43.6
	16	46.2		46.2
	15	58.9	25.8	84.6
6/23/2010	16	65.7	30.2	95.9
	17	67.2	31.6	98.8
	18	67.1	32.2	99.2
	16	44.9	22.9	67.8
7/7/2010	17	51.3	26.5	77.7
	18	52.1	27.0	79.1
	15	47.5	23.8	71.3
7/8/2010	16	55.4	27.7	83.1
	17	57.8	29.1	86.9
7/22/2010	16	59.6	28.8	88.4
	17	69.0	33.4	102.3
	16	65.2	31.5	96.7
7/23/2010	17	74.4	35.4	109.7
	18	74.6	35.5	110.1
	15	61.0	27.9	88.9
8/5/2010	16	71.6	32.2	103.8
	17	72.6	33.4	106.0

PM load control was activated in NC on 8 days during the summer of 2010. Only Cannon devices controlled on June 14, and only Comverge devices controlled on June 15. Both Cannon and Comverge devices were controlled on all other days. PM load control was used on 7 days in South Carolina, including both Cannon and Comverge on all days. Table 10 gives hourly impact results in NC and SC for each control day. The last column of Table 10 gives total PM impact in the Southeast. The highest hourly impact in the Southeast was 110.1 MW in hour 18 (5:00 – 6:00 pm EDT) on July 23.

Table 11 gives estimated load reduction per switch under peak normal weather conditions for different PM program options and load control technologies. Table 12 shows the peak normal weather conditions used to calculate the results in Table 11. The system peak is assumed to occur in the hour 5:00 – 6:00 pm EDT in the Midwest (identified as hour 18 in this report). The system peak in the Southeast is assumed to occur in the hour 4:00 – 5:00 pm EDT (identified as hour 17 in this report).

Table 11. Shed kW/switch with Peak Normal Weather

Switch Type	Control Strategy	Potential Impact			De-rated Impact		
		OH/KY	IN	NC/SC	OH/KY	IN	NC/SC
Cannon	TC 1.5	1.43	1.42		1.33	1.32	
	TC 1.0	1.06	1.07		0.99	1.00	
	TC 1.3			1.18			1.10
CSE	FC 75%	1.88	1.86		1.02	0.74	
	FC 50%	1.13	1.12		0.61	0.44	
Comverge	FC 67%			1.41			0.56

Table 12. Peak Normal Weather

	OH / KY		IN		NC / SC	
Hour	Temp	Dewpt	Temp	Dewpt	Temp	Dewpt
11	85.3	71.8	84.9	73.9	89.0	69.0
12	87.6	71.9	87.6	74.4	91.0	69.0
13	89.9	71.9	89.9	74.8	92.0	68.0
14	92.0	71.5	91.2	74.9	94.0	68.0
15	93.1	70.7	91.9	74.5	93.0	69.0
16	93.9	70.5	91.5	74.2	95.0	67.0
17	92.5	70.0	90.8	74.0	95.0	66.0
18	92.4	69.5	89.5	73.5	95.0	67.0

Section 2: Program Operations

Interviewees

As part of the process evaluation, in-depth interviews were conducted with the following program staff from Duke Energy: the lead analytic researcher in the Retail Energy Desk, the Power Manager® Product Manager, an impact analyst, a senior researcher, and an IT system architect.

Program Background

Power Manager® is a residential demand response program designed to reduce the load on peak temperature days in the summer. Power Manager® sheds load by cycling customer AC units off for a percentage of each hour during the event. The events may last 2 to 4 hours for residential customers.

The Duke Energy product manager reports that 9% of residential customers in the Carolinas are participating in the Power Manager® program. A residential load control program has been available in the Carolinas for over 30 years for curtailment in emergency events only. South Carolina received regulatory approval in 2009 to convert customers over to Power Manager®, which reduces load for economic as well as emergency events. North Carolina received regulatory approval to switch to Power Manager® in 2010. Customers were notified by letter of the change. In past years, there were very few emergency calls. The summer of 2010 was hot, and Duke Energy called several economic events. Some customers who had been enrolled and receiving the $32 incentive every year without needing to be curtailed had forgotten they had enrolled in the Power Manager® program. Duke Energy had anticipated that some customers would ask to be removed from the program, and a small but insignificant number of customers, relative to the number of participants in the program, did drop off.

Events

Events may be called for two reasons. Events will be called due to emergency load reduction needs, but may also be called for economic needs. The criteria for each are as follows:

Emergency need criteria: Emergencies may be called by System Operations for a variety of reasons, including when it is determined that there is a critical shortage in energy supply or when the reliability of the electrical grid is threatened by abnormal events.

Economic need criteria. Economic events are considered when the market price exceeds $60/MWh. Calls are not usually made unless the market price far exceeds those limits, in order to minimize inconvenience to customers.

In 2010, eight economic events were called in South Carolina and North Carolina, there were no emergency events.

The Retail Energy Desk

Within Duke Energy, the Retail Energy Desk has responsibility for determining whether an event is called. The Retail Energy Desk monitors the load forecast and weather for each upcoming day. When the indicators meet predetermined criteria, an internal conference call is held between the members of the Power Manager® team to determine whether the event will be called.

Both heat index and load data from past years are used to determine the probability that a particular combination would result in a high load. The best candidates for events are days in which 1) the heat index is one of the highest for the summer and 2) the forecasted load exceeds a certain percentage of peak for that summer.

The staff considers issues such as what hour the event will be called. From prior research, Duke Energy's customers' peak energy usage is at the 5 o'clock hour. While this is not necessarily the peak for AC load, it is the peak for residential energy use due to increased appliance usage when customers return home from work. The decision team expects to have approximately 10 economic events in a typical summer season and always needs to be prepared for any emergency needs.

Residential customers are sometimes not at home during the times that events are called, but customers can call Duke Energy's dedicated phone line to see if an event will be called on that day.

Because very few, if any, emergency events have been called, some Carolinas customers had forgotten they had enrolled in the previous version of the load control program that only curtailed use during emergencies. When Duke Energy merged with Cinergy, load control program participants who chose not to opt out were converted to the Power Manager® program, which also curtailed for economic events. Because the summer of 2010 was particularly hot, Duke Energy called a number of economic events. Customers who previously had not had their AC units cycled suddenly were being cycled; some customers called Duke Energy asking to be removed from the program. Duke Energy had anticipated this occurrence.

Incentives & Participation

New PM participants in the Carolinas must pay $35 to enroll in the program, a legacy from past program years. As participants, they receive an $8 statement credit for 4 months each year during the summer months, for a total of $32 each year.

Equipment

The Power Manager® program currently uses several types of switching devices, all of which are activated by one-way pages. The newer type of switches are made by Cannon, and are intelligent switches that can be programmed with a maximum cycling duration.

The Power Manager® program inherited the older Power Line Carrier (PLC) and Comverge switches that had been used prior to Duke Energy's merger with Cinergy. These older switches have been problematic in that many of them have reached their end

of useful life and need to be replaced. Duke Energy has recognized this as a priority and is currently engaged in a multi-year effort to update all these switches with new ones made by Cannon. The Duke Energy product manager expects the vast majority of PLC replacements can be completed in approximately two years, but it is a labor-intensive and expensive effort. With over four times as many Comverge switches as PLC, this replacement effort will take even longer. To maximize the efficiency and cost-effectiveness of these change-outs, weighted values have been assigned to the PLC and Comverge switches. Using these values, a prioritized list segmented at the zip code level has been developed. This list will guide efforts in changing out both types of switches.

Customers in the Carolinas who had the newer switches were programmed so that the maximum cycle duration would only be 22.5 minutes of each half hour (or, a 75% cycle time) to allow for 25% of AC on-time during each event. The Duke Energy product manager reports that this has increased customer satisfaction with the program.

Retail Energy Desk

Duke Energy's Retail Energy Desk monitors several indicators to determine whether an event would be warranted on the next day. They make the ultimate decision on whether to call an event, but do consult with others to help them weigh the benefits of the event against possible inconvenience to customers.

Because the same staff also implements PowerShare®, the commercial load shed program, the days on which events are called in both programs are particularly hectic. One Duke Energy staff member uses the analogy of an event call being like an emergency and staffing is comparable to staffing for a hospital emergency room.

In addition to implementing the program during an event call, the same staff is also tasked with answering customer phone calls and emails triggered by both the Power Manager® and PowerShare® events. While general questions about Power Manager® can be and are answered by a third party vendor, GoodCents, there still are some Power Manager® questions that are passed on to the program staff. PowerShare® questions are directly handled by the program staff. Duke's management has already recognized that this is not the best use of their technical staffs' time and are currently requesting that additional staff be hired to handle non-technical issues.

GoodCents

GoodCents is a third party vendor that is Duke Energy's "*boots on the ground*" for Power Manager®. They enroll new customers, install switches, perform quality checks on the switches, and remove switches for customers who discontinue.
GoodCents is responsible for replacing of all the old load control switches in North Carolina and South Carolina.

Power Manager® Research

Duke Energy has a Power Manager® research division that that is responsible for two main studies, the results of which are used in calculating program impact. One study is an AC duty cycle study, to estimate load shed potential under a variety of conditions. The

other is an operability study, to estimate the number of switches that are in operation. Please see Section 1: Impact Analysis for details on these studies.

Data Collection

Duke Energy hires a contractor to collect data for both the AC duty cycle and the operability studies. Data are collected twice each year, once in July and again in October after the control season ends. The Cannon switch can store 90 days' worth of AC runtime data; hence the need for two collections.

Because the switching devices only allow one-way communication, downloading data from each device requires a visit by a technician. Technicians also need to obtain customers' permission to read the switches. Data from the Cannon switches can be downloaded in 2 minutes.

Because of the age of switches, the data need to be recorded manually by writing them down. The Duke Energy senior researcher reports that that there was some difficulty getting consistent data due to some differences in data collection instructions given to the field technicians. The research division conducted a second data collection at the end of the season on those switches where the operability data was ambiguous. Two of the interviewees noted that there was some difficulty in locating some customer residences in North Carolina, even with the aid of a GPS system.

Only after all the data has been uploaded into the database can the research group begin their analysis.

The research group is ultimately responsible for determining the program's impact: The results of the duty cycle study provides an estimate of the load reduction per switch, and the results of the operability study are used to de-rate the load reduction by percentage of operating switches.

Program Targets

Marketing to Customers

The Duke Energy product manager reports that there are requirements for residential customers in order to participate. Customers need to own their homes and have central air conditioning. One Duke Energy staff member reports that although all customers that meet the requirements may participate, marketing efforts have targeted customers with larger homes and thus higher load shed potential.

The Power Manager® program is marketed to customers with fliers and brochures. These materials can be found in Appendix E: Power Manager Program Marketing Materials. The marketing campaigns are also targeted geographically so that switches can be installed by technicians more efficiently. Marketing efforts have been suspended in the Carolinas following the results of customer research conducted in early 2010. Due to

poor response rates of marketing efforts in SC, a customer study was conducted with customers who had received Power Manager offers but who did not enroll. The largest barrier is the $35 installation fee. Over two thirds of those responding said this fee would make them very unlikely to participate. Duke Energy is taking steps to seek regulatory approval to remove the fee. Upon removal of this fee, marketing efforts will resume. In the meantime, Duke Energy is focusing on replacement of older and inoperable switches to improve the performance of the program.

Quality Control

Duke Energy has recently approved a project that would increase the security of the data servers that drive the communications to the switches. Currently, some servers are in the Midwest and others are in the Carolinas. The new project will relocate all the servers to Charlotte, NC and upgrade the software version on the servers. The primary server and backup servers located several miles apart for increase security. This project is estimated to be completed before May 2011.

Duke Energy's IT staff also reports that an additional benefit of consolidating the servers is that the upgraded server software will use Duke Energy's preferred Active Directory security.

Carolina Program Barriers

One disincentive to participation in the Carolinas is the one-time sign up fee of $35. Customers in the Carolinas receive $32 per year. This does not offset the initial signup fee, and Duke Energy's own research shows that customers do not like it. Duke Energy is currently preparing to file a change to the program to remove the signup fee, but first must gain approval from a non-utility stakeholder group before taking the request to the regulators for their approval. Once this barrier has been removed, the Duke Energy product manager believes that the incentive is sufficient.

Future improvements already planned

Duke Energy reports that they have just started an internal process to determine best practices for operating the Power Manager® program. These findings are not available in time to be reviewed for this report.

Areas Needing Improvement

All parties mentioned that two-way communicating switches would resolve many current problems and greatly reduce the cost of gathering data. The Duke Energy product manager reports that they are considering how to integrate the load control program and future demand response programs with a Smart Grid someday.

Two interviewees in the research division mentioned that the customer database is also out of date, and that customers who have discontinued participation are still in the database. They report that there are two different customer databases in the Carolinas, the main database and one that resides inside the load control system. These two databases have drifted apart over time, and the research division reports that they have great difficulty working with them.

The Duke Energy team is also considering other program innovations. One idea is to target the cycle time by customers' indoor temperatures and customize the program for customers' different tolerance levels. Customers who are willing to accept greater increases in indoor temperatures during events could receive higher incentives. In order to customize for different tolerance levels, Power Manager® or future demand response programs may need to install control devices that incorporate the customer's indoor temperature information.

Section 3: Participant Survey Results

TecMarket Works conducted telephone surveys with 106 randomly selected program participants in the states of North Carolina (n=76) and South Carolina (n=30). This section presents the results from the surveys. The survey instrument can be found in Appendix B: Participant Survey Instrument.

For various reasons, including unfamiliarity with the subject matter a particular question, pre-determined eligibility through skip patterns, and time constraints, not all of the 106 surveyed participants answered every question of the survey. In this report any data this presented from a question with less than the maximum possible number of responses is noted with a number (N) of responses.

The survey results for North Carolina and South Carolina are presented separately, but the reader must keep in mind that the South Carolina sample is not large enough from which reliable conclusions can be drawn. However, the sample is large enough that it can provide valuable information about the South Carolina program. This reduced sample for South Carolina is driven by the state-specific evaluation budget allocation process from which the evaluation resources for South Carolina are smaller than those for North Carolina, requiring a less rigorous evaluation in South Carolina compared to North Carolina.

Participation Drivers

Surveyed Power Manager® program participants in North Carolina were likely to have been involved with the decision to participate in the Power Manager® Program with fifty-nine out of seventy-six surveyed (77.68%) indicating that they were involved. For South Carolina, the survey effort was more successful at reaching decision makers, and was still able to obtain responses from 86.7% of the customers involved in the participation decision.

Table 13. Were you involved in the decision to participate in Duke Energy's Power Manager® Program?

	NC		SC	
	N	Percent	N	percent
No	14	18.4%	3	10.0%
Yes	59	77.6%	26	86.7%
Don't Know	3	3.9%	1	3.3%

Most of the surveyed participants learned of the Power Manager® program from a direct mail offer or through a bill insert from Duke Energy. Very few surveyed participants learned of the program from the Duke Energy web site or through word of mouth. Direct mail continues to be the most successful approach for enrolling customers compared to all other approaches examined.

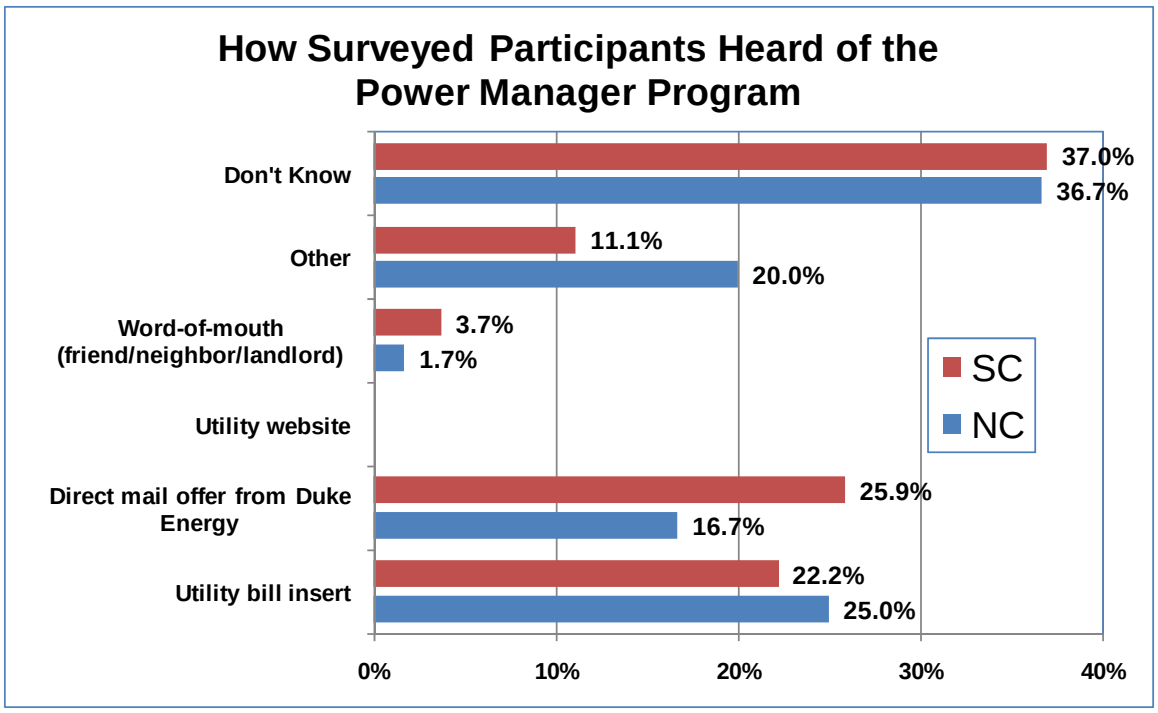


Figure 1. How Participants Learned of the Power Manager® Program

Recalling Promoted Program Benefits

During the survey, we asked participants to recall what the promoted program benefits were. The results are presented in the table below, and summarized in Figure 2. Table 14 presents the responses from the surveyed participants in the column labeled "responses". The "Tags for Summary" column categorizes the survey responses using five tag words to summarize various responses, including:

1. Money: used if the participant mentioned bill credits or lowered bills
2. Energy: used if the participant mentioned energy savings
3. Outages: used if the participant mentioned reduced load or preventing brown-outs or black outs
4. Environmental: used if the participant mentioned environmental benefits
5. Other: used if the participant mentioned benefits such as "helping the community" or other benefits that do not fall into the above categories.

The tag words/responses are then summarized in Figure 2.

Table 14. Participants' Recalled Program Benefits

Tags for summary	Responses	North Carolina		South Carolina	
		N	percent	N	percent
money	$8 credit per month	1	1.3%	1	3.3%
outages	Avoided outages	1	1.3%		

money	Bill credits	19	25%	3	10%
money outages	Bill credits & avoided power outages	2	2.6%		
money other	Bill credits & better service	1	1.3%		
money	Cost savings	1	1.3%		
money	Discount on rates	1	1.3%		
money energy	Energy savings, lower utility bills			1	3.3%
outages	Help prevent brownouts			1	3.3%
outages	Load control	1	1.3%		
money	Lower electric bill	7	9.2%	7	23.3%
outages	Prevent blackouts			2	6.7%
money	Rate reduction, save money	2	2.6%		
money outages	Reduce bills & avoid outages	1	1.3%		
outages	Reduce load			1	3.3%
energy outages	reduce power load & save energy	1	1.3%		
outages	Reduced outages	1	1.3%		
energy	Save energy	1	1.3%		
money other	Save on bills, help other customers	1	1.3%		
energy	Saves energy for everybody	1	1.3%		

In North Carolina, 42 of 76 (55.3%) of the surveyed participants were able to recall any benefits promoted by the program. In South Carolina, 16 of 30 (53.3%) were able to recall at least one benefit promoted by the program.

The surveyed participants that did recall program benefits were able to provide 95 benefits that they recalled being promoted by the program. As seen in Figure 2, of the 95 benefits recalled by these participants, 75% of them mentioned money either by recalling the bill credits or financial incentives for participating in the Power Manager® program. The next most commonly recalled promoted program participation benefit included a mention of the load control function of the program as a means of reducing blackouts and/or brownouts. Relatively few of the recalled benefits (4.7%) included a mention of energy savings.

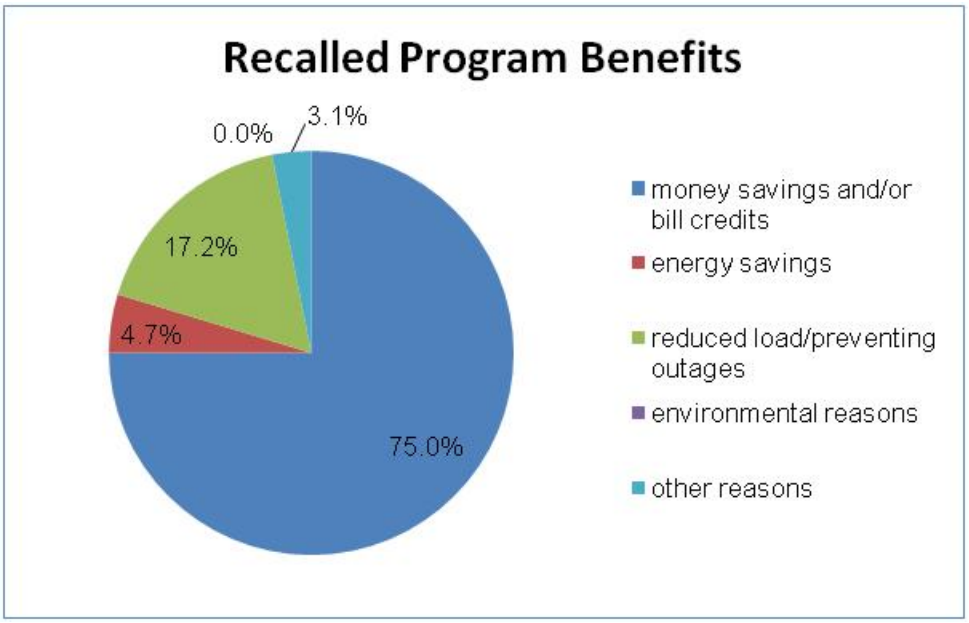


Figure 2. Recalled Program Benefits: Summary of Responses (NC and SC)

We then asked the surveyed participants about their reasons for participating in the Power Manager® program. The most common response was "to save money" in North Carolina (65.3%) and "for the bill credits" in South Carolina (23.3%). In South Carolina "to save energy was also an oft-cited response (20%).

Table 15. Reasons for Participation in Power Manager®

Reason for Participation	North Carolina		South Carolina	
	N	Percent	N	percent
For the bill credits	1	1.4%	7	23.3%
Helping Duke Energy avoid power shortages/outages	5	6.9%	3	10%
To save energy	5	6.8%	6	20%
To save money (through lower utility bills)	47	65.3%	3	10%
To help the environment	1	1.4%	0	-
I don't use the air conditioner much	1	1.4%	0	-
Other	1	1.4%	1	3.3%
Don't Know	11	15.3%	10	33.3%

"Other" responses included:

- The landlord enrolled me
- Staying on program because of the expense in removing the switch

After respondents told us why they participated in Power Manager®, we asked them if they recalled reading about that benefits or reasons presented in the program brochure. Table 16 summarizes their responses. Thirteen of 31 (41.9%) of respondents who mentioned saving money as their reason for participating in the program recalled reading about this benefit in the program brochure.

Table 16. Reason for Participation: Read in Program Brochure (NC and SC combined)

Reason	Do you recall reading about this benefit on the program brochure?					Total
	No	Yes	Do not remember brochure	Did not get brochure	Don't Know	
For the bill credits	0	2	3	0	0	5
Helping Duke Energy avoid power shortages/outages	0	1	3	0	2	6
To save energy	0	3	3	1	0	7
To save money (through lower utility bills)	1	13	14	0	3	31
To help the environment	0	1	0	0	0	1
I don't use the air conditioner much	0	1	0	0	0	1
Don't Know	0	0	0	1	0	1
Total	1	21	23	2	5	52

Importance of Environmental Issues to Participants

Most (90.1%) surveyed Power Manager® participants indicated that environmental issues are either "important" or "very important" to them. None of the respondents indicated that environmental issues were "not at all important", though one participant in South Carolina said that he or she thought environmental issues were "not important".

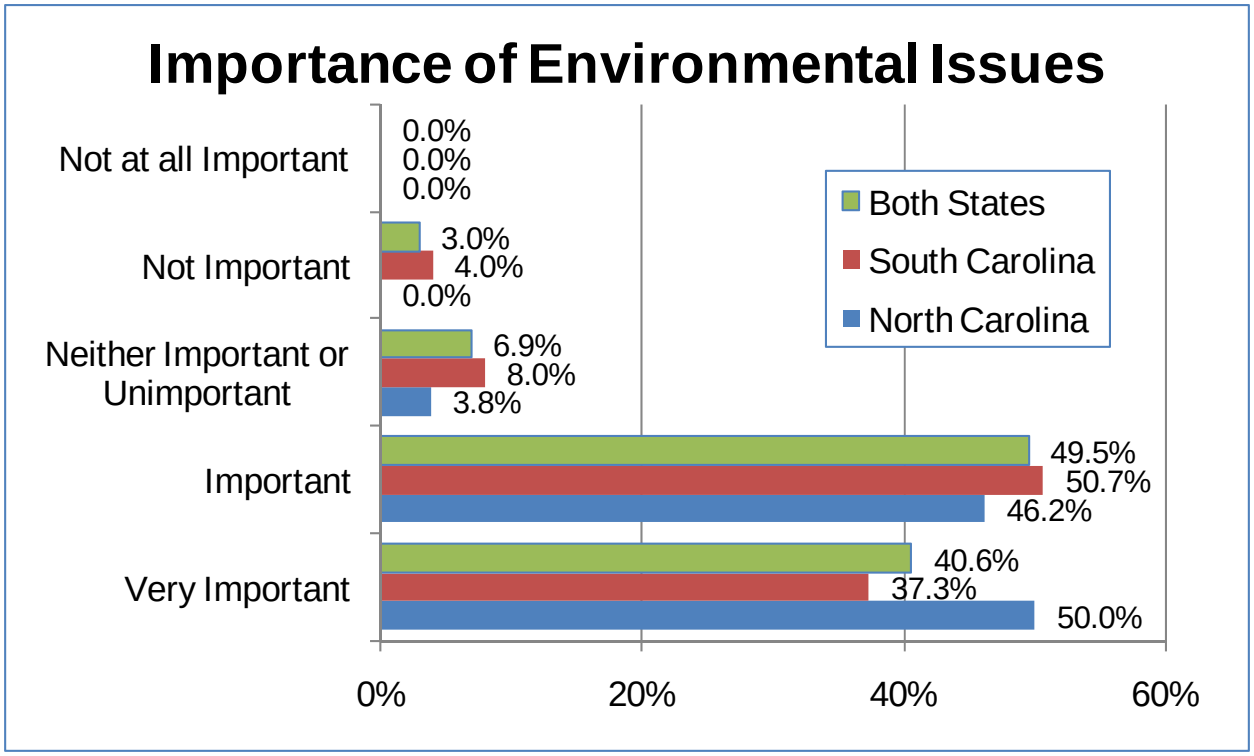


Figure 3. Importance of Environmental Issues to Power Manager® Participants

When the surveyed participants were asked about the importance of climate change issues, responses shift slightly from very important to important indicating that climate change issues are key issues for these customers. However, the change is minor at the population level with climate change issues only moving one step lower for a small part of the population. As seen in Figure 4, none of the surveyed participants indicated that climate change issues are "not at all important" to them and none of the participants in North Carolina indicated that climate change issues are "not important." Nineteen percent of South Carolina participants indicated that climate change issues are "not important" with 64% indicating that climate issues are either "important" or "very important."

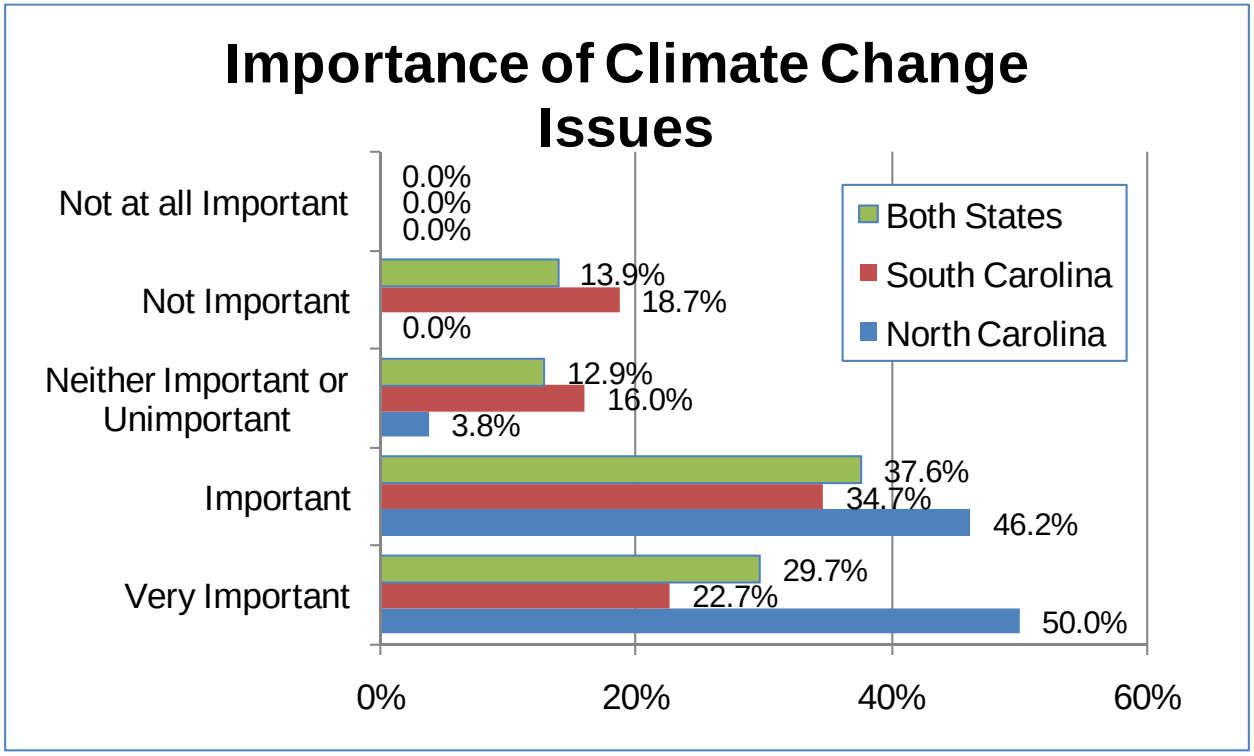


Figure 4. Importance of Climate Change Issues to Power Manager® Participants

As seen in Figure 5, reducing air pollution is rated as being important or very important by the vast majority of Power Manager® participants. Power Manager® participants represent a population segment that is focused on environmental issues and considers these issues important or very important in their participation decisions.

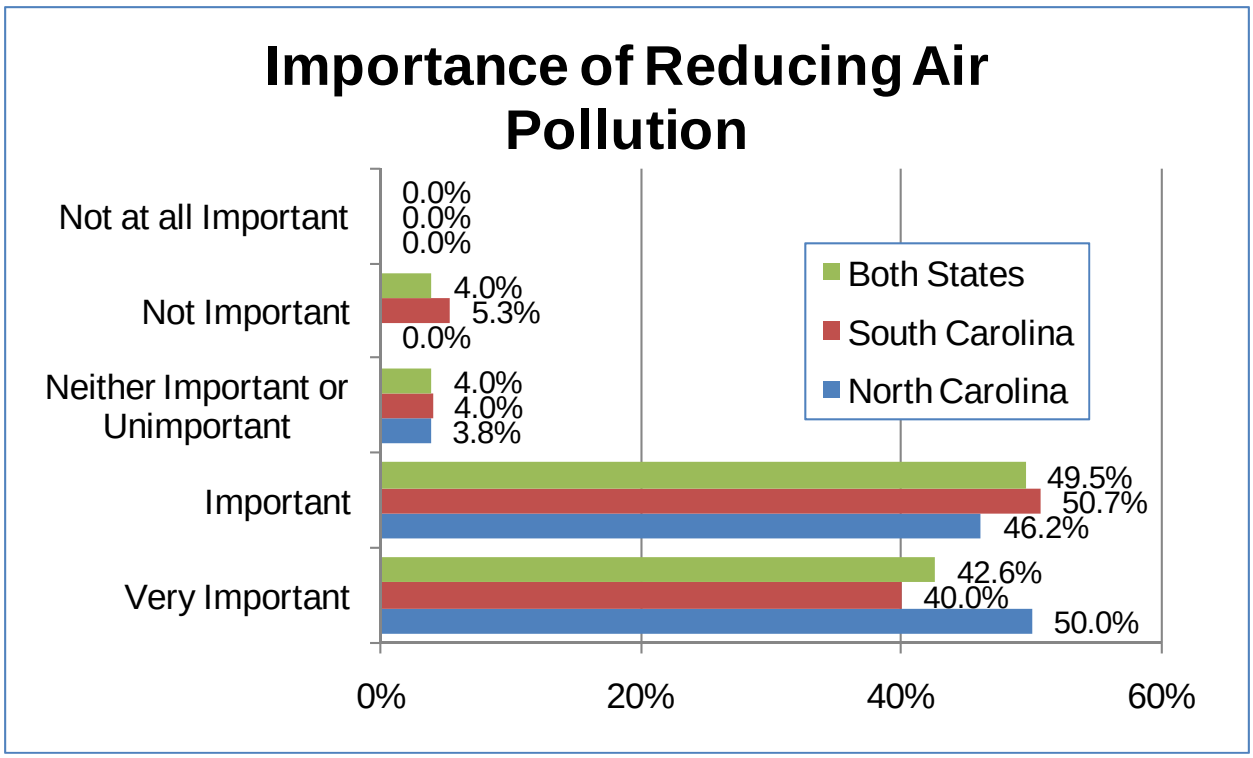


Figure 5. Importance of Reducing Air Pollution to Power Manager® Participants

When the respondents were asked how important it was to reduce the need for new power plants, opinions varied more than with previous environmental issues. Figure 6 shows that about a third (32%) of South Carolina surveyed participants said that reducing the need for new power plants is "not important" while 10.7% rated it as "very important." In contrast, 96.2% of North Carolina respondents rated this issue as either "important" or "very important" to them.

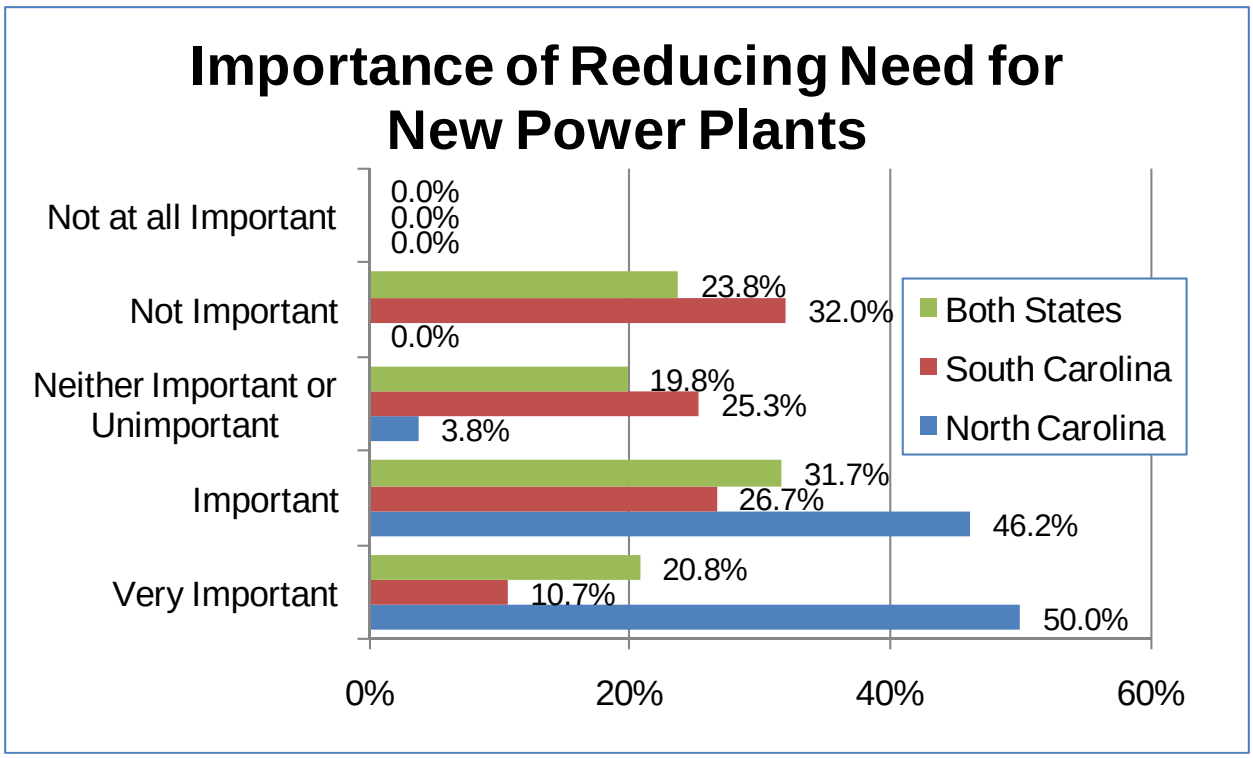


Figure 6. Importance of Reducing Need for New Power Plants to Power Manager® Participants

While enviornmental issues are important or very important to these customers, only seven of the 101 surveyed participants in both states are members of a group or club that has an environmental mission (6.9%).

Table 17. Are you a member of any groups or clubs that have environmental missions?

			No	Yes	Don't Know	Total
State	NC	Count	66	4	1	71
		% within State	93.0%	5.6%	1.4%	100.0%
	SC	Count	27	3	0	30
		% within State	90.0%	10.0%	.0%	100.0%
Total		Count	93	7	1	101
	% within State		92.1%	6.9%	1.0%	100.0%

If respondents indicated that there were a member of an organization with an environmental mission, we asked for the name of the organization. Five of them were able to provide specific names while two did not. In addition, most of these respondents identified organizations that are not environmentally focused as their primary mission, indicating that very few of the particpants are assoicated with an organization that has environmental causes as their primary mission. Their responses are listed below.

- Church

- Garden club
- Nature Conservancy
- PETA
- Society of Plastics Engineers

Participant Understanding of the Program

Participants are satisfied with the program information that was provided to them, giving the program information a mean score of 9.3 in North Carolina and 9.1 in South Carolina on a 1-10 scale with 10 indicating that they were "very satisfied".

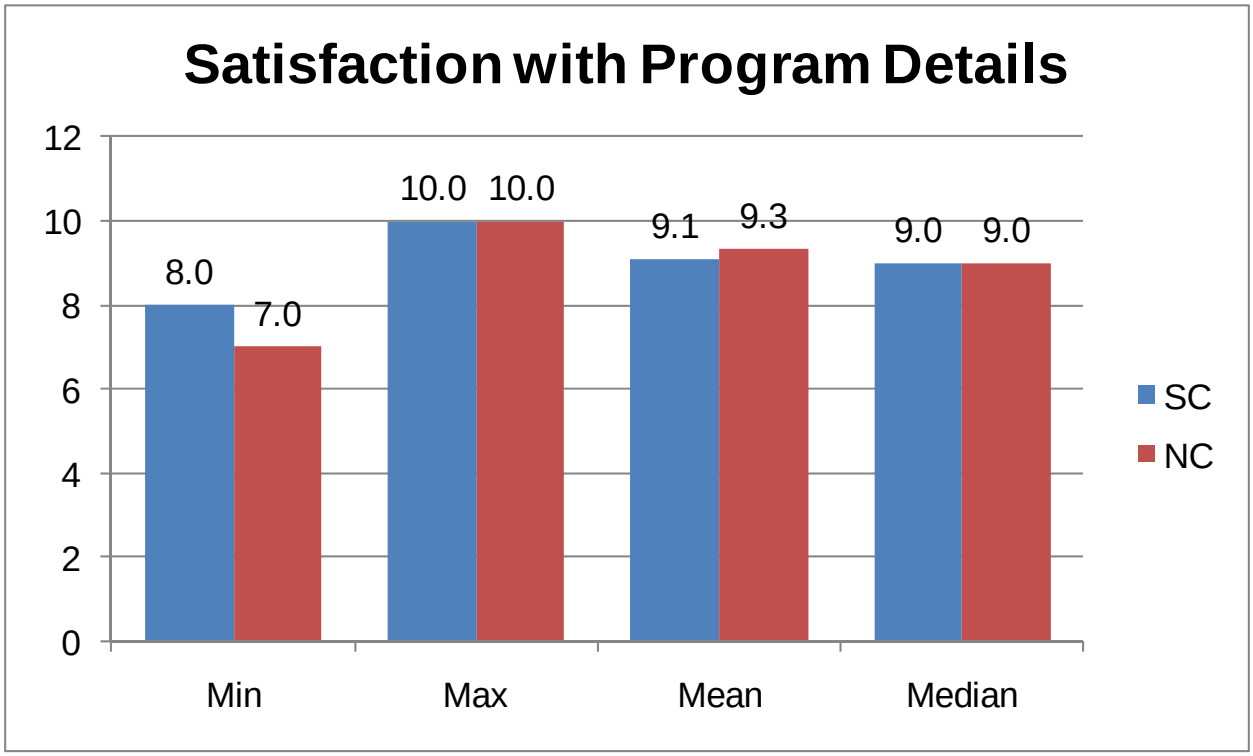


Figure 7. Participant Satisfaction with Program Details

If a respondent indicated that their satisfaction with the program details was 8 or lower, we asked them why they were less than satisfied. Two of the four survey participants that provided scores of 8 or lower could not provide a reason. The reasons for low satisfaction scores that were provided are listed below.

- Concerns about comfort
- No one is perfect

Satisfaction with Program Information Before Enrollment

Of the surveyed participants, 53.5% of them provided a high satisfaction score (8-10 on a 10-point scale) for the program information they received before they enrolled. Another 45.5% answered "don't know".

	Don't Know		Low Satisfaction Score 1-4		Neutral Satisfaction Score 5-7		High Satisfaction Score 8-10	
	N	Percent	N	Percent	N	Percent	n	Percent
South Carolina	19	63.3%					11	36.7%
North Carolina	27	38.0%			1	1.4%	43	60.6%
Southeast	**46**	**45.5%**			**1**	**0.9%**	**54**	**53.5%**

Of the surveyed South Carolina participants, 36.7% of them provided a high satisfaction score (8-10 on a 10-point scale) for the program information they received before they enrolled. The other 63.3% answered "don't know". Of the surveyed North Carolina participants, 60.6% of them provided a high satisfaction score (8-10 on a 10-point scale) for the program information they received before they enrolled. The others provided neutral scores, or answered "don't know".

Satisfaction with Program Enrollment Process

Of the surveyed participants, 88% provided a high satisfaction score (8-10 on a 10-point scale) for the program enrollment process.

	Low Satisfaction Score 1-4		Neutral Satisfaction Score 5-7		High Satisfaction Score 8-10	
	N	Percent	N	Percent	n	Percent
South Carolina			1	3.3%	29	96.7%
North Carolina	1	1.4%	10	14.3%	59	84.3%
Southeast	**1**	**1.0%**	**11**	**11.0%**	**88**	**88.0%**

Of the surveyed South Carolina participants, 96.7% provided a high satisfaction score (8-10 on a 10-point scale) for the program enrollment process. Of the surveyed North Carolina participants, 84.3% provided a high satisfaction score (8-10 on a 10-point scale) for the program enrollment process.

Satisfaction with Power Manager® Program

Of the surveyed participants, 87% provided a high satisfaction score (8-10 on a 10-point scale) for the Power Manager® program overall.

	Low Satisfaction Score 1-4		Neutral Satisfaction Score 5-7		High Satisfaction Score 8-10	
	N	Percent	N	Percent	n	Percent
South Carolina			2	6.7%	28	93.3%
North Carolina	1	1.4%	10	14.3%	59	84.3%
Southeast	**1**	**1.0%**	**12**	**12.0%**	**87**	**87.0%**

Of the surveyed South Carolina participants, 93.3% provided a high satisfaction score (8-10 on a 10-point scale) for the Power Manager® program overall. Of the surveyed North Carolina participants, 84.3% provided a high satisfaction score (8-10 on a 10-point scale) for the Power Manager® program overall.

Satisfaction with Duke Energy Overall

Of the surveyed participants, 86.9% provided a high satisfaction score (8-10 on a 10-point scale) for Duke Energy overall.

	Low Satisfaction Score 1-4		Neutral Satisfaction Score 5-7		High Satisfaction Score 8-10	
	N	Percent	N	Percent	n	Percent
South Carolina			6	20.0%	24	80.0%
North Carolina	2	2.9%	5	7.2%	62	89.9%
Southeast	**2**	**2.0%**	**11**	**11.1%**	**86**	**86.9%**

Of the surveyed South Carolina participants, 80% provided a high satisfaction score (8-10 on a 10-point scale) for Duke Energy overall. Of the surveyed North Carolina participants, 89.9% provided a high satisfaction score (8-10 on a 10-point scale) for Duke Energy overall.

Expectations of Power Manager® Events

Surveyed participants were asked how many times Duke Energy said it would activate the Power Manager® device in a summer. Close to 75% of the surveyed participants didn't know how many control events to expect. A few others didn't provide a number of events but thought they would occur as needed and determined by Duke Energy.

	Don't Know	As Needed
SC	83.3%	0.0%
NC	67.1%	17.1%

Some surveyed participants provided specific numbers or other responses. In North Carolina these responses were:

- 10
- 1 - 2 times per month
- 3 times
- 4-5 times per year
- During 3 or 4 months
- During 4 or 5 months
- During peak times - unclear
- Emergency only
- Every day
- Not a great number

- Only in emergency
- Very infrequently

South Carolina participants had the following expectations for the number of control events:

- 0
- 1
- 6
- Almost never
- Very infrequently & briefly

Expectations of Monetary Incentives for Participation

Surveyed participants were asked to estimate how many dollars they would receive in bill credits for their participation in the Power Manager® program. The responses are in Table 18 and are varied considerably, indicating a general lack of awareness of the bill credit amounts. Most respondents (over 55%) didn't respond with an answer, and instead said they didn't know.

Table 18. Expected of Bill Credits for Participating in Power Manager®

State	Response	Correct	Number	Percent
SC	$32		1	3.3%
	$100		1	3.3%
	$24-$36		1	3.3%
	$30-$40		1	3.3%
	$32 ($8 per month, July thru October)		1	3.3%
	$5/mo.		1	3.3%
	$7 over three months		1	3.3%
	$80-$100		1	3.3%
	about $25		1	3.3%
	Don't know		21	70.0%
NC	$15		1	1.3%
	$20		1	1.3%
	$24		4	5.3%
	$25		1	1.3%
	$32		6	7.9%
	$45		1	1.3%
	$50		1	1.3%
	$60		3	3.9%
	$64		1	1.3%
	$75		1	1.3%
	$100		1	1.3%
	112		1	1.3%
	$10/mo.		1	1.3%

	$24-$32		3	3.9%
	$25-$45		1	1.3%
	$30-$40		1	1.3%
	$32 or $40		1	1.3%
	$40/mo.		1	1.3%
	$8/mo.		1	1.3%
	$8/mo. for 6 months		1	1.3%
	$8/mo. over 4 or 5 months		1	1.3%
	15% reduction in bill		1	1.3%
	Don't know		40	52.6%
	Few dollars per month		1	1.3%
	Zero		1	1.3%

When surveyed participants were asked if they have received any bill credits for their Power Manager® program participation, 40% of them in North Carolina and 56.7% of them in South Carolina didn't know. Eight participants (11.3%) in North Carolina and three participants (10%) in South Carolina said that they did not get any credits when they did in fact get them due to there being events in the summer of 2010. Just over 40% of total survey participants noticed the bill credits for their participation.

Table 19. Did you receive bill credits this year from Duke Energy for participating in this program in 2010?

	NC		SC	
	N	Percent	N	Percent
No	8	11.3%	3	10.0%
Yes	33	46.5%	10	33.3%
Don't Know	30	40.0%	17	56.7%

Despite the uncertainty of many of the participants over bill credits and control events, few of the survey respondents indicated that anything about the program was unclear to them. Only about 14% of those surveyed in North Carolina and 13.3% in South Carolina had some questions about the program.

Table 20. Is anything unclear to you about how the program works?

	NC		SC	
	N	Percent	N	Percent
No	60	84.5%	20	66.7%
Yes	10	14.1%	4	13.3%
Don't Know	1	1.4%	6	20.0%

Survey participants who indicated being unclear on how the program works were asked what was unclear to them. All three survey participants from South Carolina who

provided a response to this followup question indicated that the entire program was unclear to them. The responses in North Carolina included:

- "It's all unclear." (n=6)
- "Does Duke cut the power themselves?"
- "How the cycling works." (n=2)

Survey participants were asked if they called or emailed Duke Energy to find out more about the Power Manager® program. The results are summarized in Table 21.

Table 21. Did you ever call or email Duke Energy to find out more about the Power Manager® Program?

	NC		SC	
	N	Percent	N	Percent
No	70	98.6%	26	86.7%
Yes	1	1.4%	2	6.7%
Don't Know	0	-	2	6.7%

The one surveyed participant from NC that contacted Duke Energy to find out more about the Power Manager® program was not at all satisfied (score of 1 on 1-to-10 scale) with the ease of reaching a Duke Energy representative to discuss the program because there was a slow response to her phone calls trying to enroll in the program. This participant was also unsatisfied (3 score) with how the representative responded to her questions, saying that the representative was "unable to answer or address my questions".

Two surveyed participants from SC that contacted Duke Energy to find out more about the Power Manager® program reported different levels of satisfaction with the ease of reaching a Duke Energy representative to discuss the program and in the results of that call or email. One was very satisfied overall and gave two scores of 10, but the other provided scores of 7 without providing any reasons for his or her dissatisfaction.

Awareness and Response to Activation

Over half of the surveyed respondents are not aware of the Power Manager® control events when they occur either because they are not at home, or did not notice the event or the bill credits for events.

Duke Energy performs operability checks on a sample of the Power Manager switches annually. These inspections have found that a sizable percentage of the Power Manager participants have switches that may not be operating properly and therefore may not be functioning during a control event. Table 22 presents the brand of switches installed at the homes of the surveyed participants. While the Cannon switches have a high percentage of switches that operate correctly during a control event (93%), only 15% of those surveyed had Cannon devices. The majority of surveyed participants (70.7%) have Comverge switches. Studies conducted by Duke Energy indicate that only 40% of the Comverge switches perform reliably during a control event. Customers with PLC switches have 0% operability because Duke Energy does not activate this brand of switch

during control events. The 14 surveyed participants with the PLC switches did not experience a control event. Therefore, about 58% of those responding to the survey had Power Manager switches that were not controlled during the 2010 cooling season. This should be kept in mind while reading the participant survey results, particularly when they say they were uncomfortable during an event. Many of these respondents did not experience any control events.

Table 22. System-Wide Switch Types and Operability (both SC and NC)

Switch Type	Surveyed Participants	Percent	Percent of Operable Switches
Cannon	15	15.2%	93%
Comverge	70	70.7%	40%
PLC[1]	14	14.1%	0%

In 2008, Duke Energy started working on replacing Comverge switches with Cannon switches. This change will improve the program's performance and increase the acquired energy impacts. Duke Energy plans to have this change-out complete by 2013.

Most surveyed participants do not know if Duke Energy has controlled their units. In North Carolina, more than 60% of participants said that they do not know, or they incorrectly said that their units were not controlled. Similarly in South Carolina 63.4% said that they thought their units were not controlled last summer. These results are in agreement with the percent of inoperable switches in the Carolinas.

Table 23. Has Duke Energy activated the Power Manager® device since you joined the program?

	NC		SC	
	N	Percent	N	Percent
No	5	7.1%	2	6.7%
Yes	25	33.3%	11	36.7%
Don't Know	40	53.3%	17	56.7%

Survey participants who indicated being aware of an event were then asked how they knew that the device had been activated. Participants in North Carolina gave the following responses (some participants gave multiple reasons):

- Light on meter. (n=17)
  - Light on AC unit flashes. (n=3)
  - Light on meter, then slow restart.
  - Light on meter and house temperature rises.
- The AC is off. (n=11)
- Temperature in house rises. (n=6)
- Warm inside, no thermostat control, and light on box.

[1] Duke Energy does not use PLC for economic dispatch.

- Thermostat says load control.

In South Carolina, 37% were aware of an event occurring because of the following reasons:

- The AC is off. (n=3)
    - The AC is off and there's a light on the box.
- Temperature in house rises. (n=2)
- Light on meter. (n=3)

None of the South Carolina participants that were surveyed knew how many control events occurred in the past summer (2010). The North Carolina surveyed participants offered some guesses, but 90.7% reported either "none" or that they didn't know. One respondent answered correctly with "8 or 9" events occurring.

Power Manager® allows participants to opt out of control events, but none of the surveyed participants opted out of a control event in the summer of 2010, though two respondents said they didn't know if they had opted out.

Table 24. About how many times did Duke Energy activate your Power Manager® device during this past summer?

	NC		SC	
	N	Percent	N	Percent
2 to 3	3	4.0%	1	3.3%
4 to 5	2	2.7%	0	-
8 or 9	1	1.3%	0	-
A few	1	1.3%	0	-
Don't Know	53	70.7%	28	93.3%
None	15	20.0%	1	3.3%

Table 25. When Duke Energy activates your Power Manager® device, it usually does so on summertime afternoons. Is someone usually home on weekday afternoons during the summertime?

	NC		SC	
	N	Percent	N	Percent
No	12	17.1%	5	16.7%
Yes	58	82.9%	22	73.3%
Don't Know	0	-	3	10.0%

As shown in Table 26, when the participants were asked if they were home during any of the control events, most did not know, however some (18.6% in North Carolina) said that they were home during at least one of the events. Six of the survey respondents in North

Carolina and one in South Carolina indicated that they did feel uncomfortable with the temperature of their home during the event.

Table 26. Were you or any members of your household home when Duke Energy activated your Power Manager® device this past summer?

	NC		SC	
	N	Percent	N	Percent
No	7	10%	0	0%
Yes	13	18.6%	2	6.7%
Don't Know	50	71.4%	28	93.3%

Table 27. During these times of activation, were there any periods of time that you or others at your home felt uncomfortable with the temperature of the home?

	NC		SC	
	N	Percent	N	Percent
No	6	46.2%	1	50%
Yes	7	53.8%	1	50%

All seven respondents that indicated that they felt uncomfortable during the periods of activation indicated that they felt their discomfort was a direct result of the Power Manager® program activation. The four participants that provided a number of times reported feeling this discomfort once, three times, five times, and seven times. Only one customer reported feeling very uncomfortable, while all the others reporting discomfort indicated that they were only somewhat uncomfortable during the control events. Six of the seven feeling discomfort reported that they turned cooling fans on to help them be more comfortable. In addition, three reported that they closed their blinds/shades to keep the sun from shining inside their homes, and two reported that they wore fewer clothes.

Reasons for the Power Manager® Program and Events

We asked the surveyed participants the following question: "*Why do you think Duke Energy activates your Power Manager® device on summertime weekdays during the afternoon as opposed to other times of the day or year?*" The responses are presented in Table 28. The open-ended responses are presented in the second column. The first column "Load or Peak Demand Mentioned" indicates if the respondent mentioned electric load or peak demand issues in their response. Just over half (60.5%) of the participants in North Carolina report that Power Manager® is a way for Duke Energy to control the peak demand. In South Carolina, 46.6% of the respondents mentioned peak demand or load control in their answer.

Table 28. Perceived Reasons for Power Manager®

Load or Peak Demand Mentioned	Why do you think Duke Energy activates your Power Manager® device on summertime weekdays during the afternoon as opposed to other times of	NC		SC	
		N	Percent	N	Percent

	the day or year?				
	Don't Know	13	17.1%	15	50.0%
	Fewer people are home	2	2.6%	0	-
	Hottest part of day	9	11.8%	0	-
	Hottest part of day, most people not at home	1	1.3%	0	-
Yes	Hottest time of day - peak demand	2	2.6%	1	3.3%
Yes	Hottest time of day, most power usage	1	1.3%	0	-
	Least noticeable to customers	1	1.3%	0	-
	Low demand	0	-	1	3.3%
	Most people at work	2	2.6%	0	-
	Most people not home	1	1.3%	0	-
Yes	Peak demand & many people not home	2	2.6%	0	-
Yes	Peak load time	6	7.9%	9	30.0%
Yes	Peak usage time	30	39.5%	4	13.3%
Yes	Reduce load on power grid	5	6.6%	0	-
	Save energy	1	1.3%	0	-

Program Satisfaction

Surveyed respondents indicate a high level of satisfaction with the enrollment process of the Power Manager® program. South Carolina participants report a mean satisfaction score of 9.2 with the enrollment process on a scale of 1 to 10 with 10 meaning they were very satisfied. North Carolina participants report a mean satisfaction score of 8.7 on the ten point scale.

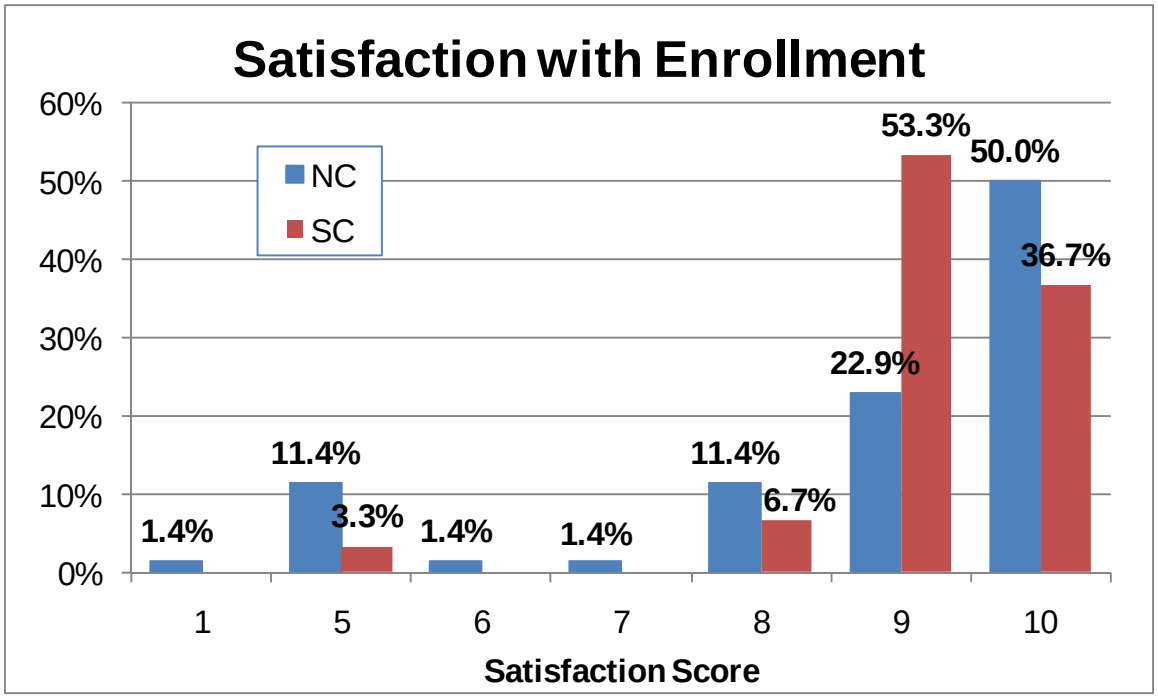


Figure 8. Satisfaction with Power Manager's® Enrollment Process

The following are the reasons for participants reporting low (score of 8 or less) satisfaction scores with the program enrollment. These scores indicate that the customers who provided low satisfaction scores typically do not have a reason for their lower enrollment satisfaction scores.

Reasons for low satisfaction scores in North Carolina:

- Didn't enroll (n=10)
- No reason (n=4)
- Doesn't remember enrolling
- Slow to enroll & provide info

No reasons provided for lower scores in South Carolina.

Overall program satisfaction scores for Power Manager® are an average of 9.0 in South Carolina and 8.8 in North Carolina. These scores are statistically identical because of the small survey sample in South Carolina. Also of note is that in North Carolina half of the survey respondents report a satisfaction score of 10 with the Power Manager® program.

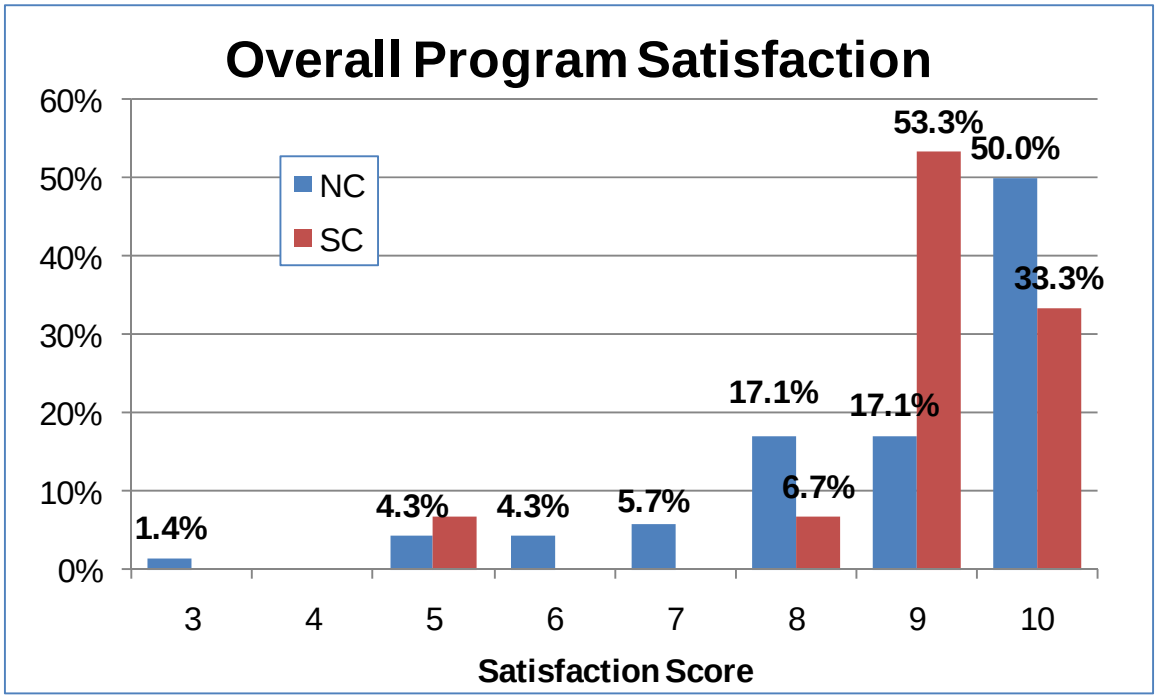


Figure 9. Overall Program Satisfaction

The following are the reasons for participants reporting low (score of 8 or less) satisfaction scores with the program overall in North Carolina:

- Bill credits/incentives not high enough (N=4)
- Uncomfortable during device activation (N=4)

- Bill rose on unused outbuilding - no explanation
- Landlord set it up, but good idea
- Not sure what happens with it
- Start program events earlier in the year
- They want more information on how it works.
- Took several calls to enroll
- Reduced bill credits since he enrolled

The following are the reasons for participants reporting low (score of 8 or less) satisfaction scores with the program overall in South Carolina:

- Uncomfortable during device activation (N=2)
- Bill credits/incentives not high enough

The majority of surveyed participants (94.3% in North Carolina and 76.7% in South Carolina) would recommend the Power Manager® program to others. Only one surveyed participant in North Carolina said he or she would not recommend the program and gave the reason that the discomfort caused by the program events outweighed the savings.

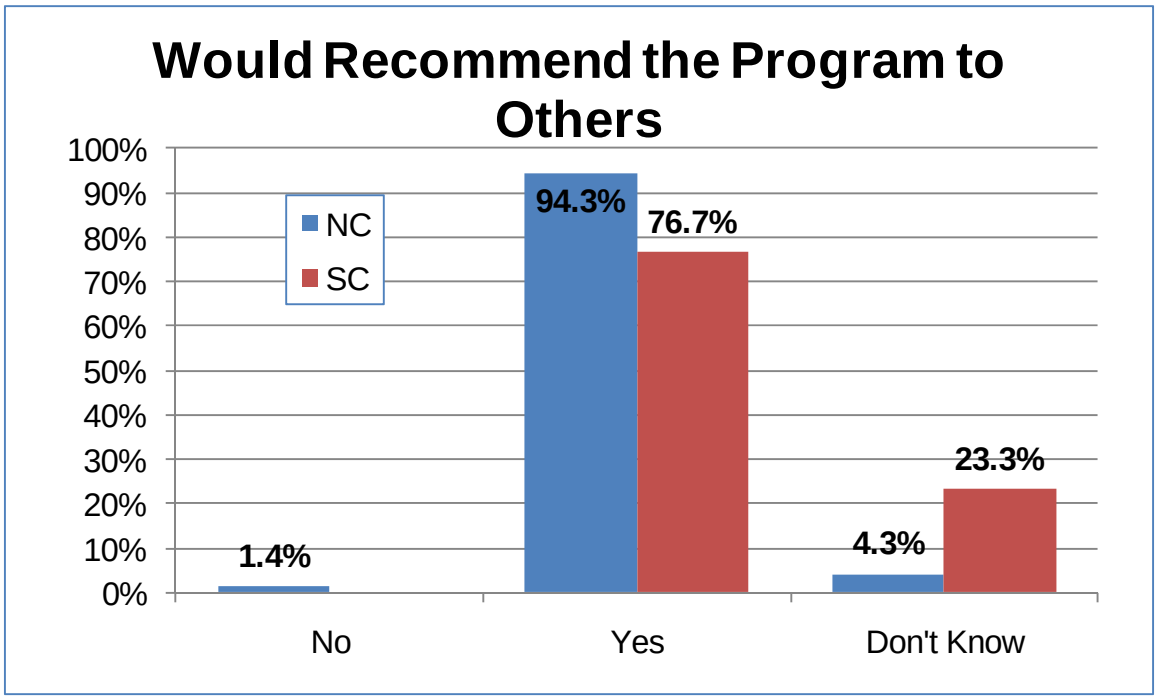


Figure 10. Percent of Participants that would Recommend the Program to Others

Awareness of Other Duke Energy Programs

We asked the surveyed participants if they were aware of any other Duke Energy programs. Slightly more than a third (34.3%) of the North Carolina participants were able to name other programs. Twenty percent were able to name the CFL Program.

	NC (n=70)		SC (n=30)	
	N	Percent	N	Percent
CFL Program	14	20.0%	2	6.7%
Energy Star Homes	6	8.6%	0	-
Personalized Energy Report	0	-	0	-
Smart Saver	0	-	0	-
Home Energy House Call	4	5.7%	1	3.3%
Low Income Program	2	2.9%	1	3.3%
Get Energy Smart K12 Program	0	-	0	-
Total	24	34.3%	4	13.3%

Interest in Other Duke Energy Programs

Even with many of the surveyed participants not fully understanding the program, or noticing that they are receiving credits for their participation, Table 29 shows that more than half of the North Carolina participants and more than 40% of South Carolina participants indicate that they would be interested in participating in other load control programs if Duke Energy were to offer them.

Table 29. If Duke Energy were to offer a program that cycles other equipment at your home such as an electric water heater, would you be interested in participating?

	NC		SC	
	N	Percent	N	Percent
No	24	34.3%	11	36.7%
Yes	41	58.6%	13	43.3%
Don't Know	5	7.1%	6	20.0%

We then asked participants what kinds of programs or services they think that Duke Energy should offer to its customers. Their responses are bulleted below.

North Carolina:

- "Credit for energy-efficient appliances & more tree-trimming above power lines, especially in winter."
- "Hard to get response to power outage complaints" - wants to know estimated time for the return of power.
- "Payment centers in safe neighborhoods"
- "Solar and renewable energy bill credits"
- "More detail on rates in bill and how to reduce usage"
- "More local payment/service centers"

- "Stop raising rates so much"
- "Rate reduction for people on fixed incomes"
- "Rebates for improving energy efficiency"

South Carolina:

- "More CFLs please"
- "Stop the environmentalist agenda"
- "Homeowner information about things that should be inspected / monitored."

Air Conditioner Practices

We asked the surveyed participants about their air conditioning use. First we asked if they used their air conditioner on only the hottest days of the cooling season, or if they used it frequently, most days, every day, or not at all. More than two-thirds of the North Carolina surveyed participants report that they use their air conditioner every day during the cooling season, and another 17.1% report they use their air conditioners most days. In South Carolina those percentages are 86.7% and 10% respectively. The Power Manager® program in North Carolina is successful in enrolling participants that use their air conditioners on the hottest days, which is the targeted group of customers that would allow this program to reduce load through control events. None of the surveyed participants from either indicated that they never use their air conditioner.

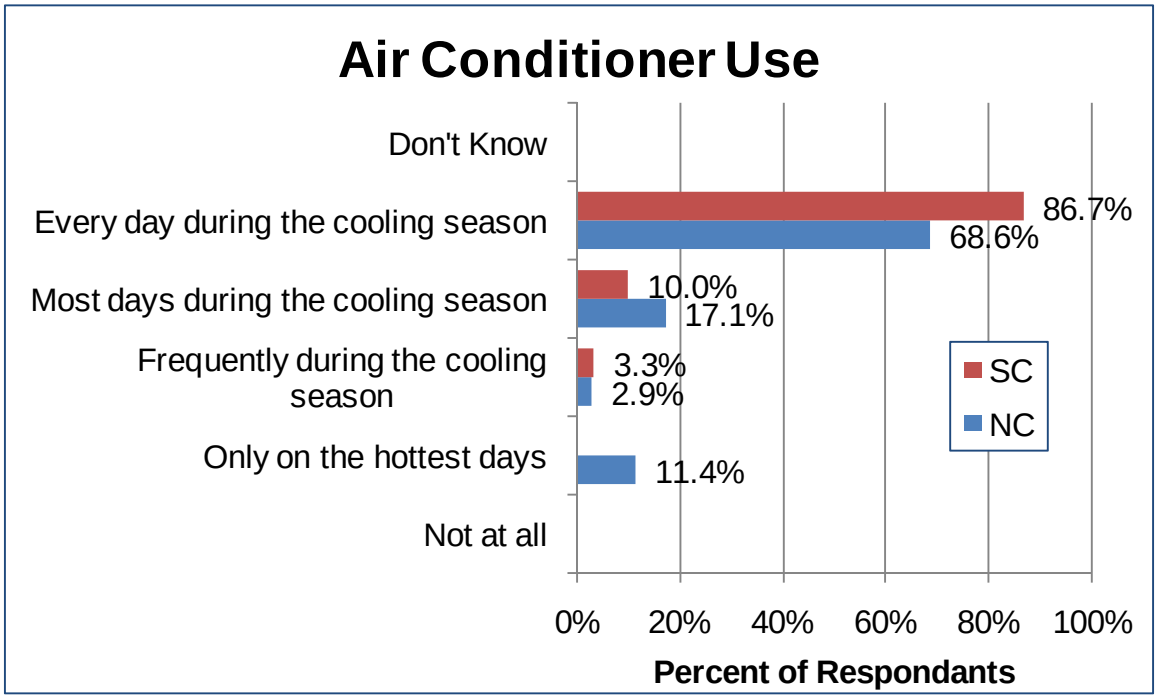
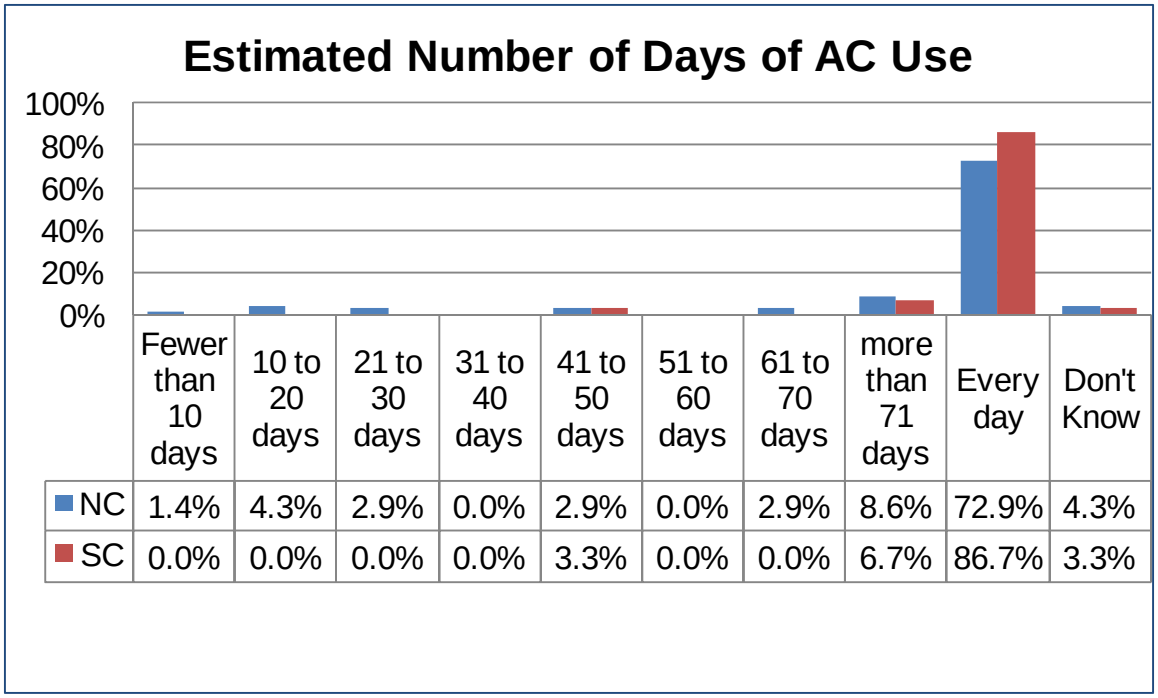


Figure 11. Air Conditioner Use of Power Manager® Participants

We then asked the surveyed participants to estimate how many days they had their air conditioners on during the summer of 2010. These results are presented in Figure 12.

These results match closely to the estimates provided in Figure 11, and a significant correlation between these two responses (.848) is shown in Table 30, indicating that these self-reported values are likely to be an accurate representation of the participants' air conditioner use.



	Fewer than 10 days	10 to 20 days	21 to 30 days	31 to 40 days	41 to 50 days	51 to 60 days	61 to 70 days	more than 71 days	Every day	Don't Know
NC	1.4%	4.3%	2.9%	0.0%	2.9%	0.0%	2.9%	8.6%	72.9%	4.3%
SC	0.0%	0.0%	0.0%	0.0%	3.3%	0.0%	0.0%	6.7%	86.7%	3.3%

Figure 12. Estimated Number of Days of Air Conditioner Use, Summer 2010

Table 30. Correlation of Air Conditioner Use Responses

		How often do you use your central air conditioner? Would you say you use it ...	About how many days would you estimate that you had your air conditioner on during the summer of 2010?
How often do you use your central air conditioner? Would you say you use it ...	Pearson Correlation	1	.848**
	Sig. (2-tailed)		.000
	N	100	96

** Correlation is significant at the 0.01 level (2-tailed).

Eighty-eight percent of the North Carolina participants and 80% of the South Carolina participants that were surveyed reported that they had someone tune-up or repair their air conditioner in the time since they enrolled in the Power Manager® program.

Table 31. Respondents Receiving AC Services (tune-up or repair) since Enrolling in Power Manager®

	NC		SC	
	N	Percent	N	Percent
No	6	8.6%	5	16.7%
Yes	62	88.6%	24	80.0%
Don't Know	2	2.9%	1	3.3%

Most of the surveyed participants in North and South Carolina had their air conditioner serviced by an AC contractor.

	NC		SC	
	N	Percent	N	Percent
Air conditioning contractor	56	90.3%	22	91.7%
Electrician	1	1.6%	0	-
Friend	1	1.6%	0	-
Homeowner	1	1.6%	1	4.2%
Don't Know	3	4.8%	1	4.2%

Table 32. Did the performance of your air conditioner improve after you had it serviced?

	NC		SC	
	N	Percent	N	Percent
No	23	37.1%	5	20.8%
Yes	33	53.2%	15	62.5%
Don't Know	6	9.7%	4	16.7%

Surveyed participants report that there is usually someone at the home and using the air conditioner on weekday summer afternoons in 88.6% of homes in North Carolina.

Table 33. Is the air conditioner typically used to keep someone at home comfortable during weekday summer afternoons before 5 P.M.?

	NC		SC	
	N	Percent	N	Percent
No	8	11.4%	5	16.7%
Yes	62	88.6%	25	83.3%

Nearly all surveyed participants in both states (97.1% in North Carolina and 100% in South Carolina) report that there are people in the house using the air conditioner on weekend summer afternoons.

Table 34. Is the air conditioner typically used to keep someone at home comfortable during weekday summer afternoons after 5 P.M.?

	NC		SC	
	N	Percent	N	Percent
No	2	2.9%	0	-
Yes	68	97.1%	30	100%

Outside Temperatures and Thermostat Settings

Surveyed Power Manager® participants were asked to think about a hot and humid summer day, and then tell us at what outside temperature they start to feel uncomfortably warm. The responses are presented in Figure 13. The average temperatures of discomfort are 84.5°F in South Carolina and 85.7°F in North Carolina.

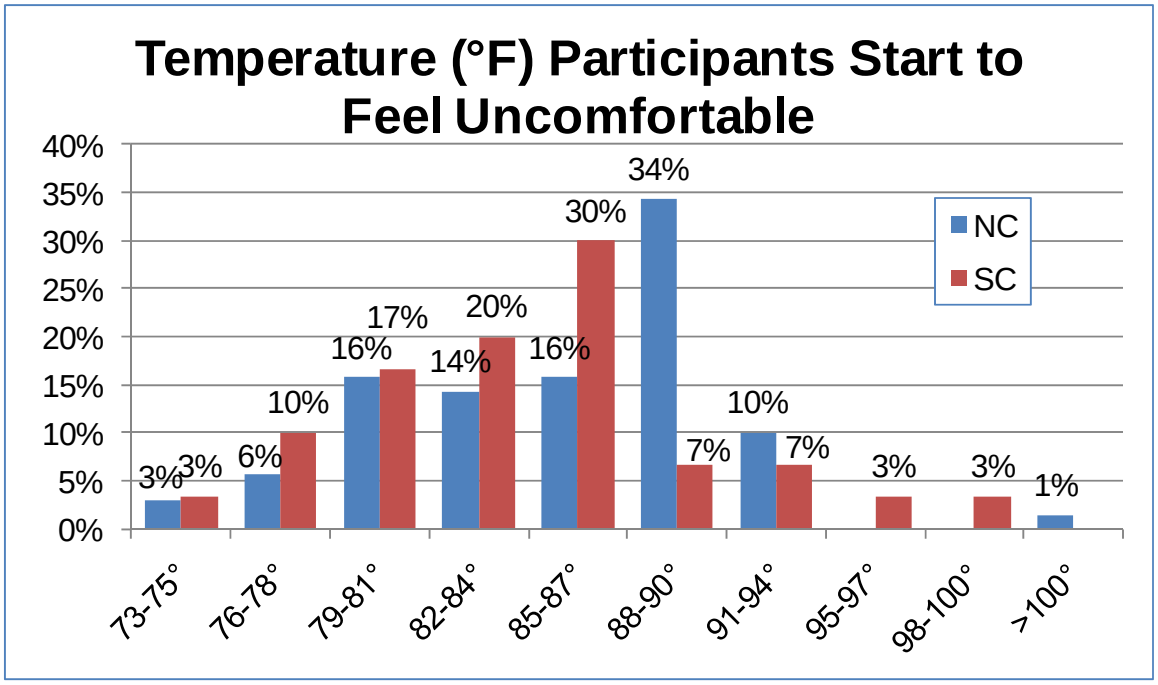


Figure 13. Outside Temperatures at Which Participants Feel Uncomfortably Warm

We then asked the surveyed participants at what outside temperature they tend to turn their air conditioners on. The average outside temperatures for which air conditioners are turned on are 81.7°F in South Carolina (half a degree higher than their discomfort level) and 83.3°F in North Carolina (1.4°F lower than their discomfort level). The frequency of responses are presented in Figure 14.

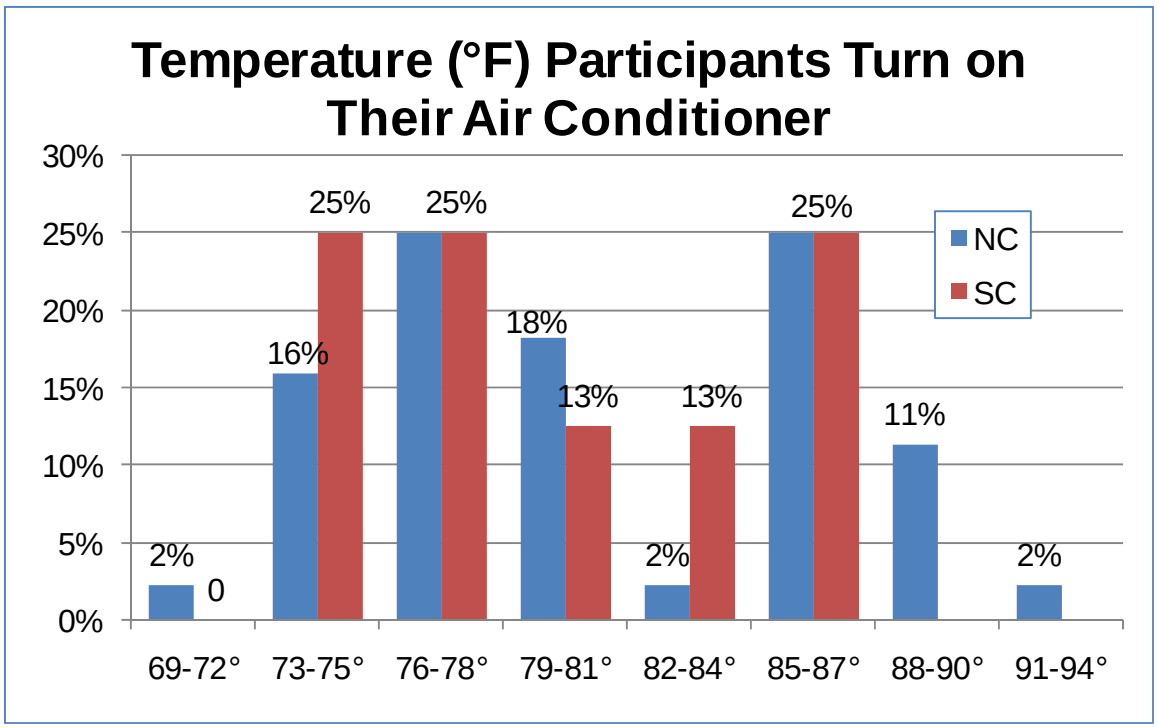


Figure 14. Outside Temperatures that Participants Turn On Their Air Conditioners

Comparing these two temperature points (of discomfort and when participants turn on their air conditioners) provides us with Figure 15, which shows that the majority (64.4%) of North Carolina participants turn on their air conditioners before the temperature becomes uncomfortable, many (28.9%) turn it as the outside temperature becomes uncomfortable temperatures, and very few (6.7%) of them wait until the temperature is higher than when they are uncomfortable. In South Carolina the first two ratios are reversed: twenty-five percent of survey respondents indicate that they turn on their air conditioner in anticipation of uncomfortable temperatures while 75% turn it as the outside temperature becomes uncomfortable.

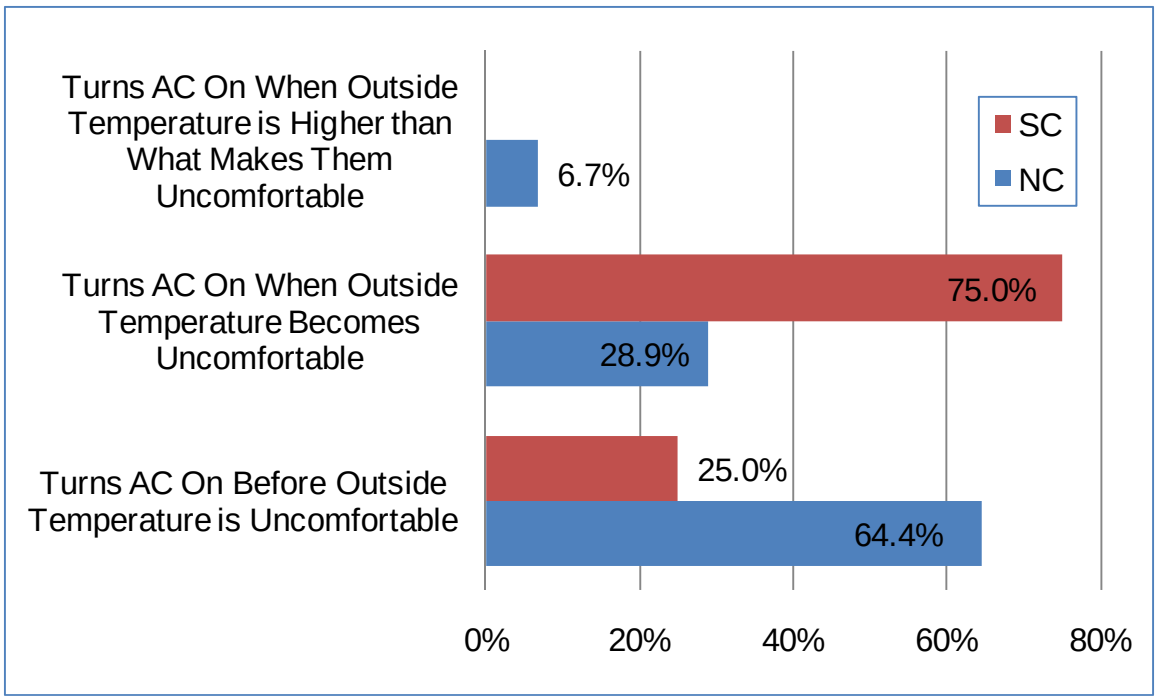


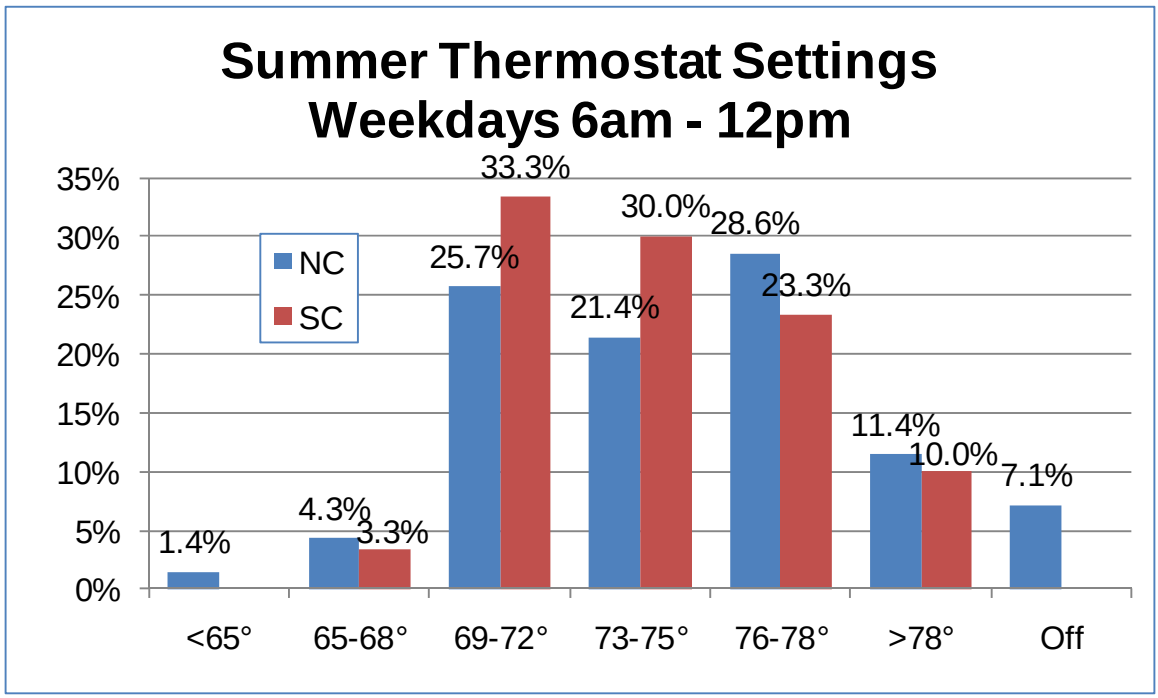
Figure 15. Percent of Participants Turning Their Air Conditioners When Temperatures Reach an Uncomfortable Level

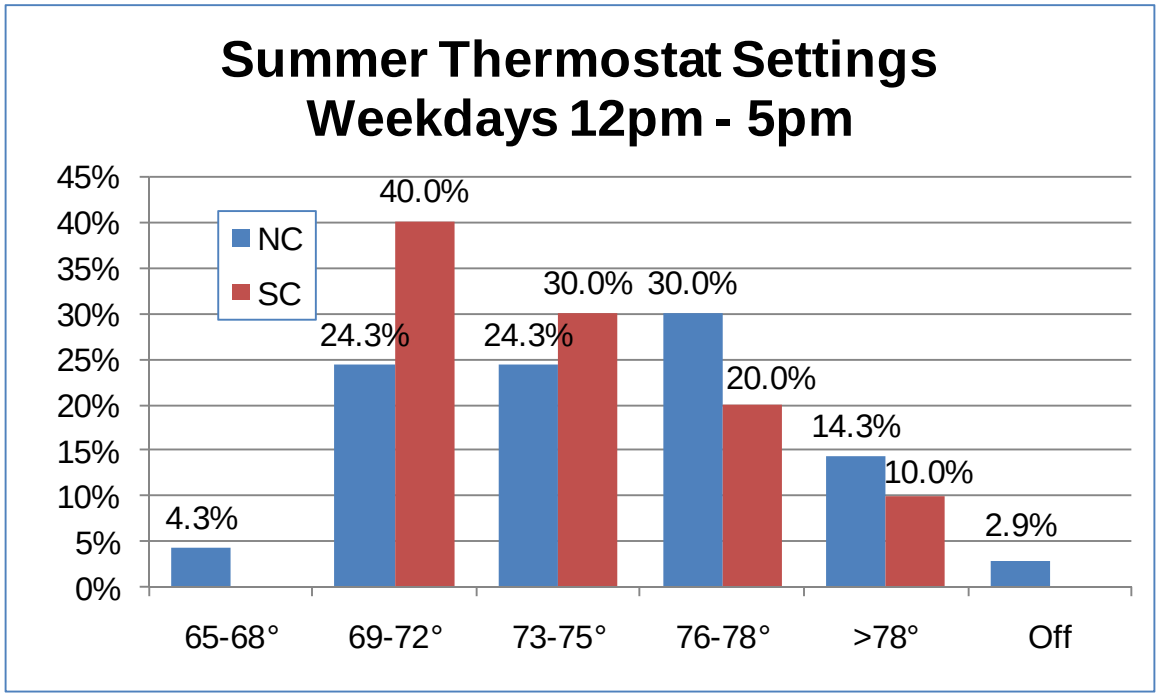
If the respondent indicated that the AC is turned on at a certain temperature through their programmed thermostat, we asked the participant if they set the thermostat seasonally or if they set it when the weather gets hot.

	NC	SC
I program the thermostat seasonally	20	21
When the weather gets hot	5	1

Thermostat Settings

The following graphs present the frequencies of thermostat settings of the South Carolina and North Carolina surveyed participants on weekdays and weekends at four time periods throughout the day (6am-12pm, 12pm-5pm, 5pm-10pm, and 10pm-6am). All eight of these graphs show that the most common thermostat setting over all days and time periods is 69-72°F.





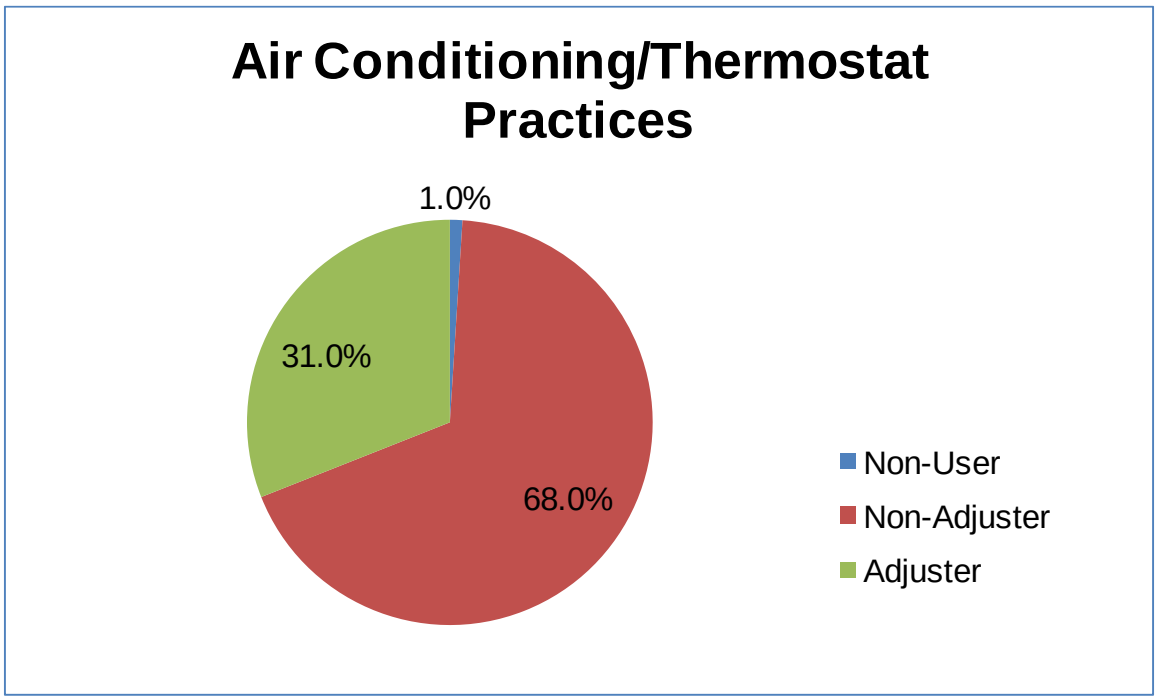
Most of the Power Manager® participants leave their settings the same every day, from weekdays to weekends. South Carolina respondents report that they are more likely to turn off the AC during the week from 6am-12pm, and North Carolina participants are more likely to lower their AC temperature settings (using more energy) on weekends

from 12-5pm. There were a few participants reporting that they set their thermostats to higher temperature settings during the weekends, as is noted in the footnotes.

Table 35. Changes in Thermostat Settings of Power Manager® Participants

	NC			SC		
Time period	Same every day	Lower AC temperature on weekends	Off during the week, on weekends	Same every day	Lower AC temperature on weekends	Off during the week, on weekends
6am-12pm	95.7%	1.4%	2.9%	86.7%	13.3%	0.0%
12pm-5pm	95.7%	0.0%[2]	0.9%	86.7%	13.3%	0.0%
5pm-10pm	97.1%	0.0%[3]	1.4%	100.0%	0.0%	0.0%
10pm-6am	100.0%	0.0%	0.0%	96.7%	0.0%	0.0%[4]

We found that there are three types of customers in the Power Manager® participant group. Those that turn their air conditioners on to a set temperature and leave it at that temperature all day, every day (non-adjusters), those that change the temperature settings (adjusters), and those that don't use their air conditioners (non-users). Figure 16 below shows that 68% of the surveyed Power Manager® participants are "non-adjusters". Thirty-one percent of the participants adjust their thermostat settings at some point during the week, and 1% do not use their air conditioner much, if at all.



[2] Two participants indicated that they set the thermostat at a higher temperature (1-3°) setting on the weekends during this time period.
[3] One participant indicated that they set the thermostat at a higher temperature (1-3°) setting on the weekends during this time period.
[4] One participant indicated that they set the thermostat at a higher temperature (1-3°) setting on the weekends during this time period.

Figure 16. Thermostat Practices of Power Manager® Participants

We split the surveyed participants into these three groups to calculate the outside temperature points at which they become uncomfortable and turn on their air conditioners. Table 36 presents these mean temperature points. Non-users have a much higher tolerance for high outdoor temperatures than the adjusters and non-adjusters. However, they reported early in the survey that they will turn their air conditioners on when the temperature reaches about 79°F.

Non-adjusters become uncomfortable when the outside temperature reaches 84°F in North Carolina, and will turn their air conditioners on when the outside temperature reaches 79°F and set the thermostat for 73°F.

Table 36. Temperature Points for Three Groups of AC Users

Non-Users	NC	SC
Mean Temperature of Discomfort	91	-
Mean Temperature to Turn AC On	85	-
Non-Adjusters		
Mean Temperature of Discomfort	84	82
Mean Temperature to Turn AC On	79	78
Mean Temperature of Thermostat	73	72
Adjusters		
Mean Temperature of Discomfort	85	84
Mean Temperature to Turn AC On	81	80

Those that make adjustments to their thermostats have a lot of variation in their patterns of adjustment. Table 37 presents the mean thermostat settings for this group of Power Manager® participants, along with the percent of participants that have their air conditioners turned off during different times of day on the weekends and weekdays.

Table 37. Adjusters' Mean Thermostat Settings

Adjusters	NC		SC	
Mean Temperature of Discomfort	8.14		7.8	
Mean Temperature to Turn AC On	6.85		6.5	
	Weekday	Weekend	Weekday	Weekend
Mean Thermostat Setting 6am-12pm	73	73	73	71
Percent with Thermostats Off	19.0%	9.5%	0.0%	0.0%
Mean Thermostat Setting 12pm-5pm	75	75	73	70
Percent with Thermostats Off	4.8%	0.0%	0.0%	0.0%
Mean Thermostat Setting 5pm-10pm	75	75	69	69
Percent with Thermostats Off	4.8%	0.0%	0.0%	0.0%
Mean Thermostat Setting 10pm-6am	73	73	69	69
Percent with Thermostats Off	19.0%	19.0%	0.0%	0.0%

Satisfaction with Duke Energy

Overall satisfaction with Duke Energy is quite high. South Carolina participants report an average satisfaction score of 8.8 on a ten-point scale, and North Carolina participants report a slightly higher average score of 8.9. The frequency of responses are presented in Figure 17.

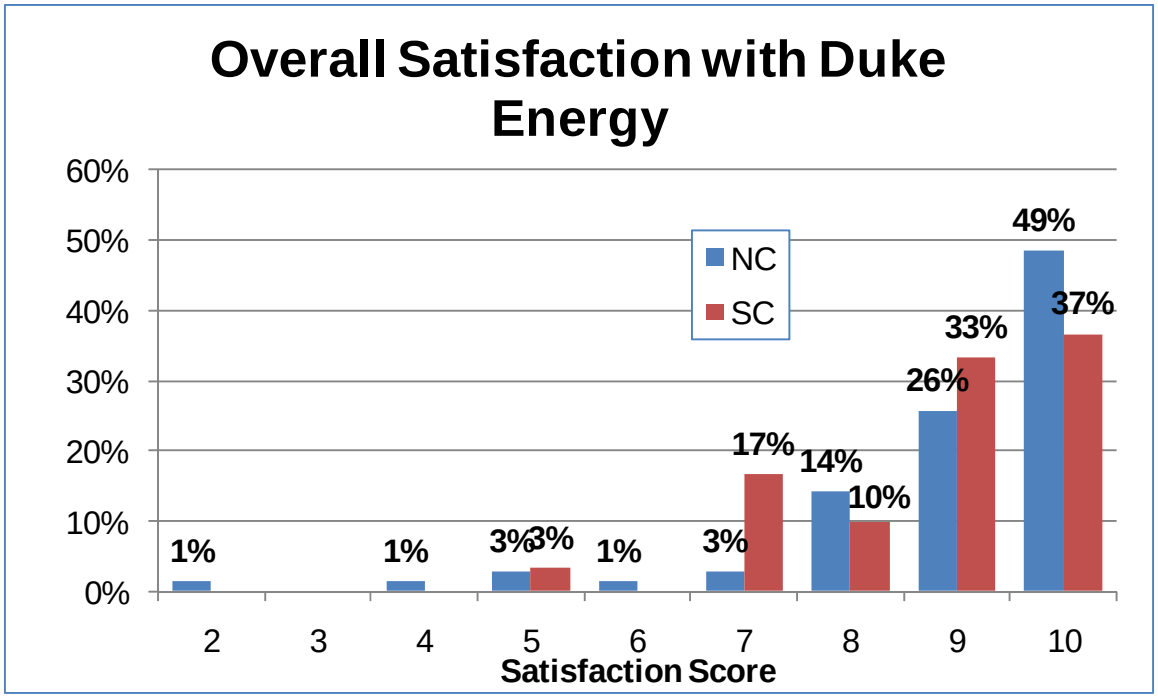


Figure 17. Overall Satisfaction with Duke Energy

The following are the reasons for participants reporting low (score of 8 or less) satisfaction scores with Duke Energy overall in North Carolina:

- "When the power is out, our street is last to resume power."
- "Duke won't help remove some nearby outdoor lights."
- "Dead tree needs cutting above easement."
- "Bill should list rate per kWh."
- "Poor management. Stock value has fallen."
- "They should have cleaner power plants."
- "Rates are too high."
- "Lack of service centers and poor quality of service."
- "Rude customer service and lack of extension periods" (automatic deferments don't synch with her payroll).
- "No payment centers" - doesn't trust Internet security.

In South Carolina:

- "Rates are too high." (n=2)

- “The power goes out when there are ice storms.”
- “Could do a better job of trimming tree limbs to prevent outages from ice storms.”
- “Took a long time (6 weeks) to respond to a problem (fixing an outside light Duke maintains).”
- “Problems during move-in weren't taken care of promptly, required repeated calls and emails to Duke.”

Section 4: Power Manager Modeling

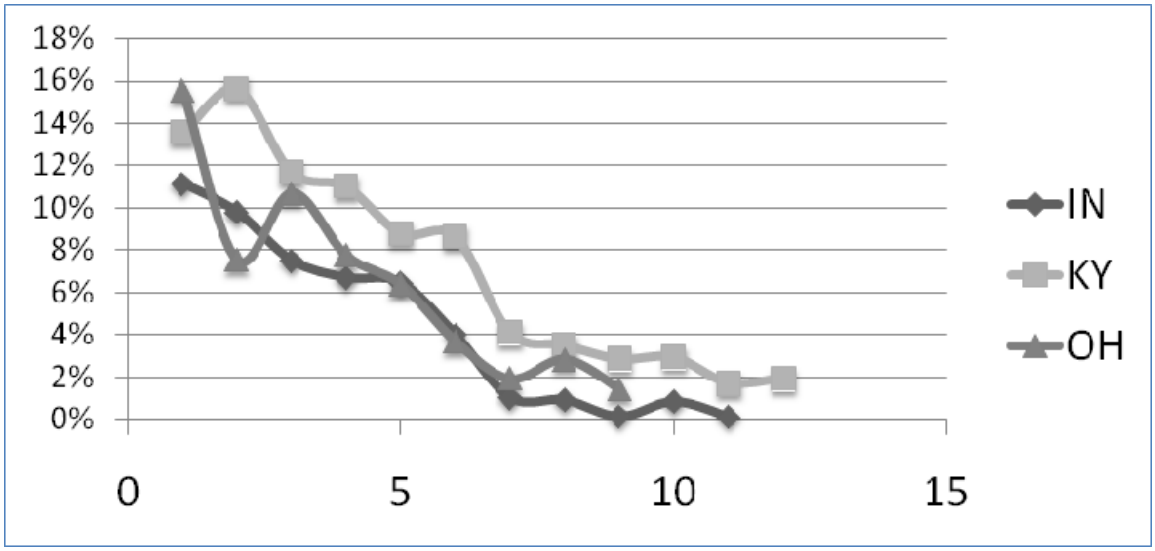
Duke Energy conducted an analysis on the type of customer likely to participate in Power Manager. They found that the Power Manager participant is likely to:

- Have had some college education
- Own their own home
- Have central air conditioning
- Have a higher average daily billed quantity
- Participate in the following programs: CFL, HEHC, Personalized Energy Report, Internet, or Budget Billing

The Power Manager participant is likely to have:

- Indiana: Low Home and Land Values, Smaller Unit Size, More Available Equity, Medium Land Size, Older / long time resident
- Kentucky: High Home Value, High Land Value, Average Mortgage Amount, Older / long time resident, Lower Percentage of Delinquent Profile Trades
- Ohio: Older Home, Large Home, Small Land Size, Higher Loan to Current Value, Higher Mortgage Amount, Higher Income, Lower Risk Score, Younger

Power Manager participation rates tend to decrease for multiple solicits, with the exception of KY, which shows slightly higher participation after the second solicit.



Appendix A: Program Manager Interview Instrument

Name: _____

Title: _____

Position description and general responsibilities:

_____

_____

_____

We are conducting this interview to obtain your opinions about and experiences with the Power Manager® program. We'll talk about the Power Manager® Program and its objectives and your thoughts on improving the program. The interview will take about two to three hours to complete. May we begin?

Program Objectives & Operations

1. In your own words please describe how the Power Manager® program works, go over its design, marketing and operational approaches. Walk us through the participatory steps starting with a customer who knows nothing about the program.
   2. Outreach and Marketing
   3. Enrollment
   4. Event Call
   5. Response
   6. Payment

7. Please describe your role and scope of responsibility in detail. What is it that you are responsible for as it relates to this program? When did you take on this role?

8. Do you feel that you have enough time and resources to adequately manage this program? Did you receive the support that you need to manage this program? What else is needed?

9. In your own words, please briefly describe the Power Manager® Program's objectives. Any other objectives?

10. Have these objectives changed in the last year or so, and if so how? Why?

11. In your opinion, which objectives do you think are being met or will be met?

12. Should the current objectives be changed in any way because of market conditions, other external or internal program influences, or any other conditions that have developed since the program objectives were devised? What changes would you put into place, and how would it affect the objectives?

13. Are there any conditions that are associated with the program or the market that are not being addressed or that you think should have more attention? If yes, which ones? How should these conditions be addressed? What should be changed? How do you think these changes will increase program participation or impacts?

14. Do you think the materials and information presented to the residential customer about the Power Manager® program provides a complete enough picture for them to understand the potential importance of the program to them and their participatory benefits of the program?

15. Do you think the incentives offered through the Power Manager® program are adequate enough to entice the residential customer to enroll in the program? Why or why not? What can be improved in the area of incentives or enticements?

16. Are there any changes to the incentives or marketing that could possibly increase participation in the program? What would happen if the incentives were decreased or increased, how would this impact your ability to acquire power reductions?

17. What kinds of marketing, outreach and customer contact approaches do you use to make your customers aware of the program? Are there any changes to the program marketing that you think would increase participation?

Program Design & Implementation

18. What market information, research or market assessments are you using to determine the best target markets or customer segments to focus on?

19. What market information, research or market assessments are you using to identify market barriers, and to develop more effective enrollment approaches?

20. How do you track, manage, and monitor or evaluate customer response?

21. What is the quality control, tracking and accounting process for determining how well control strategies work for the 100 panel members and for the typical customer?

24. Do you have any suggestions for how program participation can be increased?

25. Are there any other issues or topics you think we should know about and discuss for this evaluation?

26. Please tell me about the events that were called in 2010. How many events were called? Why were they called? Were these economic or emergency events?

27. How were the events called? What did you learn from the event call process? What was the biggest surprise? What could be done to improve the way the decision to call an event events are called in the future?

28. Did you achieve the load shift you needed? How do you know this? How do you know this beyond the panel members?

29. Did you know why some customers were not able to shed load? What were some of the reasons? Where there any customers who shed more load than expected? What were some of the reasons they did so?

30. How well did the payment process operate? Did the program staff come across any issues or problems with payment? How were they resolved?

Overall Power Manager® Management

22. We have discussed the communication problems with the switches and the failure rates in the previous evaluation. Did you experience the same problems in 2010? What has been and is being done to deal with this issue? Do you have any suggestions for improving this in addition to the approaches being taken?

23. Describe the use of any internal or outside program advisors, technical groups or organizations that have in the past or are currently helping you think through the program's approach or methods. How often do you use these resources? What do you use them for?

24. Overall, what about the Power Manager® Program works well and why?

25. What doesn't work well and why? Do you think this discourages participation?

26. What are the key market or operational barriers that impede a more efficient program operation or limit obtainable impacts?

27. In what ways can the Power Manager® Program's operations be improved?

28. If you could change any part of the program what would you change and why?

29. What would you say were some of the program's biggest successes?

Thank you for your time…

Appendix B: Participant Survey Instrument

Use five attempts at different times of the day and different days before dropping from contact list. Call times are from 10:00 a.m. to 8:00 p.m. EST or 9-7 CST Monday through Saturday. No calls on Sunday. (Sample size N =100)

SURVEY

Introduction

Note: Only read words in bold type.

Introduction

Hello, my name is _____, and I'm calling on behalf of Duke Energy. According to our information, you presently participate in Duke Energy's Power Manager® Program. This program allows Duke Energy to cycle your air conditioner when there is a critical need for electricity in the region. This survey will take about 15 minutes to complete, and the information you provide will be confidential and will help to improve the program.

1. **Are you aware of your participation in the Power Manager® program?**

❑ Yes ❑ No ❑ DK

If no, **May I please speak to the person who would be most familiar with your household's participation in the Power Manager® program?**

If not available, try to schedule a callback time. If transferred, begin survey from beginning (Introduction).

Participation Drivers

We would like to collect some information on why you agreed to participate in the program and how you heard about it.

2. **Were you involved in the decision to participate in Duke Energy's Power Manager® Program?**

❑ Yes ❑ No ❑ DK

If no, skip to question 5.

3. **Do you recall how you first heard about the program?**

❑ Yes ❑ No ❑ DK

If yes, 3a. **How did you hear about the Power Manager® Program?**

a) ❑ utility bill insert
b) ❑ direct mail offer from Duke Energy
c) ❑ utility website
d) ❑ Word-of-mouth (friend/neighbor/landlord)
e) ❑ Newspapers
f) ❑ Social network: _____
g) ❑ Don't know
h) ❑ Other: _____

4. **To the best of your ability, could you please tell me what the promoted benefits of the program were?**

a) ❑ _____
b) ❑ Don't Know.

5. **What was the main reason why you chose to participate in the program**?

a) ❑ For the bill credits
b) ❑ Helping Duke avoid power shortages/outages
c) ❑ To save energy
d) ❑ To save money (through lower utility bills)
e) ❑ To help the environment
   a. Please explain: (to reduce carbon or GHG, etc…)
   _____
f) ❑ I don't use the air conditioner much
g) ❑ I'm usually not home when the events are supposed to occur
h) ❑ Don't know
i) ❑ Other: _____

5a. **Do you recall reading about this benefit on the program brochure?**

❑ Yes ❑ No ❑ DK
❑ Did not get brochure ❑ Do not remember brochure

6. **What were your other reasons for choosing to participate in this program?**

a) ❑ For the bill credits
b) ❑ Helping Duke avoid power shortages/outages
c) ❑ To save energy (through lower utility bills)
d) ❑ To save money
e) ❑ To help the environment
   a. Please explain: (to reduce carbon or GHG, etc…)
   _____
f) ❑ I don't use the air conditioner much
g) ❑ I'm usually not home when the events are supposed to occur
h) ❑ Don't know
i) ❑ Other: _____
j) ❑ No other reasons.

6a. **Do you recall reading about this benefit on the program brochure?**

❑ Yes ❑ No ❑ DK
❑ Did not get brochure ❑ Do not remember brochure

7. **Generally speaking, how important are environmental issues to you? Would you say they are…**
   a. ❑ **Very Important**
   b. ❑ **Important**
   c. ❑ **Neither Important Nor Not Important**
   d. ❑ **Not Important, or**
   e. ❑ **Not At All Important**

8. **How important are climate change issues to you? Would you say they are…**
   a. ❑ **Very Important**
   b. ❑ **Important**
   c. ❑ **Neither Important Nor Not Important**
   d. ❑ **Not Important, or**
   e. ❑ **Not At All Important**

9. **How important is reducing air pollution to you? Would you say it is…**

   a. ❑ **Very Important**
   b. ❑ **Important**
   c. ❑ **Neither Important Nor Not Important**
   d. ❑ **Not Important, or**
   e. ❑ **Not At All Important**

10. **How important is the need to reduce the rate of building new power plants? Would you say it is…**

a. **Very Important**
b. **Important**
c. **Neither Important Nor Not Important**
d. **Not Important**
e. **Not At All Important**

11. **Are you a member of any groups or clubs that have environmental missions?**

❑ Yes ❑ No ❑ DK

If yes, 11a. **Which ones?**

a) ❑ List: _____
b) ❑ Don't know

Understanding the Program

12. **Before you enrolled in the program, you received program information from Duke Energy that described how the program works. Using a scale of 1 to 10 where 1 indicates "Very Dissatisfied" and 10 indicates "Very Satisfied", how satisfied were you with this information in helping you to understand how the program works?**

1 2 3 4 5 6 7 8 9 10

If 8 or below, 12b. **Why were you less than satisfied with this information?**

_____

❑ DK

13. **How often per year did Duke Energy say it would activate the Power Manager® device on your air conditioner?**

_____

❑ DK

14. **What's your best estimate of how many dollars you will receive in yearly bill credits from Duke Energy for participating in the Power Manager® program?**

a) ❑ $____
b) ❑ Don't know

15. **According to our information you participated in this program in 2010. Did you receive bill credits this year from Duke Energy for participating in this program in 2010?**

❑ Yes ❑ No ❑ DK

16. **Is anything unclear to you about how the program works?**

❑ Yes ❑ No ❑ DK

If yes, 16a. **What is unclear to you?**

_____

❑ DK

17. **Did you ever call or email Duke Energy to find out more about the Power Manager® Program?**

❑ Yes ❑ No ❑ DK

If no, skip to question 18.

If yes, 17a. **Using a scale of 1 to 10 where 1 indicates "Very Dissatisfied" and 10 indicates "Very Satisfied", how satisfied were you with the ease of reaching a Duke Energy representative?**

1 2 3 4 5 6 7 8 9 10

If 8 or below, 17b. **Why were you less than satisfied?**

_____

17c. **Using a scale of 1 to 10 where 1 indicates "Very Dissatisfied" and 10 indicates "Very Satisfied", how satisfied were you with how the person responded to your questions?**

1 2 3 4 5 6 7 8 9 10

If 8 or below, 17d**. Why were you less than satisfied with this information?**

a) ❑ Didn't respond to my questions/ concerns
b) ❑ Unable to answer/address my questions/concerns
c) ❑ Not professional/courteous
d) ❑ Other: _____
e) ❑ Don't know

Program Experience

18. **Has Duke Energy activated the Power Manager® device since you joined the program?** *[If they ask what this means, respond with: "Duke Energy has the ability to send a signal to activate the device to cycle your central air conditioner on and off during an event." Repeat the question.*

❑ Yes ❑ No ❑ DK

19. **How do you know when the device has been activated?**

a) ❑ _____
b) ❑ Don't know

20. **About how many times did Duke Energy activate your Power Manager® device during this past summer?**

a) ❑ _____
b) ❑ Don't know

21. **Were you or any members of your household home when Duke Energy activated your Power Manager® device this past summer?**

❑ Yes ❑ No ❑ DK

If no or don't know, skip to question 23.

22. **During these times of activation, were there any periods of time that you or others at your home felt uncomfortable with the temperature of the home?**

❑ Yes ❑ No ❑ DK

If no or don't know, skip to question 23.
If yes, 22a. **Do you feel that this was caused in any way by the program's cycling of your air conditioner?**

❑ Yes ❑ No ❑ DK

22b. **Thinking about this past summer, how many times do you think the activation of the Power Manager® program affected your level of comfort?**

a) ❑ _____
b) ❑ Don't know

22c. **During these times, how would you describe your level of comfort? Would you say that you were very uncomfortable, or somewhat uncomfortable?**

a) ❑ Very Uncomfortable
b) ❑ Somewhat Uncomfortable
c) ❑ Didn't notice a change in comfort
d) ❑ DK

22d. **When Duke Energy activated your Power Manager® device, did you or any other members of your household turn on any fans to keep cool?**

❑ Yes ❑ No ❑ DK

22e. **What else did you or other members of your household do to keep cool?**

a) ❑ Continued normal activities/ Didn't do anything different
b) ❑ Turned on room/window air conditioners
c) ❑ Closed blinds/shades
d) ❑ Moved to a cooler part of the house
e) ❑ Left the house and went somewhere cool
f) ❑ Wore less clothing
g) ❑ Drank more water/cool drinks
h) ❑ Turned on fans
i) ❑ Opened windows
j) ❑ Other: _____
k) ❑ Don't know

23. **When Duke Energy activates your Power Manager® device, it usually does so on summertime afternoons. Is someone usually home on weekday afternoons during the summertime?**

❑ Yes ❑ No ❑ DK

24. **Why do you think Duke Energy activates your Power Manager® device on summertime weekdays during the afternoon as opposed to other times of the day or year?**

a) ❑ _____
b) ❑ Don't know

Overall Program Satisfaction

25. **Using a scale of 1 to 10 where 10 indicates "Very Dissatisfied" and 10 indicates "Very Satisfied", how satisfied were you with the process of enrolling in the program?**

1 2 3 4 5 6 7 8 9 10

If 8 or below, 25b. **Why were you dissatisfied with this enrollment process?**

a) ❑ _____
b) ❑ Don't Know

26. **Using a scale of 1 to 10 where 11 indicates "Very Dissatisfied" and 10 indicates "Very Satisfied", how satisfied are you with the Power Manager® program in general?**

1 2 3 4 5 6 7 8 9 10

If 8 or below, 26b. **Why were you less than satisfied with Power Manager®?**

a) ❑ They activated my Power Manager® device more often than I would like
b) ❑ The bill credits/incentives were not large enough
c) ❑ I was uncomfortable when my Power Manager® device was activated
d) ❑ Other: _____
e) ❑ Don't Know

26c. **Were there any other reasons you were less than satisfied with Power Manager®?**

a) ❑ They activated my Power Manager® device more often than I would like
b) ❑ The bill credits/incentives were not large enough
c) ❑ I was uncomfortable when my Power Manager® device was activated
d) ❑ Other: _____
e) ❑ Don't Know
f) ❑ No

27. **Would you recommend this program to a friend, neighbor, or co-worker?**

❑ Yes ❑ No ❑ DK

If no, 27b. **Why not?**

a) ❑ _____
b) ❑ Don't Know

28. **What, if any, Duke Energy programs or services have you heard of that help customers save energy? Any others?**

a) ❑ Smart Saver (other than CFL)
b) ❑ Personalized Energy Report
c) ❑ Home Energy House Call
d) ❑ Home Energy Comparison Report
e) ❑ CFL Program
f) ❑ Energy Star Homes
g) ❑ Low Income, Weatherization, or Low Income Weatherization
h) ❑ K12, NEED, or "Get Energy Smart"
i) ❑ Other: _____
j) ❑ Don't Know

Air Conditioning Practices

Now I'm going to ask you some questions about your air conditioning use.

29. **How often do you use your central air conditioner? Would you say you use it ...**

a) ❑ **Not at all**
b) ❑ **Only on the hottest days**
c) ❑ **Frequently during the cooling season**
d) ❑ **Most days during the cooling season**
e) ❑ **Everyday during the cooling season**
f) ❑ **Don't know**

If b-e, 29a. **About how many days would you estimate that you had your air conditioner on during the summer of 2010?**

a) ❑ Fewer than 10 days
b) ❑ 10 to 20 days
c) ❑ 21 to 30 days
d) ❑ 31 to 40 days
e) ❑ 41 to 50 days
f) ❑ 51 to 60 days

g) ❑ 61 to 70 days
h) ❑ more than 71 days
i) ❑ every day
j) ❑ Don't know

30. **Have you had your air conditioner tuned-up or serviced since you enrolled in the Power Manager® program?**

❑ Yes ❑ No ❑ DK

If yes, 30a. **Did the performance of your air conditioner improve after you had it serviced?**

❑ Yes ❑ No ❑ DK

30b. **Who serviced your air conditioner?**

a) ❑ Air conditioning contractor
b) ❑ Duke Energy
c) ❑ Electrician
d) ❑ Other: _____
e) ❑ Don't Know

31. **Is the air conditioner typically used to keep someone at home comfortable during weekday summer afternoons before 5 P.M.?**

❑ Yes ❑ No ❑ DK

32. **Is the air conditioner typically used to keep someone at home comfortable during summer weekdays after 5 P.M.?**

❑ Yes ❑ No ❑ DK

33. **When you think of a typical hot and humid summer day, at what outside temperature do you tend to feel uncomfortably warm?**

a) ❑ < 65 degrees
b) ❑ 65-68 degrees
c) ❑ 69-72 degrees
d) ❑ 73-75 degrees
e) ❑ 76-78 degrees
f) ❑ 79-81 degrees
g) ❑ 82-84 degrees
h) ❑ 85-87 degrees

i) ❑ 88-90 degrees
j) ❑ 91-94 degrees
k) ❑ 95-97 degrees
l) ❑ 98-100 degrees
m) ❑ > 100 degrees

34. **At what outside temperature do you tend to turn on the air conditioner?**

a) ❑ < 65 degrees
b) ❑ 65-68 degrees
c) ❑ 69-72 degrees
d) ❑ 73-75 degrees
e) ❑ 76-78 degrees
f) ❑ 79-81 degrees
g) ❑ 82-84 degrees
h) ❑ 85-87 degrees
i) ❑ 88-90 degrees
j) ❑ 91-94 degrees
k) ❑ 95-97 degrees
l) ❑ 98-100 degrees
m) ❑ > 100 degrees
n) ❑ It's programmed into the thermostat.

If n, 34a. **Do you set your thermostat seasonally or when the weather gets hot?**

i. ❑ I program the thermostat seasonally
ii. ❑ When the weather gets hot
iii. ❑ Other: _____

35. **I am going to read a list of time periods. For each time period, please tell me the temperature that your thermostat is typically set to on a hot summer weekday when you are using the air conditioner, or if it is turned off.**

35a. **On a hot weekday morning from 6 am to noon.**

o) ❑ < 65 degrees
p) ❑ 65-68 degrees
q) ❑ 69-72 degrees
r) ❑ 73-75 degrees
s) ❑ 76-78 degrees
t) ❑ >78 degrees

u) ❑ No change from an average summer week day
v) ❑ OFF

35b. **On a hot weekday afternoon from noon to 5 pm**

a) ❑ < 65 degrees
b) ❑ 65-68 degrees
c) ❑ 69-72 degrees
d) ❑ 73-75 degrees
e) ❑ 76-78 degrees
f) ❑ >78 degrees
g) ❑ No change from an average summer week day
h) ❑ OFF

35b. **On a hot weekday evening from 5 pm to 10pm.**

a) ❑ < 65 degrees
b) ❑ 65-68 degrees
c) ❑ 69-72 degrees
d) ❑ 73-75 degrees
e) ❑ 76-78 degrees
f) ❑ >78 degrees
g) ❑ No change from an average summer week day
h) ❑ OFF

35d. **During a hot weekday night from 10pm to 6am.**

a) ❑ < 65 degrees
b) ❑ 65-68 degrees
c) ❑ 69-72 degrees
d) ❑ 73-75 degrees
e) ❑ 76-78 degrees
f) ❑ >78 degrees
g) ❑ No change from an average summer week day
h) ❑ OFF

36. **I would now like to know the thermostat temperature setting for those same time periods but on a hot summer weekend.**

36a. **On a hot weekend morning from 6 am to noon.**

a) ❑ < 65 degrees

b) ❑ 65-68 degrees
c) ❑ 69-72 degrees
d) ❑ 73-75 degrees
e) ❑ 76-78 degrees
f) ❑ >78 degrees
g) ❑ No change from an average summer weekend day
h) ❑ OFF

36b. **On a hot weekend afternoon from noon to 5 pm**

a) ❑ < 65 degrees
b) ❑ 65-68 degrees
c) ❑ 69-72 degrees
d) ❑ 73-75 degrees
e) ❑ 76-78 degrees
f) ❑ >78 degrees
g) ❑ No change from an average summer weekend day
h) ❑ OFF

36b. **On a hot weekend evening from 5 pm to 10pm.**

a) ❑ < 65 degrees
b) ❑ 65-68 degrees
c) ❑ 69-72 degrees
d) ❑ 73-75 degrees
e) ❑ 76-78 degrees
f) ❑ >78 degrees
g) ❑ No change from an average summer weekend day
h) ❑ OFF

36d. **During a hot weekend night from 10pm to 6am.**

a) ❑ < 65 degrees
b) ❑ 65-68 degrees
c) ❑ 69-72 degrees
d) ❑ 73-75 degrees
e) ❑ 76-78 degrees
f) ❑ >78 degrees
g) ❑ No change from an average summer weekend day
h) ❑ OFF

37. **Duke Energy is always looking for other ways to help their customers. If Duke were to offer a program that cycles other equipment at your home such as an electric water heater, would you be interested in participating??**

❑ Yes ❑ No ❑ DK

38. **Are there any programs or services that you think Duke Energy should provide to its residential customers that are currently not provided?**

❑ Yes ❑ No ❑ DK

If yes, 38b. **What services or types of programs?**

_____

39. **Using a scale of 1 to 10 where 11 indicates "Very Dissatisfied" and 10 indicates "Very Satisfied", What is your overall satisfaction with Duke Energy?**

1 2 3 4 5 6 7 8 9 10

If 8 or below, 39b. **Why were you less than satisfied with Duke Energy?**

_____

Demographics

Finally, we have two short demographic questions.

40. **How many people live in this home?**

i) ❑ 1
j) ❑ 2
k) ❑ 3
l) ❑ 4
m) ❑ 5
n) ❑ 6
o) ❑ 7
p) ❑ 8 or more

41. **How many persons are usually home on a weekday afternoon?**

a) ❑ 1

b) ❑ 2
c) ❑ 3
d) ❑ 4
e) ❑ 5
f) ❑ 6
g) ❑ 7
h) ❑ 8 or more

Thank you for your time and feedback today! *Politely end call.*

Appendix C: Duty Cycle Models for M&V Units

GSO Region in NC											
Unit	Model	Model t-values				Unit	Model	Model t-values			
		Hr15	Hr16	Hr17	Hr18			Hr15	Hr16	Hr17	Hr18
0000023515	Htxav6	5.7	4.7	4.8	4.0	0002399623B	THIav6	3.9	3.9	3.6	3.4
0000369836A	THIwav	5.2	7.6	10.7	9.0	0002457429	Htxav6	9.8	9.6	11.0	11.2
0000369836B	THIav4	8.6	7.4	7.4	6.4	0002533838	Htxwav	11.5	12.4	10.8	11.2
0000602261	Htxav6	6.4	8.6	9.1	9.0	0002631859	THIwav	11.5	11.3	12.2	9.8
0000681434A	Tpwav	4.9	5.4	5.3	6.0	0003228323	Htxav6	8.7	8.2	10.4	8.9
0000681434B	Tpav6	4.4	4.9	4.1	3.1	0003446188A	Htxav4	7.4	5.9	5.5	4.9
0000767960	Tpav2	7.7	7.2	7.2	5.9	0003446188B	Htxav6	6.4	5.8	6.1	4.5
0000801163	Htxav6	4.7	3.5	3.2	4.9	0003723443	Tpav2	2.8	3.6	2.3	2.3
0001212955	THIav6	3.1	3.1	2.4	2.8	0003769823	Tpav4	3.1	3.1	2.5	2.3
0001326031A	Tpav4	4.2	4.2	2.6	2.6	0004092368	THIav2	11.1	7.9	6.2	6.2
0001505872A	Htxav2	8.3	8.6	7.9	7.2	0004394003	Htxav4	7.7	8.7	8.8	8.4
0001505872B	Tpav4	15.9	14.5	13.3	12.6	0004488786	THIav6	4.1	4.6	4.8	5.3
0001513367A	THIav6	5.5	4.9	4.2	4.3	0004663145	Htxav2	5.8	5.4	7.0	6.3
0001513367C	THIwav	2.9	4.2	4.3	4.6	1096250482	Htxav2	11.4	12.9	11.8	7.8
0001682068A	Tpav2	4.6	6.2	2.4		1097698937	Htxav6	11.3	11.2	8.7	5.6
0001682068B	Tpav2	6.4	5.5	7.0	4.8	1111215766	THIav2	2.6	2.7	2.1	2.1
0001686710	THIav2	10.7	6.9	6.2	8.5	1201334341A	Tpav2	5.8	6.9	7.0	7.1
0001850408	THIav6	7.2	8.9	8.6	5.5	1201334341B	Htxwav	11.1	9.4	10.2	9.3
0002004609A	THIav2	3.8	2.0	2.0	2.0	1244628738	Htxav6	6.7	6.9	7.0	6.6
0002004609B	Htxav2	9.9	9.8	7.8	6.8	1294560968A	Htxav6	7.9	5.8	5.7	5.0
0002030162	Htxav6	7.4	10.2	14.1	10.5	1294560968B	THIav2	7.2	7.1	8.3	8.7
0002038516	THIav6	5.5	5.9	5.7	3.3	1325409242A	Htxav2	4.1	3.2	4.1	4.0
0002152068	Htxav6	2.7	2.6	2.8	3.2	1385193358	Tpav6	4.1	2.6	2.1	2.1
0002188837	Tpav6	6.5	6.4	7.7	6.4	1699121956	Htxav6	12.1	9.0	8.3	7.4
0002212277	THIav6	8.6	8.4	8.3	9.5	1724223752	Tpav2	5.6	3.4	3.1	3.5
0002399623A	Htxav2	5.1	4.3	4.3	4.5	1793600721	Tpav2	8.7	8.6	8.2	6.8

CLT Region in NC / SC											
Unit	Model	Model t-values				Unit	Model	Model t-values			
		Hr15	Hr16	Hr17	Hr18			Hr15	Hr16	Hr17	Hr18
0000090188	THIwav	6.3	5.4	5.7	5.2	1376546640	THIav4	5.5	6.2	6.5	5.8
0000336093A	Tpwav	2.3	2.3	2.3	2.3	1387164186A	THIav6	2.4	2.6	2.6	2.6
0000336093B	Htxav2	5.3	5.2	5.2	4.5	1387164186B	Htxav6	4.3	4.2	4.4	4.3
0000911146A	THIav6	2.8	2.3	1.9	4.3	1422845032	Htxav6	2.6	2.6	2.3	2.3
0000911146B	Htxav6	7.3	7.5	7.5	7.2	1430039061	THIwav	7.7	7.3	7.7	8.6
0001012859	Htxav6	6.2	5.9	5.5	5.7	1431027130A	Htxwav	12.9	12.9	9.2	9.5
0001072327	THIwav	4.0	3.0	2.1	2.1	1436267257	THIwav	7.0	8.0	8.2	8.3
0001217849	Tpav6	3.3	4.0	3.2	2.5	1547932035	Tpav6	3.5	3.5	3.5	3.5
0001248034A	Tpav6	10.1	11.2	9.1	12.7	1617241030	Tpwav	10.6	7.9		4.1
0001248034B	Tpav4	3.7	3.7	3.7	3.7	1709534368A	Htxav2	2.9	2.8	2.8	2.5
0001252048	Tpav4	11.8	13.4	16.8	11.1	1709534368B	Tpav6	5.2	5.8	5.4	5.2
0001571684	Tpav6	12.4	11.6	10.5	11.5	1806104848	Tpav2	2.5	2.9	2.9	3.2
0001603810	Htxwav	9.9	15.4	13.9	15.7	1816127751	Htxav6	5.8	5.4	3.7	2.7
0001753212	THIav6	13.5	13.6	12.8	11.8	1931337321	Htxav6	2.1	2.8	3.1	3.6
0002088897	THIav6	4.1	4.3	3.9	3.0	1955967351	Tpav2	4.2	3.9	3.1	4.5
0002267668	Tpwav	3.1	3.1	3.1	3.1	1973263151A	THIav6	3.5	4.1	4.5	5.0
0002624272	THIwav	8.4	7.6	8.1	5.9	1973263151B	Tpav2	2.9	2.9	3.1	2.6
0002633906	THIwav	3.2	3.2	3.6	3.8	1977138025A	Tpav2	11.5	10.8	9.9	10.3
0003803700	THIav2	2.7	2.7	2.8	3.2	1977138025B	Tpwav	6.4	5.3	5.6	5.4
1124004857A	Tpav2	3.9	3.4	2.5	3.6	1997899665A	Htxav2	4.1	3.9	4.9	5.0
1159125862	THIav6	3.4	3.9	5.4	4.3	1997899665B	THIav2	5.3	5.4	5.5	5.0
1169379498	Tpav2	3.1	3.9	3.7	2.4	2046737153	Tpwav	10.6	12.0	9.7	4.8

GSP Region in NC / SC											
Unit	Model	Model t-values				Unit	Model	Model t-values			
		Hr15	Hr16	Hr17	Hr18			Hr15	Hr16	Hr17	Hr18
0000062018	Htxav2	5.7	5.9	4.4	4.7	0001347681B	Tpav6	2.5	2.6	2.5	2.6
0000065298A	THIwav	11.5	11.2	10.6	9.4	0001527915	Htxav6	11.3	11.1	10.4	10.0
0000065298B	Tpav6	4.4	3.3	2.5	2.5	0001544097	Htxav6	7.0	9.8	10.3	10.2
0000472135	THIwav	6.2	6.4	5.9	6.7	0001713966	Htxav4	7.6	8.1	7.9	7.7
0000496067	Htxav6	3.8	4.1	5.2	4.0	0001742061	THIav6	5.2	4.0	4.3	3.3
0000633303	Htxav6	12.5	13.3	13.1	11.4	0001875476A	THIav6	2.1	2.6	2.7	1.8
0000637990	Htxav6	10.4	9.7	9.8	9.7	0001875476B	Htxav4	10.6	9.8	9.7	9.2
0000639033A	Tpav6	3.2	3.3	3.0	3.2	0002049288	Tpav2	8.6	9.1	8.2	6.2
0000639033B	Htxwav	2.2	2.8	3.4	3.7	0002227067A	Tpav6	6.2	5.8	6.0	6.4
0000640116	THIwav	4.8	5.2	5.2	4.7	0002227067B	Htxav6	4.9	4.7	5.4	6.1
0000641583	THIav6	8.6	8.4	7.6	8.8	0002274541	Htxav6	6.2	6.2	5.6	4.2
0000650456	THIav6	7.0	7.7	7.2	6.4	0003696128	Tpwav	6.2	5.9	6.0	5.7
0000673481	THIwav	2.7	3.9	4.5	4.1	1138759002	Htxwav	7.1	3.6	5.6	5.3
0000852023	Tpav2	2.3	2.5	2.6	2.6	1155278305A	Htxav6	3.8	4.0	3.7	3.6
0000853292	THIwav	3.9	4.5	3.6	4.4	1155278305B	Htxav6	3.1	3.1	3.1	3.1
0000983605	Htxav6	10.8	9.1	7.6	6.0	1252121195	Tpav6	5.3	6.0	5.8	5.4
0000987977	Htxav2	3.3	4.6	6.3	5.7	1473389349A	Tpav6	3.8	4.2	4.8	4.4
0001007770	THIav4	2.6	3.0	2.0	2.2	1473389349B	Tpav2	3.6	3.2	3.9	3.3
0001033840	THIav6	6.0	5.9	5.6	6.0	1569362514	Htxav6	2.2	3.2	7.6	3.9
0001086488	Htxwav	8.6	9.2	8.8	9.6	1865161045	Tpav6	6.0	3.9	2.6	2.1
0001341219B	THIav6	7.2	7.6	6.0	5.2	2032040092	THIav2	9.8	8.4	7.5	7.5
0001347681A	Htxwav	7.2	6.8	7.3	7.3	2095927154	Htxav6	22.8	22.3	19.5	20.0

Appendix D: Connected Loads for M&V Units

Southeast										
AC unit	Strata	KW		AC unit	Strata	KW		AC unit	Strata	KW
0000023515	H	3.52		1097698937	H	3.15		0001252048	L	5.72
0000062018	H	3.48		1124004857A	H	2.53		0001505872A	L	2.22
0000065298A	H	1.92		1124004857B	H	3.15		0001505872B	L	2.22
0000065298B	H	1.99		1138759002	H	3.33		0001513367A	L	1.68
0000090188	H	3.60		1159125862	H	3.15		0001513367B	L	2.89
0000336093A	H	1.77		1201334341A	H	3.00		0001513367C	L	1.94
0000336093B	H	1.86		1201334341B	H	3.11		0001527915	L	4.08
0000472135	H	6.33		1294560968A	H	2.89		0001544097	L	2.66
0000637990	H	4.69		1294560968B	H	2.66		0001603810	L	5.70
0000639033A	H	2.72		1325409242A	H	2.18		0001686710	L	3.56
0000639033B	H	2.59		1325409242B	H	3.17		0001742061	L	3.20
0000667445	H	5.14		1385193358	H	3.47		0001850408	L	2.68
0000681434A	H	1.94		1387164186A	H	3.35		0001910472	L	3.63
0000681434B	H	4.62		1387164186B	H	3.19		0002030162	L	3.63
0000767960	H	3.26		1422845032	H	2.50		0002038516	L	3.00
0000801163	H	3.04		1430039061	H	5.50		0002049288	L	3.52
0000911146A	H	4.47		1431027130A	H	3.43		0002088897	L	2.78
0000911146B	H	2.33		1431027130B	H	1.47		0002152068	L	1.36
0001007770	H	3.33		1547932035	H	3.52		0002188837	L	3.91
0001072327	H	3.97		1569362514	H	4.45		0002212277	L	2.12
0001248034A	H	3.45		1699121956	H	3.48		0002227067A	L	2.22
0001248034B	H	2.66		1709534368A	H	2.98		0002227067B	L	2.94
0001326031A	H	5.25		1709534368B	H	4.25		0002260925	L	2.98
0001326031B	H	3.00		1793600721	H	5.18		0002457429	L	2.85
0001341219A	H	3.26		1806104848	H	5.74		0002624272	L	2.89
0001341219B	H	1.47		1816127751	H	3.80		0003228323	L	2.22
0001347681A	H	2.87		1955967351	H	3.97		0003723443	L	2.79
0001347681B	H	1.96		1977138025A	H	2.72		0003769823	L	3.32
0001571684	H	3.52		1977138025B	H	3.20		0003803700	L	2.53
0001682068A	H	2.22		1997899665A	H	3.84		0004333509	L	3.52
0001682068B	H	2.20		1997899665B	H	1.92		0004394003	L	2.83
0001713966	H	5.01		2032040092	H	3.54		0004488786	L	4.58
0001753212	H	3.30		2046737153	H	3.52		1096250482	L	2.48
0001875476A	H	1.84		0000369836A	L	3.65		1111215766	L	2.38
0001875476B	H	1.84		0000369836B	L	5.10		1155278305A	L	2.24
0002004609A	H	3.17		0000496067	L	3.74		1155278305B	L	2.98
0002004609B	H	2.91		0000602261	L	4.14		1169379498	L	2.87
0002267668	H	3.61		0000633303	L	3.32		1244628738	L	2.72
0002274541	H	3.39		0000640116	L	3.61		1252121195	L	3.24
0002399623A	H	4.58		0000641583	L	3.54		1376546640	L	1.79
0002399623B	H	4.58		0000650456	L	3.52		1436267257	L	3.52
0002533838	H	2.65		0000673481	L	3.99		1473389349A	L	4.28
0002631859	H	3.24		0000852023	L	1.73		1473389349B	L	1.71
0002633906	H	2.79		0000853292	L	5.85		1538582341	L	NA
0003446188A	H	2.44		0000983605	L	1.96		1617241030	L	2.07
0003446188B	H	2.44		0000987977	L	2.72		1724223752	L	2.25

0003696128	H	4.30		0001012859	L	4.43		1865161045	L	2.76
0003950480	H	3.32		0001033840	L	4.01		1931337321	L	3.97
0004092368	H	3.63		0001086488	L	2.55		1973263151A	L	2.03
0004663145	H	3.71		0001212955	L	2.63		1973263151B	L	2.22
0004806311	H	NA		0001217849	L	1.58		2095927154	L	3.26

Appendix E: Power Manager Program Marketing Materials

THANKS FOR YOUR PARTICIPATION IN POWER MANAGER®

Duke Energy®

Thank you for your participation in the Duke Energy Power Manager Program. We appreciate your efforts in making a difference in helping reduce the demand for electricity, which in turn may delay construction of new facilities and keep rates low. As a reminder, Power Manager is a voluntary program that allows Duke Energy to manage your air conditioning system during times of peak energy demand. For the months of July through October, you receive an $8 monthly credit ($32 yearly). With the exception of a severe system emergency, we typically will not use Power Manager during nights, weekends or holidays. To learn if an event is occurring, you may call 1-800-832-3169 for status updates.

SUMMER ENERGY EFFICIENCY TIPS

- Close curtains or blinds on the sunny side of your home during the day.
- Replace standard light bulbs with CFLs. They use less energy, last longer and don't create as much heat.
- Inspect, clean or replace air filters monthly.
- Do laundry and run your dishwasher at night.
- Raise your thermostat setting and use ceiling fans to keep you cool. Like a light, be sure to turn off the fan when you're out of the room.

If you have any questions about Power Manager, please call us at 1-800-777-9898.

POWER MANAGER®
SAVE MONEY, ENERGY AND THE ENVIRONMENT

Duke Energy

Duke Energy
526 South Church Street
Charlotte, NC 28202

800-777-9898
www.duke-energy.com/powermanager

Duke Energy

Mixed Sources
Product group from well-managed forests, controlled sources and recycled wood or fiber
www.fsc.org Certificate number SCS-COC-000
© 1996 Forest Stewardship Council

FSC

091040 – SE | Revised 1/09

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save $32 off your energy bill every year!

The Power Manager unit is a small device wired directly to your air conditioner.

Cold weather may be here, but it's never too early to plan for next year's hot weather. Sign up for Power Manager® and save energy, save money and help the environment.

SAVINGS FOR YOU

It works this way. We install a small device near your outside air conditioning unit. On especially hot days when demand for power is high, the device may cycle your unit off and on a few minutes each half hour. Typically the cycling only occurs five to 10 times per summer and never on weekends. Because your indoor fan continues to run, you stay cool and comfortable. And you earn an $8.00 monthly credit for the months of July, August, September and October – that's $32 in savings each year!*

SAVINGS FOR THE ENVIRONMENT

With Power Manager, you can make a difference in helping reduce the peak demand for electricity. As demand increases, we have to use more natural resources and build more power plants to supply electricity to meet the need. But by reducing demand, we may delay construction of new facilities and keep rates low.

SIGN UP NOW

Join more than 250,000 Power Manager customers in the Carolinas who are doing something positive for themselves and the environment.

Call 800-777-9898 to learn more or enroll today.

* Savings are after the $35 installation fee.

☐ **YES! PLEASE SIGN ME UP FOR THE POWER MANAGER PROGRAM.**

Name on Account: _____

Street Address: _____

City: _____

State: _____ Zip Code: _____

Daytime Contact Phone Number (required): _____

E-mail Address: _____

Number of Outdoor Air Conditioning Units: _____

Duke Energy Account No. (if known): _____

Signature: _____

Date: _____

☐ Check here if an appointment will need to be scheduled for us to gain access to your outdoor air conditioning unit/premises (e.g., locked gate).

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PLEASE RETAIN FOR YOUR RECORDS

Thank you for your participation in Duke Energy's Power Manager® Program.

We are pleased to inform you that your Power Manager® device has been successfully installed. Below are some frequently asked questions about the Power Manager® program. If you have any additional inquiries, please give us a call at 1-800-777-9898 or visit us on www.duke-energy.com/powermanager.

How does Power Manager® work?
On days when demand for power is especially high, the radio-controlled device turns your outdoor air conditioning unit off for only a few minutes each half hour and then automatically turns it back on.

How often will my air conditioner be cycled each summer?
Cycling events may occur a few times per month during the months of June through September. If the weather is mild, cycling may not occur at all.

How do I know if my air conditioner is being cycled?
Locate the load management device near the outdoor unit of your air conditioner. A red light will be illuminated on the front panel of the switch when the switch has been activated. The light will remain on during the time that your compressor is cycled off. When the light goes out, the switch has been deactivated and the compressor will run when the thermostat calls for cooling. For cycling event information, you can also call 1-800-832-3169 and listen to the pre-recorded message.

The temperature in my home is warmer than normal and I am not sure if my air conditioner is working properly. Should I call my air conditioning contractor?
If your home seems warmer than you expect, first call 1-800-832-3169 to hear a message on our cycling status. If your air conditioner is being cycled, it is normal for the home to gain a few degrees during the event. After the cycling period ends, your air conditioner may run continuously until your home reaches your thermostat temperature.

If you feel your air conditioner is not working properly, please call 1-877-392-4848 and a qualified technician can help you determine if a service call from your air conditioning contractor is needed.

What if my heating and air conditioning company's service technician recommends that I have my switch disconnected or removed?
Please have the service technician call 1-800-777-9898 before allowing them to proceed.

When will I receive my credits on my Duke Energy bill?
You will receive an $8 monthly credit on your electric bill per month from July through October.

For any other questions about the program, please call 1-800-777-9898. To listen to a message regarding specific Power Manager® events, please call 1-800-832-3169.

100159 SE

Duke Energy®

PLEASE RETAIN FOR YOUR RECORDS

Your participation in the Duke Energy Power Manager® program helps to save money, energy and the environment.

☐ We have tested and/or replaced your Power Manager® device. If you experience any difficulties, please contact us at the following number 1-888-463-5022.

☐ We need to test and/or replace your Power Manager® device but are unable to get to your air conditioning unit due to a barrier, such as a fence, dog, etc. Please call 1-888-463-5022 so we may schedule an appointment that is convenient for you.

If you need more information about the Duke Energy Power Manager® program or have any questions about the services performed at your home today, visit us online at Duke-Energy.com/powermanager.asp.

Duke Energy®

Su participación el programa Power Manager® (Control de Energía) de Duke Energy le ayuda a ahorrar dinero, energía y a preservar el medioambiente.

- ☐ Hemos probado y/o reemplazado su dispositivo Power Manager®. Si tiene algún problema, por favor contáctenos al siguiente número: 1-888-463-5022.

- ☐ Necesitamos probar y/o reemplazar su dispositivo Power Manager®, pero no podemos obtener acceso a su sistema de aire acondicionado por causa de alguna barrera u obstáculo, como una cerca, perro, etc. Por favor llame al 1-888-463-5022 para hacer una cita en el tiempo que más le convenga.

Si necesita más información sobre el programa Power Manager® de Duke Energy o si tiene alguna pregunta sobre el servicio efectuado en su domicilio el día de hoy, visítenos en internet a: Duke-Energy.com/powermanager.asp.

Duke Energy®

Duke Energy Residential Smart $aver® CFL Program in North Carolina and South Carolina

Results of a Process and Impact Evaluation

Prepared for

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139 East Fourth Street
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February 15, 2011

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Executive Summary

This report presents the findings of the Residential Smart $aver® Compact Fluorescent Lightbulb (CFL) Program for Duke Energy from September 2009 through July 2010. Two campaigns took place during this time:

1. Campaign 556 was four manufacturer's coupons redeemable at any store for 2 GE Energy Smart 2-packs. (September 10th, 2009 – December 31st, 2009)
2. Campaign 617 was a manufacturer's coupon redeemable at Wal-Mart for a free GE 6-pack. (March 3rd, 2010 – July 15th, 2010)

Both of these campaigns featuring mailed coupons. This report reviews the program's customer satisfaction, demographics, CFL use, and the energy savings from the CFLs purchased through the program. The evaluation is separated into the two components: a process evaluation and an energy impact analysis: To support this a coupon redeemer survey was conducted. In addition, interviews were conducted of Duke Energy's program manager, CFL bulb retailers, and manufacturers that offered CFL coupons. Finally, for the impact evaluation, a lighting logger study was conducted with customers who redeemed CFL coupons to estimate lighting usage in their home.

Methodology

To conduct the energy impact analysis this study combined the information from two data collection approaches that together allowed the estimation of saved energy. In addition, this study conducted interviews with the program manager and retail store managers that when combined with customer surveys allowed for the assessment of the operations of the program.

The kilowatt hour savings were calculated using the data obtained from the lighting logger study performed on homes in the targeted areas served by the program, which provided average hours of use for each room type in which the CFLs were installed. These values were used to inform the customer responses to the CFL coupon redeemer survey which indicated the room type, wattage of lamp installed, wattage of lamp replaced, and customer-estimated hours of use.

A coupon redeemer survey was sent to customers who redeemed Duke Energy coupons for CFL bulbs. The coupon redeemer survey asked customers to provide information regarding their purchase of CFL bulbs, their experience with CFL bulbs, and their satisfaction with CFL bulbs. The survey can be found in the appendices of this report.

Program operations were evaluated through an in-depth interview with two program managers and five retail store managers.

Summary of Findings

An overview of the key findings and recommendations identified through this evaluation is presented below.

Findings

1. Duke Energy's CFL coupons are very popular with retailers, boosting sales 500 to 1,000 percent over typical sales, in some cases causing stores to move product from non-Duke Energy territories, providing substitutions and extending expiration dates for offers. This is a substantial increase in sales and reflects well on Duke Energy and on their marketing efforts and promotional initiatives. Duke Energy managers report large movements of CFLs in all Duke Energy territory stores carrying the GE brand with retailers reporting sales as fast as they can stock the covered bulbs.

2. Discount coupons are recently experiencing diminishing returns as far as reaching new customers to redeem the price reduction the coupons. Strategies are now being implemented to reach non-coupon users. Additional targeting and motivational appeals at younger and more mobile customers who are less likely to redeem coupons is needed if the use of discount coupons is maintained to increase redemption from this group. However, Duke Energy has moved to a no cost coupon for a free 6 pack of CFLs that has increased sales of CFLs to the point where the market is having trouble stocking bulbs and retailers are asking for advance notice of coupon distribution to enable them to have enough stock in the stores. Duke Energy managers report that redemption rates are running between 20% and 25% compared to about 3% with the price reduction coupons.

3. The strategy of using individual customer-coded coupons allows Duke Energy to focus on accurately tracking customer purchases rather than reconciling participation and sales counts with retailers. The move to customer-specific coupons also allow Duke Energy to move away from a store-focus program to a customer-targeted program, a more efficient method of operation that can expand and contract as needed by including or not including customers in direct mail targeting. The method also allows for strategic geo-expansion of the program by targeting more areas rather than increasing coordination with specific stores. This also allows Duke Energy the flexibility of moving between a discount coupon and a free bulb coupon to match the energy and cost effectiveness goals. This method has also allowed Duke Energy to identify a few (less than 10) customers who have copied the coupon in order to obtain more than the maximum number of free bulbs.

4. Home Depot (for example) did not carry the partnered brand resulting in a large CFL retailer not being allowed to participate in the program. The manufacturers' coupon was successful in acquiring cooperation with other specific retailers, such as an expansion into Wal-Mart. Since the coupon campaign, Duke Energy has also allowed customers to acquire the CFLs over the web if they cannot or are unable to go to one of the retail outlets, increasing exposure and adoption rates. In the web process Duke Energy can validate the potential participant's status as a Duke Energy customer and verify that they are eligible for the CFLs. This allows Duke Energy to mail only the number of bulbs that the customer is eligible to receive (up to 15 bulbs) by using a real-time database verification to see if they have redeemed a coupon in the past.

5. Retailers report that the coupons significantly affect sales and a discontinuation of the program would result in much fewer CFLs purchased as well as a significantly lower focus on CFL sales by the retailer.

6. Retailers report they need additional lead time to acquire additional stock because of the higher sales volumes that have occurred after Duke Energy's coupons were distributed. This is a problem growing out of the success of the effort. That is, the effort was successful enough that the retailers report needing extra time to obtain inventory from their non-Duke Energy territory stores to support the increased sales. Also, because of the increased demand and the strong customer acceptance, retailers report that coupons should have longer duration periods to allow them to not expire so quickly and allow participants more time to redeem their coupons. GE reported sending out 1.5 million postcards to Duke Energy's customers to let them know that they could still redeem their coupons after the expiration date to compensate for lack of stock. To be fair to Duke Energy, it should be noted that the program had advised retailers to stock more bulbs than they would have normally needed. However, few of the retailers took this action.

7. CFL coupons were far and away the primary driver for participants to purchase CFLs, and more than 40 % of coupon redeemers indicated that they would have purchased zero CFLs if the Duke Energy coupon had not been available.

8. While CFL coupons are driving spillover to more CFL purchases, the coupons are having only a small effect on simultaneous purchases of other energy efficiency technologies such as insulation and weather stripping.

9. Of the CFLs redeemed with coupons, 90% in North Carolina and 84% in South Carolina were reported to be installed and operating in sockets at the time of the survey.

10. Prior use of CFLs had no bearing on CFL program satisfaction ratings of CFL redeemers or self-reported likelihood of redeemers purchasing CFLs in the future, however those redeemers who experienced any bulb failure or removed at least one CFL because of light quality had a lower overall satisfaction rating with CFLs.

11. Prior use did have an effect on forward-looking confidence in CFLs with more new adopters than previous adopters finding they were much more confident in CFLs after participating in the program.

12. CFL forward-looking buying and installation habits are similar for new and previous adopters

Energy Savings Summary

Gross Energy Savings Calculations

Past evaluations have indicated that self-reported hours of use tend to over-estimate estimated savings by over-estimating typical hours of use. As a result, in order to reliably estimate energy

impacts, it was necessary to use the results of the logger study that recorded the actual hours of use. This allowed the impact estimate to be based on the measured hours of use, times the difference in wattage between the lamp replaced and the lamp installed, as reported by the participants. From this calculation there is a gross yearly energy savings of 46.9 kWh per lamp in North Carolina and 40.3 kWh per lamp in South Carolina.

Free Riders and Free Drivers

From the survey results, it was determined that 19% of CFL purchases made were due to free riders[1], while 32% of purchases made were due to free drivers[2] for a net-to-gross adjustment factor of 107% excluding additional market effects caused by the program beyond the participant purchases[3].

Total Program Net Energy Savings Calculations

Program impacts are presented in the Impact Evaluation Summary Table below.

Table 1. Impact Evaluation Summary Table

Metric	North Carolina	South Carolina
Total lamps redeemed	1,619,990	490,670
ISR	0.9053	0.9102
Gross kWh per lamp redeemed	42.4265	36.6900
Gross kW per lamp redeemed	0.0445513	0.0378810
Coincidence Factor	0.123	0.123
Gross Coincident kW per lamp redeemed	0.0055	0.0047
Total Gross Program MWh Savings	68,731	18,003
Total Gross Program kW Savings	72,173	18,587
Total Gross Program Coincident kW Savings	8,877	2,286
Free rider adjustment	0.81	0.81
Spillover adjustment	1.32	1.32
Net to gross ratio including spillover	1.07	1.07
Total Net Program MWh Savings (free riders only)	55,672	14,582
Total Net Program kW Savings (free riders only)	58,460	15,056
Total Net Program Coincident kW Savings (free riders only)	7,191	1,852
Net kWh per lamp redeemed (free riders only) (A)	34.37	29.72
Net kW per lamp redeemed (free riders only)	0.0361	0.0307
Net Coincident kW per lamp redeemed (free riders only)	0.0044	0.0038
Total Net Program MWh Savings (free riders plus spillover)	73,542	19,263
Total Net Program kW Savings (free riders plus spillover)	77,225	19,888
Total Net Program Coincident kW Savings (free riders plus spillover)	9,499	2,446
Net kWh per lamp redeemed (free riders plus spillover) (B)	45.40	39.26

[1] Free rider: someone who would have taken the same action without the program's influence.
[2] Free driver: someone who takes additional actions as a result of the influence of the program.
[3] As retailers focus on stocking and displaying more CFL products as a result of the program's marketing push, additional sales are generated by non-participating shoppers. This study excludes the savings acquired by non-participating customers as a result of the way in which the program influenced total CFL sales.

Net kW per lamp redeemed (free riders plus spillover)	0.0477	0.0405
Net Coincident kW per lamp redeemed (free riders plus spillover)	0.0059	0.0050
Measure life	5	5
Lifetime net MWh savings (free riders only)	278,359	72,911
Lifetime net MWh savings (free riders plus spillover)	367,708	96,314

(A): Net kWh per lamp redeemed, for the free riders only, is calculated using the total net program MWh savings (free riders only) divided by the total lamps redeemed.
(B): Net kWh per lamp redeemed, including both free riders and spillover, is calculated using the total net program MWh savings (free riders plus spillover) divided by the total lamps redeemed.

* While the advertised expected life of the installed CFLs is greater (10 years), recent research in California has indicated that CFL bulbs installed in typical rooms have switching behaviors that erode about half the advertized effective useful life. The adjustment approach for reducing the effective useful life to 5 years is presented in Appendix E: Effective Useful Life Adjustment Factor for Installed CFLs.

Recommendations

TecMarket Works and Building Metrics offer the following recommendations for the Smart $aver® CFL Program.

1. Consider conducting light logger studies at different times of the year to observe the daylength effect. Doing the logging studies over the equinox removes the daylength effect from the logger data. However, if Duke Energy would like to study the magnitude of the daylength effect, the evaluation team will need to design an experiment that would require logging at different times of the year. Doing so will involve much larger samples and a longer timeframe than what was needed for this or previous studies, so this should be considered carefully given the budget and timeline expansions needed if Duke Energy would like to explore this effect in future evaluations.

2. Link light logger installations unambiguously to self-reported hours of use data.

3. Continue use of targeted marketing efforts to identify customers most likely to purchase CFLs during the specific promotion or campaign. 2008 targeted messaging analysis shows that targeting messages to customers based on likelihood of adoption is successful in providing lift to populations that were not as likely to purchase CFLs. (Note: during the drafting of this report Duke Energy has continued testing motivational message content and redemption rates and reports that they have narrowed the messaging to energy and environmental appeals that experience the higher adoption and redemption rates and have moved to the use of free product coupons that together are substantially increasing redemption rates for CFLs.)

4. Savings for typical CFL bulbs may decrease over the long term as more customers adopt CFLs and continue to install bulbs in lower use sockets and fixtures. Recognizing the need to cost-effectively distribute CFLs, Duke Energy designed a tracking system to mitigate over-distribution of traditional CFLs. Consider transitioning the CFL program to incorporate other types of CFL offers, such as specialty bulbs (candelabras, torchieres, outdoor, etc.), LEDs, and other emerging technologies as they become cost effective. (Evaluation Review Follow-Up Note: Duke Energy reports that they are currently examining the inclusion of specialty bulbs to understand their potential with both past CFL redeemers and previous purchasers of CFLs as well as approaches for reaching new customers with specialty bulb appeals and offers. In addition, TecMarket Works is currently assessing the market for CFLs and will address the potential for specialty bulbs in the CFL potentials report to be delivered in April 2011. Duke Energy also reports that CFL adoption has increased due to offering web and phone-based ordering platforms where CFLs can be shipped directly to the customer's home as soon as they are ordered. Duke Energy customers can check eligibility and request CFLs by accessing a unique URL or OLS (Online Services) or by calling a toll-free number.

5. Consider incorporating a market effects study to identify ways to transition the program moving forward as traditional incandescents are phased out in the coming years, as shown in Table 2 below.

Table 2. EISA Schedule for General Service Incandescent[4]

Current Wattage	Rated Lumen Ranges	Maximum Rated Wattage	Minimum Rated Lifetime	Effective Date (Manufactured on or after)
100	1490-2600	72	1,000 hours	1/1/2012
75	1050-1489	53	1,000 hours	1/1/2013
60	750-1049	43	1,000 hours	1/1/2014
40	310-749	29	1,000 hours	1/1/2014

6. Consider coupling CFL efforts with other energy saving measures and/or programs. Customers did not buy many other energy efficiency items in addition to the CFLs when making their CFL purchases. Program managers could leverage both redeemer and non redeemers' awareness of ENERGY STAR to incorporate other energy saving items and/or encourage customers take other energy saving actions at the same time they are purchasing CFLs. Coupon redeemers purchased other energy saving measures (caulking, weather stripping, low-flow showerhead) in small quantities and might be interested in other simple energy saving measures if they were co-marketed with a CFL offer. Both redeemers and non redeemers may be interested in such measures as ENERGY STAR appliances, or other Duke Energy programs offering energy efficient measures such as HVAC or home audits. (Evaluation Review Follow-Up Note: Duke Energy reports that they have already started coordinating program services to include multi-product appeals and exposure in their small business programs, the Home Energy House Call program, neighborhood canvassing, and are considering other programs that can act as aggregation efforts to expose customers to multiple measures.)

7. Non coupon redeemers are generally not influenced by receiving Duke Energy coupons to purchase CFLs elsewhere, however, the price of CFLs is a factor for these customers. Consider additional marketing strategies for these customers that incorporate the Duke Energy reduced price of CFLs, recommendations of friends and family, and other types of advertising appeals. These customers were more influenced by in-store advertising than the coupon redeemers, so other types of offers for CFL savings, such as point of purchase offers, may appeal to these customers. (Evaluation Review Follow-Up Note: Duke Energy reports that they have started these efforts with property management programs, business reply cards and web campaigns.)

[4] Source: http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/lighting_legislation_fact_sheet_03_13_08.pdf

Process Evaluation

Program Design and Operations

The overall design of the program as related by program managers is to encourage people to start thinking in terms of energy efficiency in their homes and not necessarily to push CFLs specifically. CFLs are not seen as a long-term program offering but instead serve as a bridge to emerging technologies like LEDs and potentially high efficiency incandescent bulbs. Program managers also view the CFL offering as a high profile entry point for informing customers of other energy efficient technologies that are currently available through Duke Energy's programs such as programmable thermostats, high efficiency appliances, etc.

Program manager noted that while savings are measured at the bulb level, the program focuses on customers and the number of customers that can be cost effectively reached for the typical number of bulbs per participating customer. Managers report that the program is not an attempt at marketing CFLs to the point of socket saturation, but is an attempt to raise awareness of energy efficient products and behaviors via a focus on CFLs.

The customer incentive (value of the coupon) is delivered using direct-mail manufacturers' coupons partnering with GE, and for a period prior to the completion the program partnered with Lowe's and offered coupons for *BrightEffects* bulbs. Originally the program partnered with individual retailers.

The program is very popular with retailers. Neither of the retail partners interviewed could identify a component of the program or the approach used that is in need of improvement and indicated that their sales are very positively affected by the coupons.

Program managers however, suggest that there is room for expansion in CFL sales because of the number of sockets still filled with incandescent bulbs and the potential for expanded adoption of the technology. Managers report concern that with the changes in the federal standard, the window for CFLs as a program-pushed technology is not more than two years. Retail partners agree but also think that there is room for sales growth and report that saturation of first-time buyers is only 20% of the market with 80% of the households in their retail areas not yet adopting CFLs. They also report that second-time buyers need an incentive to continue to buy CFLs. They note that the vast majority of sockets are still filled with incandescent bulbs and note the availability of specialty CFL bulbs that can capture a larger share of the market. Retailers note that they continue to sell far more standard bulbs than CFLs.

Program managers note that the approach using GE bulbs works well because GE has their own fulfillment house that pays the stores the Duke Energy incentive and then bills Duke Energy for those coupon sales, greatly simplifying the operations of the program thereby increasing program cost effectiveness. It also allows the GE fulfillment house to maintain accurate records on program sales that are then made available to Duke Energy as a program tracking metric. In this way Duke Energy can avoid much of the management and administration costs of the coupon payments and focus on tracking customers, market share progress and energy savings from those who used the coupons.

Challenges

The redemption rate of discount coupons distributed is dropping and may indicate a beginning of a reduction in need for additional CFLs for the targeted group of coupon users. While customers who use their coupons may not be sent follow-up offers if they have already obtained their maximum number of CFLs, managers note that some customers just don't use coupons. Managers note that they need to find a cost effective way to motivate the non-coupon user to buy CFLs now rather than waiting until they have no choice.

The mailing of coupons is targeted by zip code and calibrated to the need for savings and the budget for the program. Partners are informed of the mailing, and store managers report that it can be a challenge to anticipate the high traffic. Some store managers report an increase in CFL sales volumes of 500%. As an example, Sylvania (before the switch to GE) gave Duke Energy four weeks of data on sales before a coupon mailing. After the mailing the volume jumped to 10 times the weekly average for several weeks.

As a result, store managers report needing as much lead time as possible to plan for the increased traffic. They report that because they order their bulbs months in advance, they need longer notification lead times. However, when asked what changes are needed to the program, retail managers only identified the need for longer lead times between notification of the mailings and the actual mailing to allow them to prepare for the sales surge and the need to extend the coupon expiration date to allow for a longer sales period.

Response to Possible Slowing of Redemption Rates

Duke Energy managers noted that should they see a reduction in redemption rates for the discounted CFLs, they are considering ways to increase penetration. Duke Energy is exploring the opportunities for partnering with property managers and apartment owners to help promote CFL use by their tenants. Each of these approaches represents an added market niche for pushing CFL adoption and use to save energy. In view that the costs for CFLs are low, and savings are comparatively high for such a low cost item, it make sense for Duke Energy to move as many of the CFLs into the market as possible in ways that acquire net savings that are below program costs. In view that there is a need to acquire net savings to meet Duke Energy's savings goals, all cost effective routes for moving CFLs into the market should be explored until such time that new federal appliance standards make CFLs mandatory. Exploring and using all cost effective routes into the market, until such time as the market is effectively transformed, as documented by a market conditions in which most sockets are filled with efficient lighting products, can also serve as market channels for more efficient LED bulbs or other similar products as they become cost effective to deliver via these same routes. At this time the CFL market does not appear to be transformed and should not be considered transformed until the vast majority of bulbs sold are at least as efficient as CFLs. Retail managers report that the vast majority of the bulbs they sell remain incandescent bulbs. This period of time, in which the market still buys incandescence bulbs as the lighting technology of choice represents an opportunity period in which new net savings can be acquired via approaches that increase the sales and use of CFLs. This market opportunity may not last but a few more years as Duke Energy and other market interventions transform the market to the point where CFLs represent the majority of sales and net new savings become difficult to acquire.

CFL Coupon Redeemers

This survey focused on customers who, according to program tracking records, redeemed their CFL coupons. A total of 1,000 mail surveys were sent out to CFL redeemers (NC 747, SC 253). A total of 218 surveys were returned for a response rate of 21 percent.. Of these, 167 surveys were returned in North Carolina and 51 were returned in South Carolina with usable responses.

Participation in the Program

As seen in Table 4 nearly all of the redeemers responding to the survey (95.8% in North Carolina and 98.0% in South Carolina) recall using the coupons provided by Duke Energy themselves, while some (7.8% in both North and South Carolina) recall giving at least one of their coupons away to another user.

Table 3. Participation in the Program

	Used Coupon themselves		Gave coupons to someone else	
	Yes	No	Yes	No
NC (n=130)	95.8%	4.2%	7.8%	92.2%
SC (n=51)	98.0%	2.0%	7.8%	92.2%
Weighted average	**96.3%**	**3.7%**	**7.8%**	**92.2%**

Redeemers were asked to rate the influence several categories on their decision to purchase CFLs These categories included:

- The Duke Energy CFL coupon
- In-store advertising
- Advertising that was not in-store, such as tv, radio and newspaper ads
- Other advertising
- CFL brand
- Sales associates
- Friends and family

Possible responses for each category were Very Influential, Somewhat Influential, and Not Influential at All.

One-hundred thirty-one (82.9%) redeemers in North Carolina and thirty-six (76.6%) in South Carolina found the coupon from Duke Energy to be "very influential" in their decision to purchase CFLs, indicating that the coupon was a key purchase driver. Although previous Duke Energy CFL studies have found the CFL coupon from Duke Energy to be even more influential, the coupon still seems to be the main driver in redeemers' decisions to purchase CFLs.[5] In-store CFL

[5] "An Evaluation of Energy Star Products: Results of a Process and Impact Evaluation of Duke Energy's CFL Promotion and Lighting Logger Programs" prepared for Duke Energy by TecMarket Works and Building Metrics, September 24, 2008, page 38. This study will be referenced as the "2008 study" through this report.

displays and signs were found to be somewhat influential, and other forms of advertising were found to be not at all influential by most redeemers. Redeemers did not find CFL branding or friends and family recommendations to be influential in their decision to purchase CFLs. As indicated in Table 5 and Figures 1 and 2, the Duke Energy coupon was the primary driver leading to the purchase of the program-induced CFL by a significant margin, however, the decision was also influenced, to a limited degree, by other events.

Table 4. Factors influencing CFL buying decision

	NC				SC		
	Very influential	Somewhat influential	Not at all		Very influential	Somewhat influential	Not at all
The coupon from Duke Energy	131	23	4		36	10	0
	82.9%	**14.6%**	**2.5%**		**78.3%**	**21.7%**	**0.0%**
CFL Brand	35	39	33		12	11	11
	32.7%	**36.4%**	**30.8%**		**35.3%**	**32.4%**	**32.4%**
Non in-store advertising (TV, radio, newspaper, etc.)	16	53	35		9	11	12
	15.4%	**51.0%**	**33.7%**		**28.1%**	**34.4%**	**37.5%**
In-store CFL displays and signs	25	51	32		7	19	12
	23.1%	**47.2%**	**29.6%**		**18.4%**	**50.0%**	**31.6%**
Friends or family	24	32	41		9	10	12
	24.7%	**33.0%**	**42.3%**		**29.0%**	**32.3%**	**38.7%**
Other advertising	10	25	42		3	11	12
	13.0%	**32.5%**	**54.5%**		**11.5%**	**42.3%**	**46.2%**
Sales associates at the store	35	39	33		5	7	17
	15.6%	**17.8%**	**66.7%**		**17.2%**	**24.1%**	**58.6%**
Online coupon from Duke-energy.com	13	5	10		1	3	3
	46.4%	**17.9%**	**35.7%**		**14.3%**	**42.9%**	**42.9%**

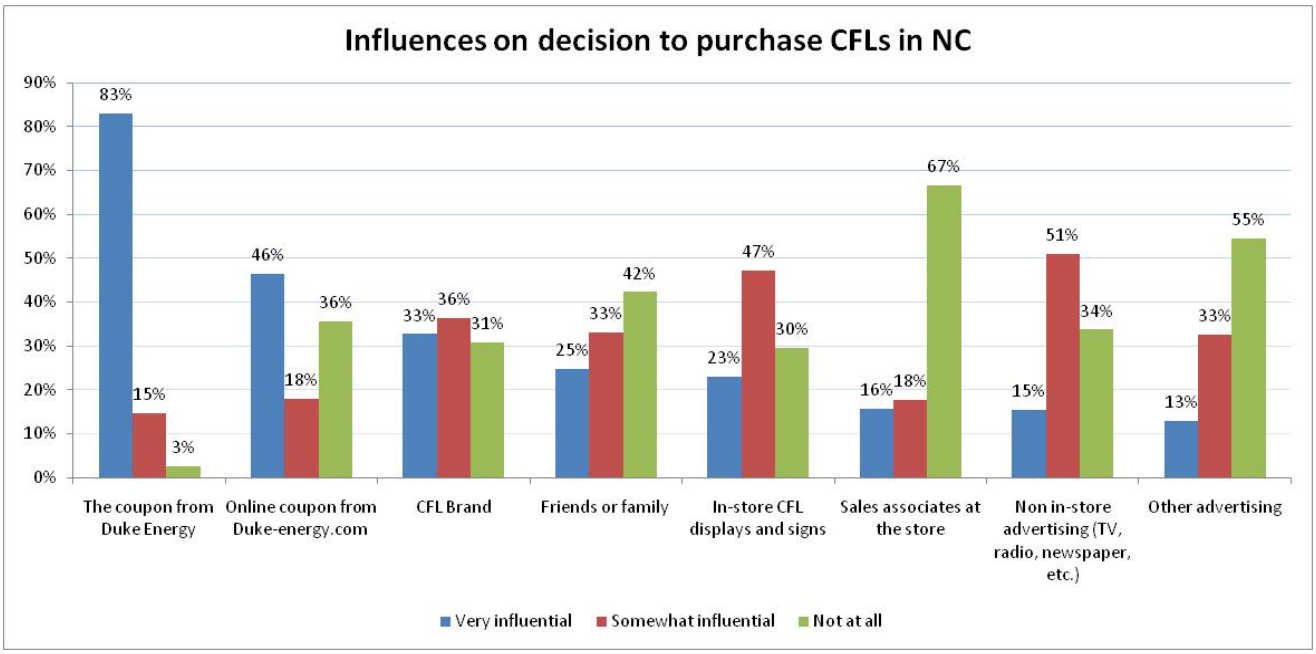

Figure 1. Influences on Decision to Purchase CFLs in North Carolina

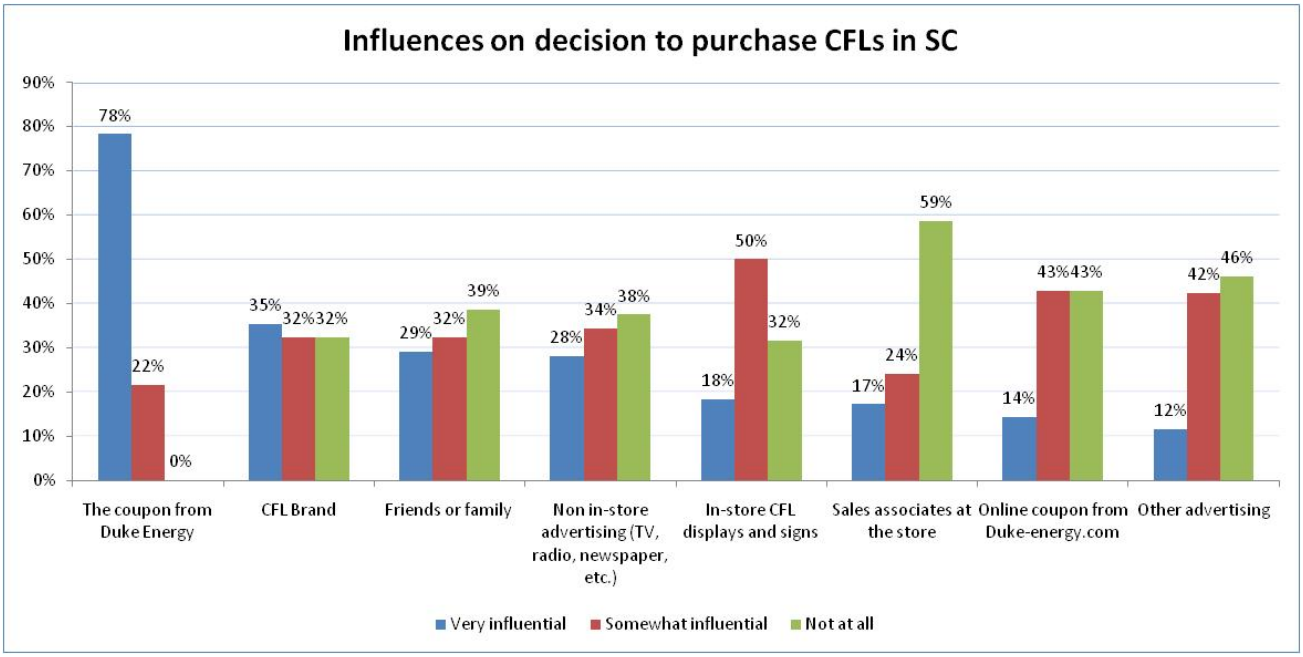

Figure 2. Influences on Decision to Purchase CFLs in South Carolina

As shown in the table below, the majority of redeemers in North Carolina (63.5%) and South Carolina (52.9%) recalled purchasing their CFLs at Wal-Mart using the CFL coupons. In addition, redeemers also mentioned other stores where they recalled purchasing CFL bulbs using the manufacturer's coupons.

Table 5. Location of CFL coupons redeemed

Store	NC		SC	
	N	%	N	%
Wal-Mart	106	**63.5%**	27	**52.9%**
Not specified	45	**26.9%**	21	**41.2%**
Home Depot	2	**1.8%**	1	**2%**
Lowe's	8	**4.8%**	1	**2%**
Target	3	**1.8%**	0	**0%**
Walgreens	1	**0.6%**	0	**0%**
Dollar General	2	**1.2%**	0	**0%**
Publix	0	**0%**	1	**2%**

Redeemers were asked if they purchased any of the following additional items when they purchased their CFLs: wall/ceiling insulation, faucet aerators, showerheads, weather stripping, caulking, outlet gaskets, or programmable thermostats. Most redeemers did not purchase additional items when purchasing their CFLs (88.3% in North Carolina and 90.2% in South Carolina). In North Carolina those redeemers who did purchase additional items purchased weather stripping, caulking, outlet gaskets, wall or ceiling insulation, or a programmable thermostat. In South Carolina redeemers who purchased additional items purchased weather stripping or caulking. These numbers reflect that when program participation influences additional purchases, those typically focus on lower cost items.

Table 6. Additional measures purchased when redeeming Duke Energy's CFL coupon

Measure	NC		SC	
	N	%	N	%
None	150	**88.3%**	46	**90.2%**
Caulking	7	**4.1%**	2	**3.9%**
Weather stripping	6	**4.6%**	3	**5.9%**
Low flow showerhead	2	**1.2.%**	0	**0%**
Faucet aerators	0	**0.0%**	0	**0.0%**
Electric wall outlet gaskets	1	**0.6%**	0	**0%**
Wall or ceiling insulation	3	**1.8%**	0	**0%**
Programmable thermostat	3	**1.8%**	0	**0%**

Use of CFL Coupons

Redeemers could have purchased between four and sixteen bulbs using the Duke Energy coupons. The majority of redeemers stated they purchased four or more CFLs, with over half of redeemers (64.5% in North Carolina and 47.4% in South Carolina) indicating they purchased six

or more CFLs. This data indicates that not only was the Duke Energy coupon the key driver for the purchase decision, but that purchase decisions typically involved four or more bulbs. A small number of redeemers stated that they purchased 1 or 2 CFLs. Since the CFLs eligible for the coupons were packages of 2 or 6 bulbs, these redeemers may have been describing the number of packages of CFLs they purchased, or they did not recall the number of bulbs purchased and were providing their best guess. The results are shown in Table 8.

Table 7. Number CFLs purchased, installed and stored for later use as a percentage of redeemers.

			0	1	2	3	4	5	6	7-11	12+
CFLs purchased with coupon	NC	N	5	3	7	10	23	3	53	30	10
		%	**3.5%**	**2.1%**	**4.9%**	**6.9%**	**16.0%**	**2.1%**	**36.8%**	**20.8%**	**6.9%**
	SC	N	2	1	4	4	8	1	17	8	3
		%	**4.2%**	**2.1%**	**8.3%**	**8.3%**	**16.7%**	**2.1%**	**35.4%**	**16.7%**	**6.3%**
CFLS installed	NC	N	6	8	10	15	25	4	49	24	8
		%	**4.0%**	**5.4%**	**6.7%**	**10.1%**	**16.8%**	**2.7%**	**32.9%**	**16.1%**	**5.4%**
	SC	N	3	1	6	9	7	1	13	5	1
		%	**6.5%**	**2.2%**	**13.0%**	**19.6%**	**15.2%**	**2.2%**	**28.3%**	**10.9%**	**2.2%**
CFLs stored for later use	NC	N	103	9	12	7	7	0	7	3	0
		%	**69.6%**	**6.1%**	**8.1%**	**4.7%**	**4.7%**	**0.0%**	**4.7%**	**2.0%**	**0.0%**
	SC	N	35	2	3	3	1	0	3	1	1
		%	**71.4%**	**4.1%**	**6.1%**	**6.1%**	**2.0%**	**0.0%**	**6.1%**	**2.0%**	**2.0%**

CFL Installation Rates

In North Carolina redeemers indicated that they had purchased 903 CFLs with coupons and of those 827 (91.6%) were installed. Two-hundred eighty-three (283) CFLs were purchased with coupons and 218 (77.1%) were installed in South Carolina. To obtain these numbers the 7-11 choice category was averaged to 9 bulbs and the specific numbers given by redeemers who had more than 12 CFLs were used. Along with the high installation rates Figure 8 illustrates that a high percentage of program CFLs are being put installed in sockets.

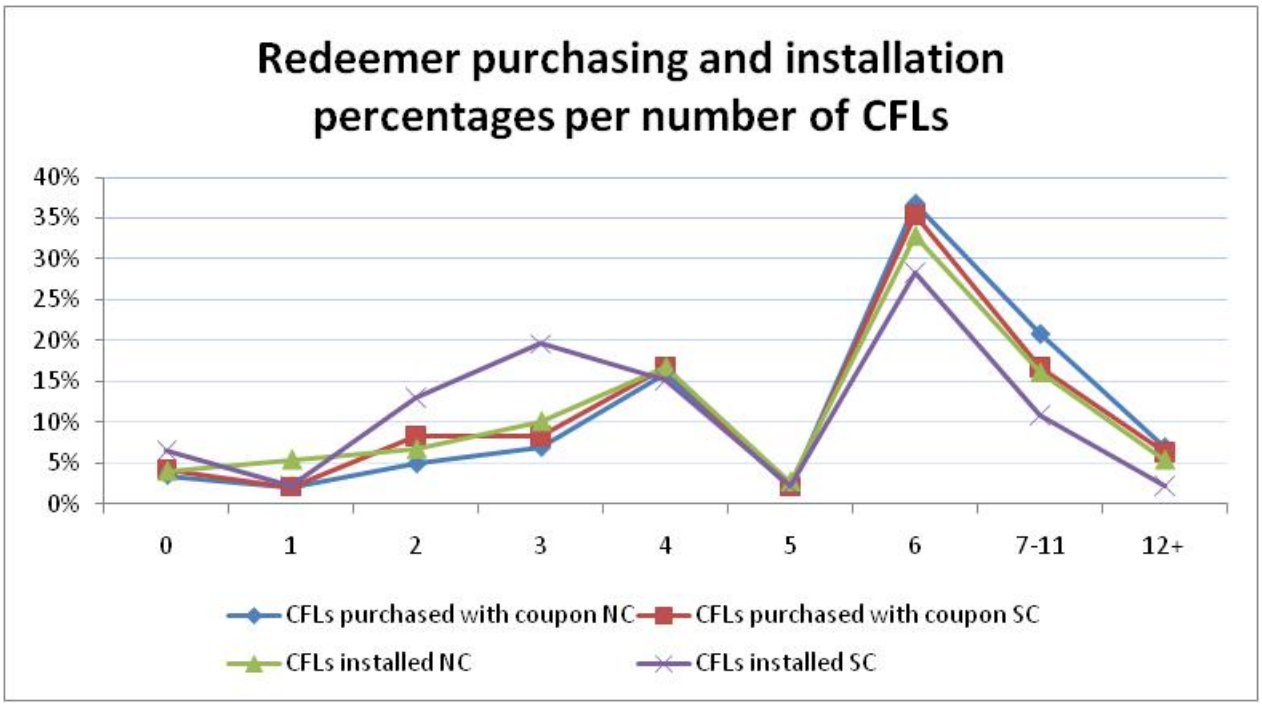

Figure 3. Number of CFLs purchased, installed and stored as a percentage of respondents

CFL Coupon Estimated Negative Influence

Redeemers were asked if they would have purchased any CFLs if the Duke Energy Smart $aver® coupon had not been available, and, if so, how many.

As shown in Table 8, more than 40% (43% in North Carolina and 48.6% in South Carolina) of redeemers stated that they would not have bought any CFLs if the coupon had not been available, and an even larger number of redeemers (51.8% in North Carolina and 55.6% in South Carolina) stated that they have not purchased any additional CFLs since using the coupon. These two statements corroborate the previous statement made by redeemers that receiving the coupon in the mail was most influential in a participant's decision to purchase CFLs.

Table 8. Estimated Influence of No Coupon, Additional Purchases and CFLs given away

			None	1	2	3	4	5	6	7-11	12+
Estimated CFLS bought if coupon had not been available	NC	N	69	5	14	10	19	1	16	9	4
		%	**46.9%**	**3.4%**	**9.5%**	**6.8%**	**12.9%**	**0.7%**	**10.9%**	**6.1%**	**2.7%**
	SC	N	23	1	9	1	3	0	6	4	2
		%	**46.9%**	**2.0%**	**18.4%**	**2.0%**	**6.1%**	**0.0%**	**12.2%**	**8.2%**	**4.1%**
CFLs purchased since participating	NC	N	93	3	9	3	14	2	10	12	2
		%	**62.4%**	**2.0%**	**6.0%**	**2.0%**	**9.4%**	**1.3%**	**6.7%**	**8.1%**	**2.0%**
	SC	N	25	1	2	2	7	2	7	2	2

		%	**50.0%**	**2.0%**	**4.0%**	**4.0%**	**14.0%**	**4.0%**	**14.0%**	**4.0%**	**4.0%**
CFLs given away	**NC**	N	138	2	1	3	0	0	2	0	0
		%	94.5%	1.4%	0.7%	2.1%	0.0%	0.0%	1.4%	0.0%	0.0%
	SC	N	41	1	1	1	1	1	1	0	1
		%	85.4%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	0.0%	2.1%

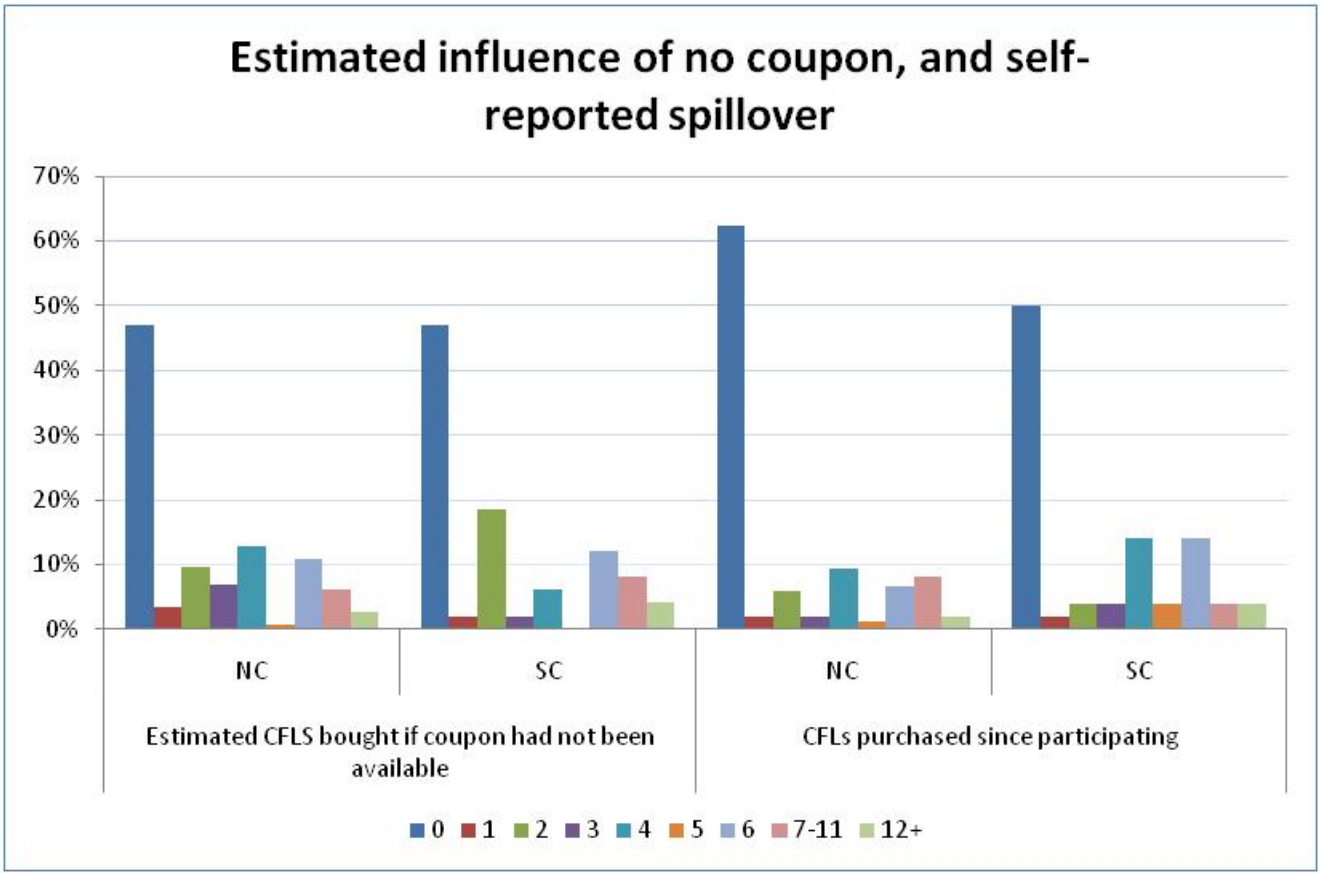

Figure 4. Estimated amount of bulbs bought if no coupon had been available, and additional purchases of CFLs in NC and SC

CFL Usage and Satisfaction

Redeemers were asked if their lighting hours of use had changed at all after installing CFLs. Most redeemers have not altered their behavior after installing their CFLs; that is, 84.3% of redeemers in North Carolina and 82.2% of redeemers in South Carolina reported that they have not changed the hours of use of light fixtures. Of those redeemers who did change their usage in North Carolina, 11.1% reported increasing hours and 4.6% reported decreasing their hours of use. In South Carolina 13.3% of redeemers reported decreasing their hours of use while 4.5% said that their hours of use had increased. This data suggests that snap-back is not associated with the Duke Energy CFL purchases – that is, customers are not using their fixtures more now that they are saving money on the use of those fixtures.

Eighty-nine percent (89%) of redeemers in North Carolina and 88% of redeemers in South Carolina reported that they have not removed any of the CFLs they installed. Of those redeemers who did remove a CFL they had installed, two-thirds (66.7%) in North Carolina and 46.7% in South Carolina did so because the bulb burned out.

Table 9. Lighting hours of use changes in NC and SC

	NC			SC		
	Increased	Decreased	No change	Increased	Decreased	No change
Fixture hours of use	17	7	129	2	6	37
	11.1%	**4.6%**	**84.3%**	**4.5%**	**13.3%**	**82.2%**

Table 10. CFLs bought with coupon and subsequently removed

Number of bulbs		0	1	2	3	4	5
NC	N	97	9	14	7	2	2
	%	**74.0%**	**6.9%**	**10.7%**	**5.3%**	**1.5%**	**1.5%**
SC	N	31	5	2	1	1	0
	%	**77.5%**	**12.5%**	**5.0%**	**2.5%**	**2.5%**	**0%**

Table 11. Reasons for removing coupon CFLs

Reasons for removal→		**Burned out**	**Not bright enough**	**Too slow to start**	**Did not like the light**	**Other**
NC	N	24	5	5	1	2
	% of all bulbs removed	**66.7%**	**13.9%**	**13.9%**	**2.8%**	**5.6%**
SC	N	6	4	2	0	2

	% of all bulbs removed	**46.7%**	**26.7%**	**13.3%**	**0%**	**13.3%**

Survey respondents in both North Carolina and South Carolina who chose "other" for their reason of removal declined to give specific reasons.

Previously installed CFLs

44.1% of redeemers in NC and 66.7% in SC stated they already had at least one CFL installed in their house before purchasing bulbs with Duke Energy coupons, and just over half of redeemers stated they had not already had CFLs installed. Of those redeemers who indicated that they had already installed a CFL, 52.1% in North Carolina and 58.9% in South Carolina had already installed 2, 3, or 4 bulbs. That is while they were already users, the level of use was small, representing only a few sockets per home. That is, these customers had not been previously transformed by other market pressures to be dedicated CFL users

32% of redeemers in North Carolina and 29.5% in South Carolina with previously installed CFLs had 6 or more bulbs installed. This translates to 16.9% of all redeemers surveyed in North Carolina, and 19.5% in South Carolina. CFLs continue to penetrate the market with new adopters moving to CFLs and significantly more new adaptors moving to CFLs via Duke Energy programs. Duke Energy is moving the market forward with respects to CFL first us adopters and increased adoption from previous adopters.

Table 12. Pre-installed CFLs

	NC		**SC**	
	Yes	No	Yes	No
CFLs pre-installed?	75	95	34	17
	44.1%	**55.9%**	**66.7%**	**33.3%**

Table 13. Numbers and percentages of pre-installed CFLs

Number of bulbs pre-installed →		**1**	**2**	**3**	**4**	**5**	**6**	**7-11**	**12+**
NC	N	8	13	11	15	2	4	5	13
	% of respondents with pre-installed CFLs (n=75)	10.7%	17.3%	14.7%	20%	2.7%	5.3%	6.7%	17.3%
	% of all surveyed (n=170)	**6.2%**	**10%**	**8.5%**	**11.5%**	**1.5%**	**3.1%**	**3.8%**	**10%**
SC	N	4	4	5	11	0	4	4	2
	% of respondents with pre-installed CFLs (n=33)	11.8%	11.8%	14.7%	32.4%	0.0%	11.8%	11.8%	5.9%
	% of all surveyed (n=51)	**7.8%**	**7.8%**	**9.8%**	**21.6%**	**0.0%**	**7.8%**	**7.8%**	**3.9%**

Table 14. Addition CFL purchases in NC and SC

	Number of respondents who purchased additional CFLs	Percentage of all respondents	Number of CFLs purchased	CFLs purchased divided by all survey respondents
NC	58	34.7%	322	1.93
SC	24	47.0%	139	2.72

In addition to the number of pre-installed CFLs, redeemers were asked how long they had been using CFLs before using the Duke Energy coupon. Responses included:

- Never purchased until now
- 1 year or less
- 1-2 years
- 2-3 year
- 3-4 years
- 4 or more years

As seen in Table 15 below, 17.9% of redeemers in NC and 34.7% of redeemers in SC indicate that they have been using CFLs for more than two years and 33.3% of redeemers in North Carolina and 26.5% of redeemers in SC indicate that this is their first time using a CFL. This data suggests that CFL saturation is still low within the coupon redeeming population prior to the use of the Duke Energy coupon.

Table 15. Time since first purchase of CFLs in NC and SC

	Never purchased until now	1 year or less	1-2 Years	2-3 Years	3-4 Years	4 or more years
NC	52	29	47	18	3	7
	33.3%	**18.6%**	**30.1%**	**11.5%**	**1.9%**	**4.5%**
SC	13	9	10	11	2	4
	26.5%	**18.4%**	**20.4%**	**22.4%**	**4.1%**	**8.2%**

Redeemers were asked to rate their satisfaction with the CFLs redeemed with their Duke Energy coupon. Ninety-eight percent (97.9%) of redeemers in North Carolina and 93.6% or redeemers in South Carolina are at least somewhat satisfied and 79.9% of redeemers in North Carolina and 74.5% of redeemers in South Carolina of were very satisfied with their CFLs.

Table 16. CFL satisfaction in NC and SC

	Very	Somewhat satisfied	Not at all satisfied

		Satisfied		
NC	N	115	26	3
	%	**79.9%**	**18.1%**	**2.1%**
SC	N	35	9	3
	%	**74.5%**	**19.1%**	**6.4%**

When CFL satisfaction was tallied for only those redeemers who removed the CFLs purchased with the Duke Energy coupon, 83% (5 of 6) of redeemers in South Carolina and 65% (11of 17) of redeemers in North Carolina indicated they were very satisfied with their Duke Energy CFLs. In North Carolina 35% (6 of 17) of redeemers who removed a CFL indicated that they were somewhat satisfied with the CFLs. This is twice the percentage of "somewhat satisfied" responses in the overall survey population and nearly a third of all the "somewhat satisfied" responses in North Carolina, indicating that bulb removal, as would be expected, has a negative correlation with CFL satisfaction. Time since first installation of CFLs had no impact on satisfaction levels suggesting that long-time users are not more or less satisfied with their CFLs than are new users.

Effects of Price on Future CFL Purchases

Redeemers were asked to consider their future CFL purchases and identify how many CFLs they would expect to purchase in the next year if CFLs were offered at a certain price compared to a standard (incandescent) bulb. The prices offered were:

- The same price as a standard bulb
- $1 more than a standard bulb
- $2 more than a standard bulb
- $3 more than a standard bulb

Redeemers were also asked how many CFLs they would purchase if they were free, but required a mail-in rebate form.

Results are shown for North Carolina in Table 17 and for South Carolina in Table 18 below and illustrated in Figure 5 through Figure 7. With CFLs being offered at the same prices as a standard bulb, 91.3% of redeemers in North Carolina and 83.7% of redeemers in South Carolina will purchase at least one CFL, and 72.4% of redeemers in North Carolina and 74.4% of redeemers in South Carolina indicated they would purchase four or more. More than 71% of redeemers in North Carolina and 68% of redeemers in South Carolina indicated they would purchase at least one CFL bulb if the price per bulb was $1 more than standard incandescent bulbs. When the price reaches $2 more 54.7% of redeemers in North Carolina and 46.5% of redeemers in South Carolina indicate they would not purchase CFL bulbs. This indicates that customers are expecting CFL prices that are comparable to incandescent lighting.

If the CFL bulbs are free with a rebate form, 80.3% of redeemers in North Carolina and 81.0% of redeemers in South Carolina said that they would purchase at least one CFL. Since these

percentages are lower than the percentages for CFLs at the same price as incandescent bulbs in both states, this suggests that 10% to 15% of redeemers may be experiencing a barrier other than price when deciding to purchase CFLs.

For example, some customers may not be at all interested in purchasing CFLs due to size, slow illumination, aesthetics or the quality of light and would not purchase CFLs regardless of price or price difference. In addition, for some of these redeemers the hassle of the rebate process may outweigh other advantages of purchasing CFLs; for example, 17 (9.9%) redeemers in North Carolina and 3 (7.4%) redeemers in South Carolina stated they would purchase CFLs at a price equal to standard bulbs would not obtain them if they were free through the use of a rebate.

Table 17. Hypothetical CFL buying habits in North Carolina under 4 different pricing scenarios

		0	1-2	3	4	5	6	7-11	12+
If CFLs were the same price as a standard bulb	N	13	17	7	12	5	28	19	33
	%	**9.7%**	**12.7%**	**5.2%**	**9.0%**	**3.7%**	**20.9%**	**14.2%**	**24.6%**
If CFLs were $1.00 more than standard bulbs	N	33	19	9	15	6	17	5	11
	%	**28.7%**	**16.5%**	**7.8%**	**13.0%**	**5.2%**	**14.8%**	**4.3%**	**9.6%**
If CFLs were $2.00 more than standard bulbs	N	58	18	7	11	6	2	0	4
	%	**54.7%**	**17.0%**	**6.6%**	**10.4%**	**5.7%**	**1.9%**	**0.0%**	**3.8%**
If CFLs were $3.00 more than standard bulbs	N	75	14	5	7	1	4	0	2
	%	**69.4%**	**13.0%**	**4.6%**	**6.5%**	**0.9%**	**3.7%**	**0.0%**	**1.9%**
If CFLs were free but required a mail-in rebate form	N	24	9	6	11	2	21	15	34
	%	**19.7%**	**7.4%**	**4.9%**	**9.0%**	**1.6%**	**17.2%**	**12.3%**	**27.9%**

Table 18. Hypothetical CFL buying habits in South Carolina under 4 different buying scenarios

		0	1-2	3	4	5	6	7-11	12+
If CFLs were the same price as a standard bulb	N	7	4	0	5	2	13	4	8
	%	**16.3%**	**9.3%**	**0.0%**	**11.6%**	**4.7%**	**30.2%**	**9.3%**	**18.6%**
If CFLs were $1.00 more than standard bulbs	N	13	5	2	4	4	9	0	4
	%	**31.7%**	**12.2%**	**4.9%**	**9.8%**	**9.8%**	**22.0%**	**0.0%**	**9.8%**

If CFLs were $2.00 more than standard bulbs	N	20	9	5	1	1	4	2	1
	%	**46.5%**	**20.9%**	**11.6%**	**2.3%**	**2.3%**	**9.3%**	**4.7%**	**2.3%**
If CFLs were $3.00 more than standard bulbs	N	32	1	3	2	0	2	0	1
	%	**78.0%**	**2.4%**	**7.3%**	**4.9%**	**0.0%**	**4.9%**	**0.0%**	**2.4%**
If CFLs were free but required a mail-in rebate form	N	8	5	0	4	3	13	3	6
	%	**19.0%**	**11.9%**	**0.0%**	**9.5%**	**7.1%**	**31.0%**	**7.1%**	**14.3%**

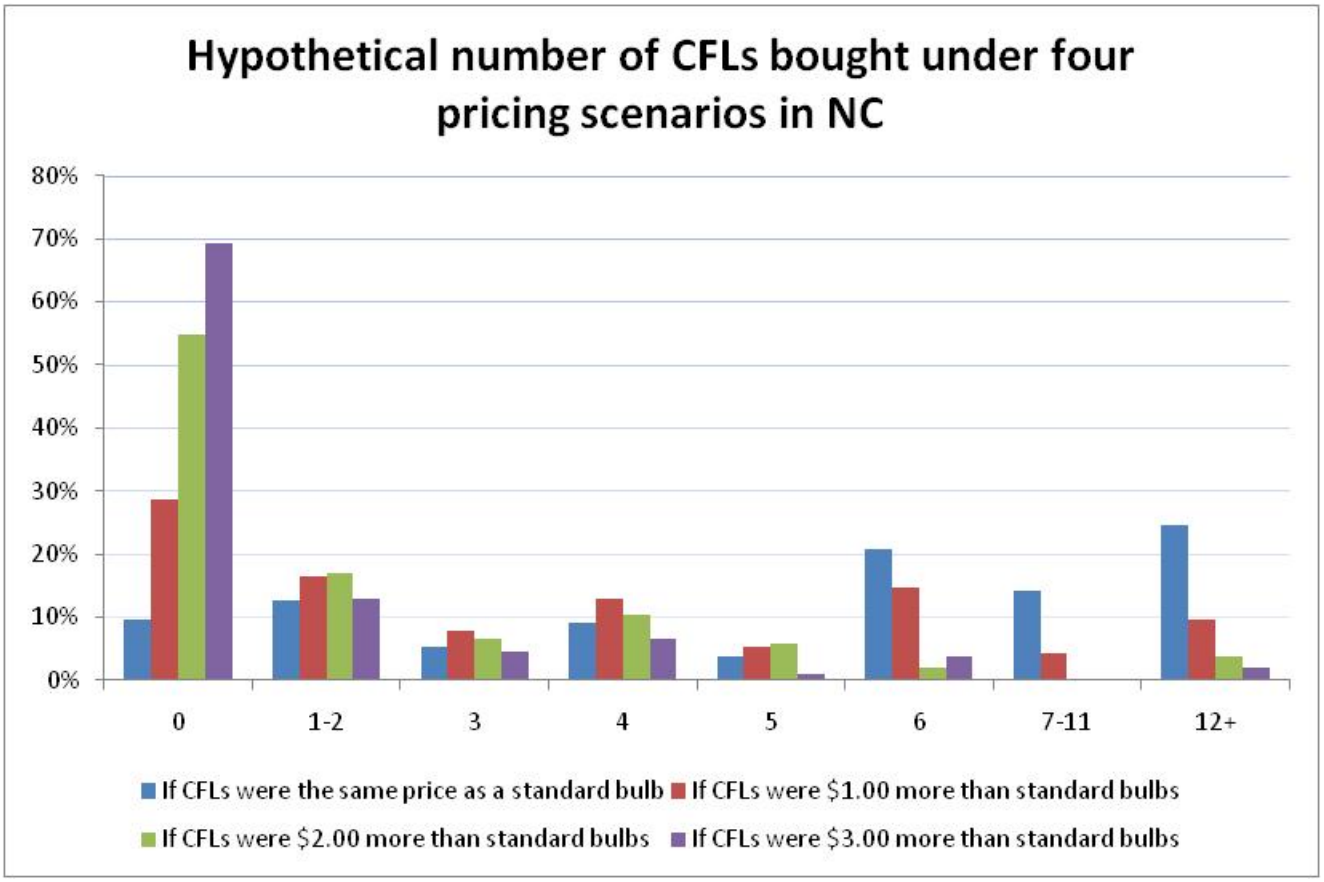

Figure 5. Hypothetical CFL pricing scenarios in North Carolina

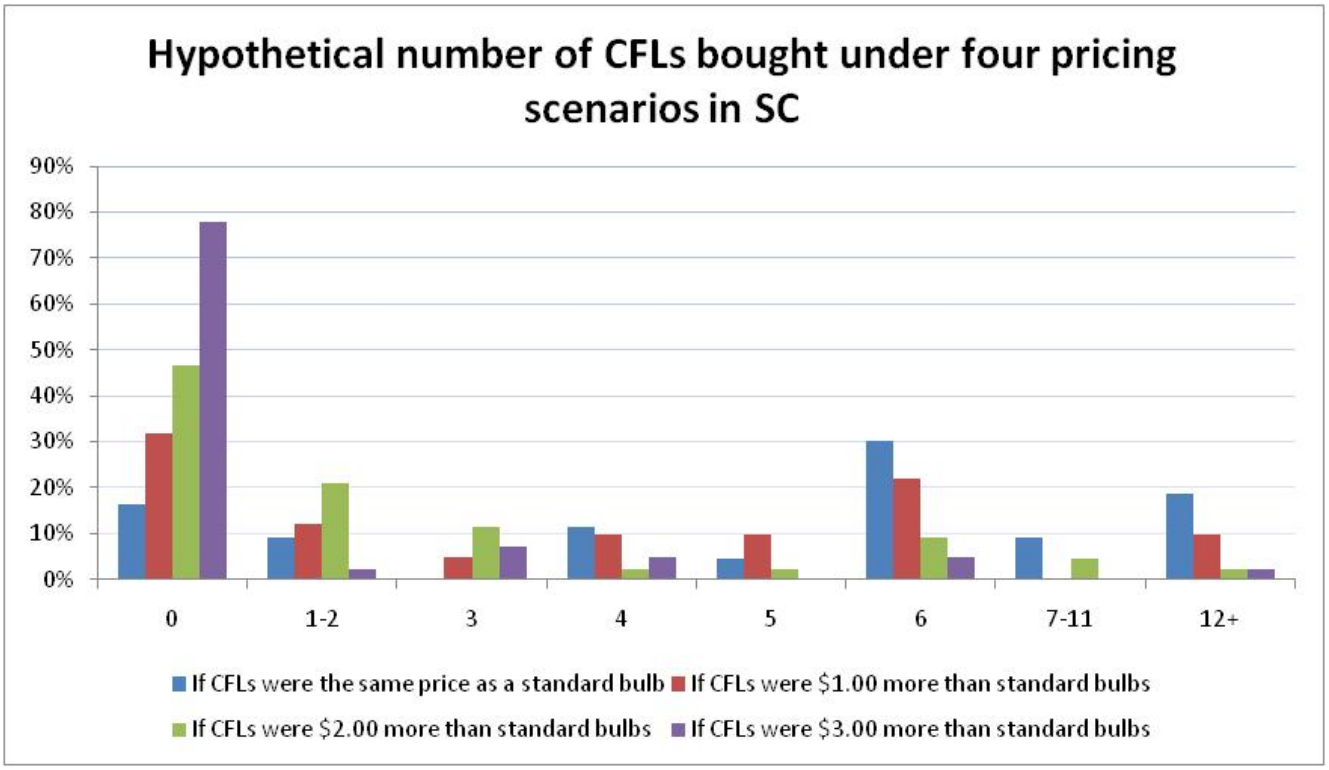

Figure 6. Hypothetical pricing scenarios in South Carolina

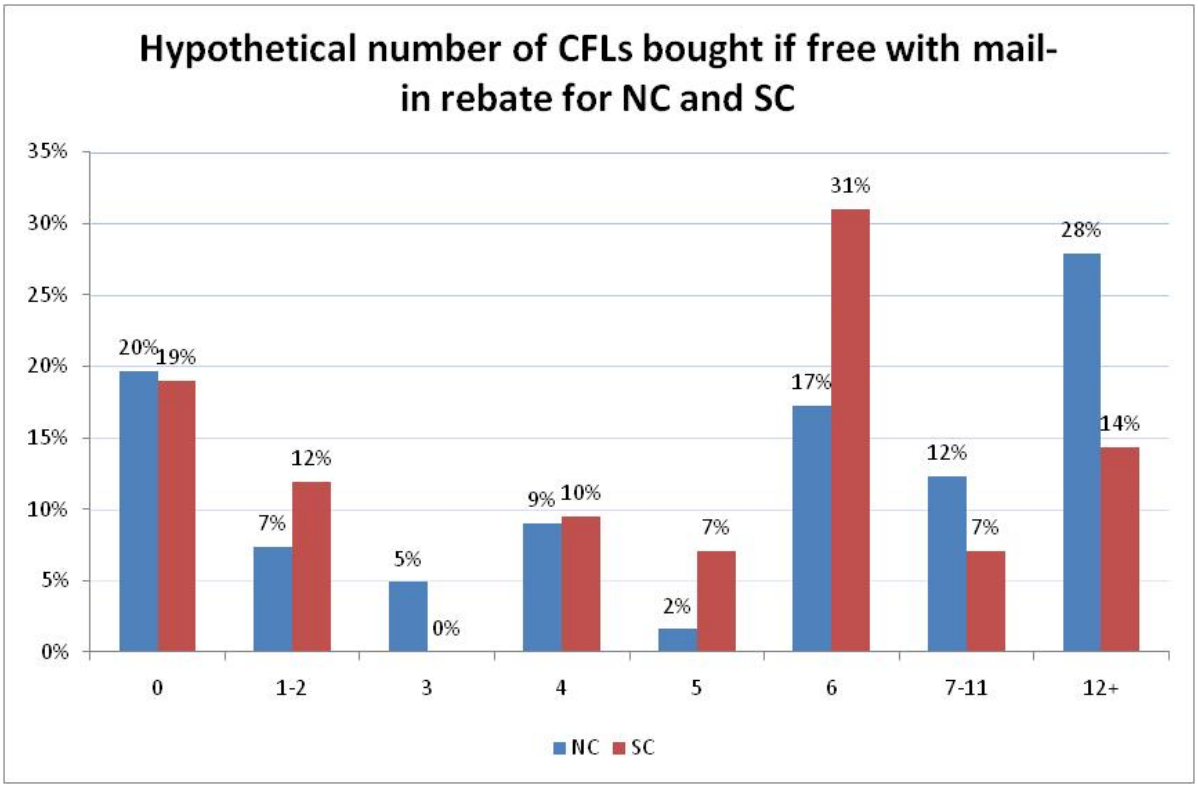

Figure 7. Hypothetical CFLs bought with free mail-in rebate in NC and SC

Influence of program CFLs on redeemer confidence and future use of CFLs

Redeemers were asked a series of five questions to determine the influence of program CFLs on their confidence in CFLs and their likelihood of buying CFLs in the future.

The specific categories to rate were:

- Confidence to use CFLs in the future
- Coupon's influence to in choosing CFLs in the future
- Confidence in performance of CFLs bought with the coupon to meet expectations
- Likelihood of buying CFLs in the future
- Likelihood to use a CFL if you had to change a light bulb

Each category had five ratings for redeemers to choose from:

- Much more likely/confident/better
- More likely/confident/better
- About the same
- Less likely/confident or worse
- Much less likely confident or worse

Results are compared between new and previous adopters and summarized in Figure 8 and Figure 9 below. NC and SC results were combined to provide a more reliable sample size for both adopter categories.

Overall, new adopters rated their confidence in CFLs, influence of the program, and performance of CFLs higher than redeemers who had used CFLs previously. However, when combining the ratings of "about the same" or higher, new adopters and previous adopters had very similar total percentages in all categories. This suggests that the program has a positive influence on the confidence level of new adopters of CFLs and does not negatively affect the opinions of previous adopters.

Figure 9 shows that new adopters and previous adopters are equally as likely to purchase and install CFLs in the future. This suggests that in North and South Carolina, new adopters who participate in the Duke Energy Smart $aver® CFL program are likely to deliver savings via installation and continued use rates that are comparable to previous adopters of CFLs.

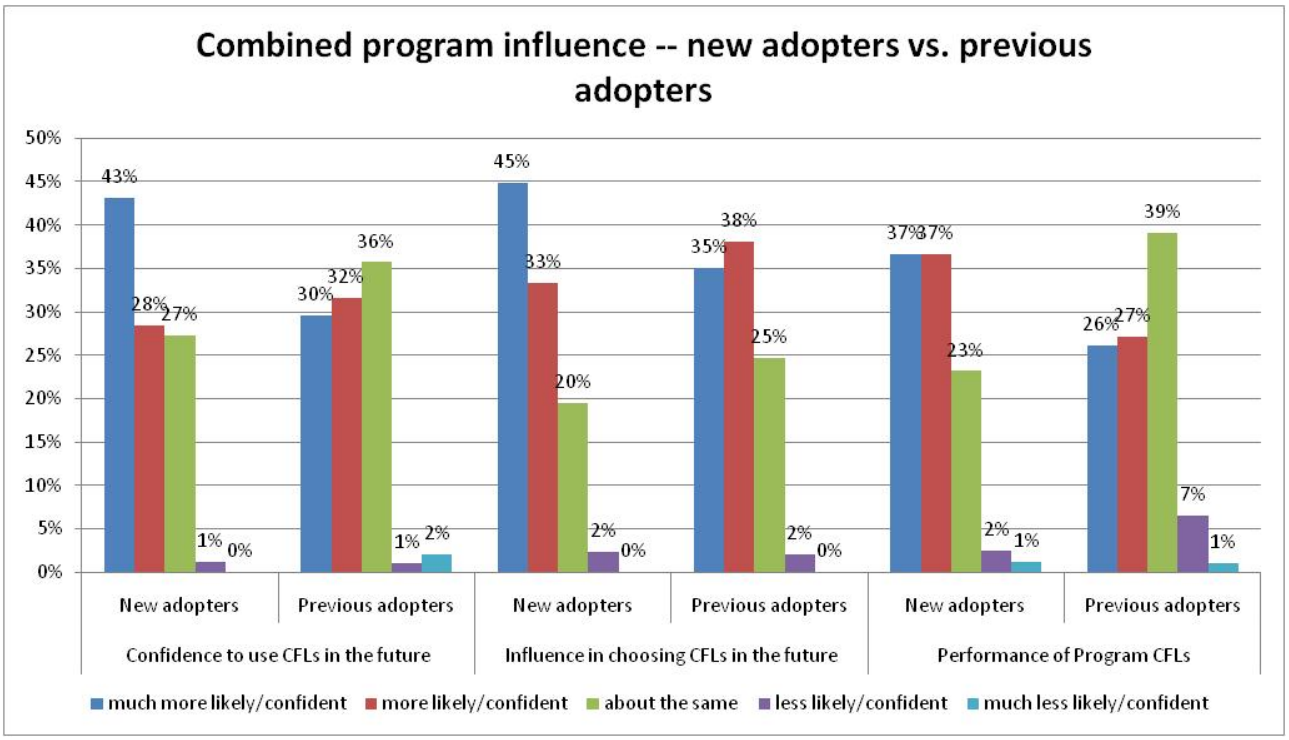

Figure 8. Forward looking influence of program in NC and SC combined. N=97 for previous adopters. N=87 for new adopters.

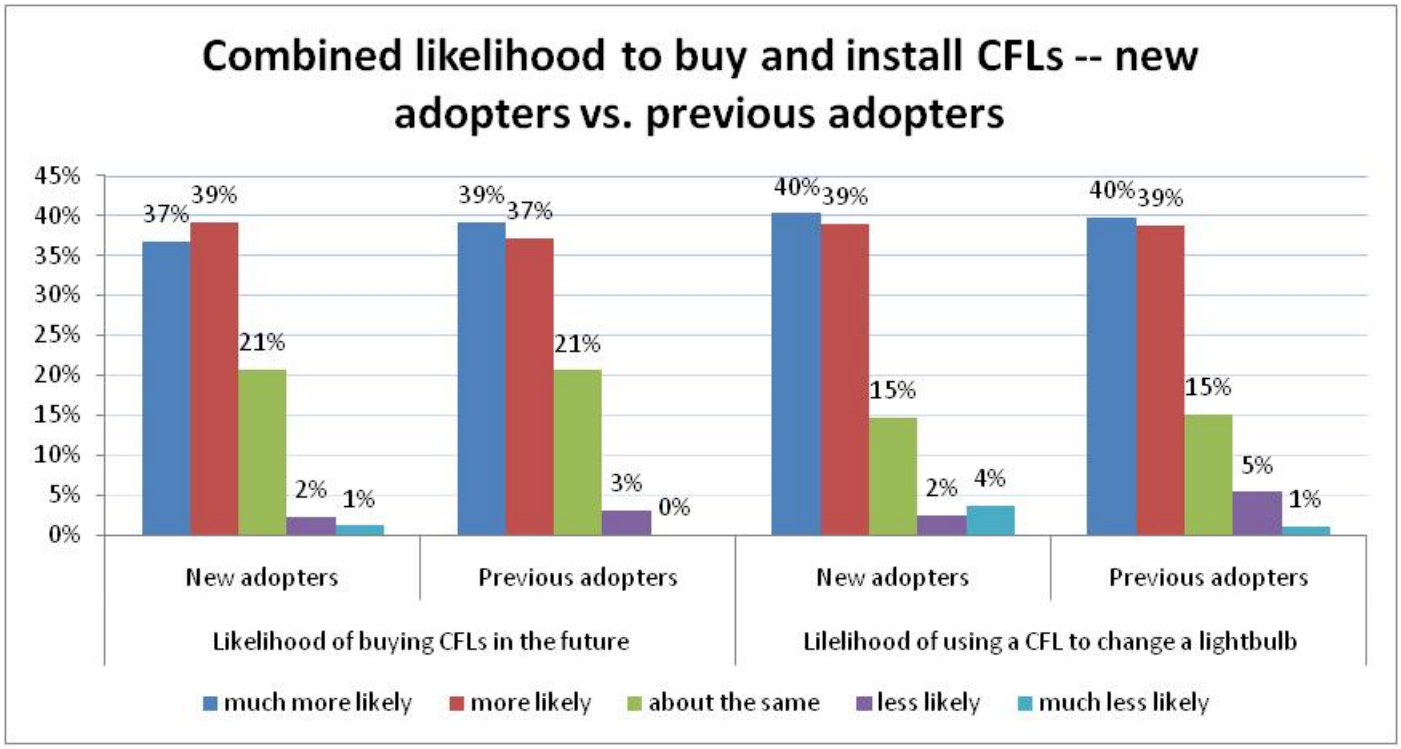

Figure 9. Forward-looking influence of program on buying and replacing habits in NC and SC combined. N=97 for previous adopters. N=87 for new adopters.

CFL Net to Gross Analysis

In order to assess the net impacts of the CFL coupon distribution effort we assessed the level of freeridership (those who would have taken the same action without the program) and the level of spillover (similar actions taken on their own after the program experience as a result of the program but without the Duke Energy coupon). Together the results of these two analyses are combined to estimate the total short-term net effects of the program and to calculate the net-to-gross ratio for the savings achieved as a result of the effort. These approaches and their results are presented below:

Freerider Analysis

The freerider analysis uses a typical self-reporting approach for estimating freeridership levels. This analysis compares what people actually purchased with what they said they would have purchased without the Duke Energy Coupon. The purchase records for each customer were taken from the Duke Energy coupon redemption database. This database tracks all coupons redeemed by the individual customer who received the coupon. Each coupon was bar-coded for the individual customer's address, allowing each customer's purchase behavior to be tracked, including the number of bulbs they purchased. The number of bulbs that these customers said that they would have purchased was taken directly from the coupon redeemer survey. To estimate the level of freeridership, only the surveys from customers who answered the question about their purchase behavior in the absence of the coupons were used. Likewise, only the number of bulbs actually purchased from these same customers was used in the freerider analysis. This approach, while reducing the population for the analysis, does allow the freeridership analysis to be conducted using a direct comparison of purchase behavior and stated purchase intent (without the program). All freeridership data from customers who could not answer the purchase behavior questions is not used in the analysis. In addition, the survey data was cleaned of illogical responses. That is, when the customer indicated that they would have bought more CFLs without the discounted price than they had purchased with the coupons, these survey responses, and the associated bulbs that they had purchased, were also excluded from the freeridership analysis. It does not make logical sense that participants would buy more CFLs at a higher price than they would have purchased as a reduced price.

A total of 1,000 mail surveys were sent out to CFL redeemers (NC 747, SC 253). A total of 218 surveys were returned for a response rate of 21 percent. Of the 218 surveys that were returned for analysis, 132 of the respondents were able to provide answers to the questions regarding how many bulbs they would have purchased without the Duke Energy coupon (61%) and also provided logical responses to these questions. In this data quality control step customers were allowed to indicate that they would have purchased up to the total amount of bulbs that were purchased with the Duke Energy coupons as the maximum level of bulbs that they would have purchased without the program. If the customer said that they would have purchased more bulbs than the maximum level without the discounted price (coupon value) without the program, his or her survey answers were excluded from the freeridership analysis for having invalid responses. The responses from this group of 132 respondents are used to calculate the freerider rate by comparing their self-reported estimate of the amount they would have purchased with the number of bulbs they actually purchased. This is called the self-report approach.

Self-report approaches typically provide conservatively biased results that act to increase the apparent freerider rate over the actual freerider rate. When self-report approaches are used, the resulting analyses should be considered conservatively biased, and represent the highest level of freeridership that would be typical for that population. There are three types of embedded biases which act to increase the apparent level of freeridership. These include:

1. **Self selection bias:** Customers who returned a CFL survey are a self-selected population. That is, they have elected to return the survey on their own, without prompting or incentives that act to increase response rates and potentially lowering the rate of bias. That is, customers who are most interested in CFLs and are more likely to use them on their own, and have a greater probability of returning the survey than people who do not.
2. **Socially accepted response bias:** People who respond to behavior-related surveys in which they are asked to report if they have taken an action associated with a social expectation are more likely to provide the more socially acceptable response. Because of the amount of social pressures to lower energy use and lower carbon footprint, survey respondents are more likely to indicate that they would have taken the socially accepted action without being pushed to take that action via a market push effort.
3. **Positive outcome bias:** The social science literature also indicates that causal attribution responses are influence by the outcome of the results of the behavior taken. If a respondent likes the results (saved energy / lowered utility bill) they are more likely to take credit for that behavior, and indicate that they would have taken the action on their own. If they do not like the results of the behavior taken, then they are more likely to credit that behavior to someone or something other than themselves.

This analysis assigned zero effects to these biases. That is, the results of the freerider analysis are not adjusted to account for these biases that tend to increase apparent freerider rates and lower apparent net savings. As a result, the levels of freeridership and the resulting net benefits should be considered conservative. It is likely the net energy savings estimated as a result of this analysis are greater than that indicated below.

There were a total of 908 bulbs purchased by the participants who were also able to provide responses to the survey questions on how many bulbs they would have purchased without the program's coupons. The total number of bulbs that these customers said that they would have purchased without the Duke Energy coupons is 172 bulbs.

Table 19. CFL freeridership estimate

	Number of bulbs purchased by the 278 respondents	Number of bulbs they said that they would have bought at the same time without the coupon	Freerider estimate
Summary analysis	908	172	18.9%

This means that according to the customer's responses pertaining to what they would have purchased if the program had not been in effect, 81.1% of all bulbs acquired would not have been acquired without the Duke Energy coupons. By distributing discount coupons to Duke

Energy's customers, approximately 18.9% of those bulbs would have been purchased without the program. This level of freeridership is also consistent with previous evaluations that indicate that freeridership for CFLs typically falls in the 20 to 40% range, but also indicate that when mass mailed coupons are used, the freeridership rate may be less than the score for programs in which participants must first enroll in a program to receive their bulbs. That is, the Duke Energy coupon program may put more CFLs in homes of people who would not have acquired them on their own than programs that require the completion of a program application.

Spillover Analysis

Spillover is defined as additional savings that are caused by the program, but not associated with the actions (rebates or coupons) offered by a program. They are the actions that customers take because of the behavior changes caused directly or indirectly by participation in a program. There are two types of spillover (participant and non-participant), and within the two types of spillover there are two categories of spillover (short-term and long-term).

Table 20. CFL spillover matrix

	Short-Term Spillover	Long-term Spillover also called Market Effects
Participant	Actions taken by a participant above and beyond those provided by a program, but which were caused as a result of taking part in a program. (For example: When a participant replicates a program action outside of a program because of the influence of the program on their short-term purchase behavior.)	Savings achieved through a long-term change in the decision systems of a participant so that the energy efficient choice is replicated over a long term period; a more permanent behavior change. (For example: When a participant tries a technology via a program, likes it, and then decides to use only that technology whenever possible, over the longer term.)
Non-participant	Actions taken by a non-participant which were caused as a result of someone taking part in a program. (For example: when a participant tells a neighbor about what they did via the program, and the neighbor replicates that action taken by the participant, but does not take part in the program themselves.)	Actions taken that are the result of the effects of a program's impact on the ways a market operates. (For example: A program that changes the way technologies are ordered, stocked and sold in a market, when that change can be demonstrated as a result of the program's effects on that market.)

The spillover analyzed in this study examine only the short-term participant spillover.

In order to estimate the short-term spillover effects of the program we asked customers if they purchased additional CFLs that were influenced by their experience with the program's CFLs.

In conducting this analysis we applied cause-and-effect coefficients to estimate the percent of the additional bulbs purchased by participants that were caused or influenced by the program.

To conduct this analysis we asked participants how many additional bulbs they had purchased without the coupons following their purchase of the Duke Energy CFLs. Again, not all customers could provide answers to this question. Thus, this analysis only includes the responses from the customers that could answer the spillover questions. In addition, the answer to the questions that indicate spillover effects are not applied to the population and are only counted as spillover for the individual.

One-hundred forty-nine (149) of the surveyed respondents were able to provide answers for the spillover questions and also indicated that they had purchased additional CFLs. Of the 149 providing answers to the spillover questions, these customers self-reported that they had purchased an additional 307 bulbs following their participation in the program. This set 307 as the maximum number of bulbs that could potentially be counted as spillover impacts.

We then asked them questions pertaining to the influence of the Duke Energy coupons on their purchase decisions. Two different spillover influence factors were asked of this group; one focusing on the program impact in their confidence associated with using CFLs in the future, and the other focusing on confidence in purchasing CFLs in the future. This allowed the spillover analysis to be based on two different, but related, spillover calculation metrics (confidence in future purchases and confidence in future use). The spillover analysis was set to prohibit any double counting of savings from spillover (metric values greater than 1.0 when combined) but also to set the metrics at a conservative level to allow a bulb to be counted as spillover only when both the confidence in purchase question and the confidence in use question were scored at their maximum level of cause and effect.

To accomplish this we set the maximum value for each of these confidence factors at .5 and added their values to obtain a per customer spillover score. Credit for a spillover effect was only given if the respondent scored these factors as the program causing them to be “much more confident” (.5 score) or “more confident” (.25 score). That is, they had to provide a positive score across both these metrics in order to receive any credit as a spillover bulb. In addition, they had to provide the maximum response for both questions in order for a follow-up purchase to be considered a fully counted bulb. This approach provides a level of analytical assurance that spillover bulbs would not be over-counted, but left open the possibility that spillover bulbs could be undercounted. In conducting this analysis we only included bulbs that the participant reported that they had already purchased. While we asked if they are more likely to buy CFLs in the future because of their experience with the Duke Energy CFLs, this score was not used to project additional future sales, or provide a larger spillover credit for those projected sales. This approach allows the spillover analysis to be conservative in the estimated impacts. As a result of this approach, it is likely that spillover impacts are considerably higher than what is reflected in this analysis, especially if longer-term spillover were counted.

The scoring for both of the spillover factors (purchase and use) were conducted as follows:

Table 21. CFL confidence spillover scoring percentage

Much more confident	50% credit on follow-up purchases
More confident	25% credit for follow-up purchases
About the same level of confidence	zero % (0) credit for follow up purchases
Less confident	zero % (0) credit for follow up purchases
Much less confident	zero % (0) credit for follow up purchases

Using this scoring approach, if the participants indicated that their level of confidence was unchanged or less, no credit for a market effect is provided even if they followed up and purchased additional CFLs after receiving their Duke Energy CFLs and even if they indicated that the program increased the likelihood that they would purchase additional CFLs in the future as a result of the receipt and use of the Duke Energy CFL.

Table 22. CFL spillover percentage

	Confidence to use CFLs in future	Confidence to buy CFLs in future
Much more confident (.5 points)	39%	46%
More confident (.25 points)	28%	30%
About the same/ less confident or much less confident (zero points)	33%	24%
Total	100%	100%

The respondents who purchased addition bulbs indicated that they had purchased an addition 307 CFL bulbs after their acquisition of the Duke Energy CFLs. Applying the approach specified above on a per participant basis (see appendix for an extrapolated table of this algorithm) indicates that an additional 234 of these bulbs were purchased as a result of the customers experience with the Duke Energy CFLs. The remaining 73 spillover bulbs (307 – 234 = 73) purchased were not influenced by the Duke Energy CFLs. That is, on average, across the 149 participants who could answer the survey freeridership and spillover responses, the Duke Energy CFL experience caused the typical participant to buy an additional 1.7 net CFLs between their acquisition of the Duke Energy CFLs and the evaluation survey (approximately 1 month).

Duke Energy customers surveyed in this study who could answer the freeridership and spillover questions acquired 736 net CFLs via the Duke Energy program and an additional 234 net bulbs via short term spillover for a total of 970 net bulbs. Together, the total bulbs acquired by the population who could provide responses to the freeridership questions (n=149) had acquired 908 gross program bulbs, plus an additional 307 gross short-term spillover bulbs for a total of 1,215 gross bulbs. The following graphic displays the distribution of the number of participants and their spillover characteristics.

As a result of this analysis we conclude that the net to gross ratio for the program, including adjustments for freeriders and short term spillover is 1.07 as reflected in the following table.

Table 23. CFL Net to Gross Ratio

Acquired via	Gross bulbs	Net Bulbs	NTG ratio
Duke Energy Program	908	736	.81
Spillover	307	234	1.32
Totals	1215	970	1.07

Note: the NTG ratio for the spillover effects are added to the program's NTG ratio because the spillover bulbs are acquired as a result of the short term market effects of the program. That is, they are acquired at no cost to the program, yet the benefits are acquired because of the efforts of the program. Because this analysis is conservative, that is it does not include adjustments for the three types of bias or the market transformation benefits of adding the longer-term market effects bulbs, it is likely that the net to gross ratio for the program is higher than 1.07 if the longer term benefits and adjustments could be made.

Impact Evaluation

The savings presented in this section were calculated using survey data from participants in the 2010 CFL campaigns. Customers provided data describing their installation of the CFL bulbs purchased with Duke Energy coupons. This data was supplemented with lighting logger data collected from participants' homes during the month of September 2010. These two data sets were combined to calculate the per-bulb savings for this program.

Self Reported CFL Data

Customers who returned surveys indicating their participation in the CFL program (some of whom also participated in the lighting logger study) were asked to indicate where the CFL bulbs they purchased were installed, what wattage of bulb the CFLs replaced, and approximately how many hours the bulbs were used each day. Table 24 below presents the responses from the 256 survey responses obtained from those that redeemed the CFL coupons in North Carolina.

Table 24. NC CFL Redeemer Survey: Self Reported Location of Purchased Bulbs, n=256

Room	Total	% of Total
Living room	36	14.1%
Master bedroom	30	11.7%
Dining room	25	9.8%
Kitchen	25	9.8%
Bathroom	40	15.6%
Hall	29	11.3%
Other Bedroom	54	21.1%
Basement	3	1.2%
Other	14	5.5%
Total	256	

Table 25 below presents the responses from the 65 survey responses obtained from those that redeemed the CFL coupons in South Carolina.

Table 25. SC CFL Redeemer Survey: Self Reported Location of Purchased Bulbs, n=65

Room	Total	% of Total
Living room	11	16.9%
Master bedroom	8	12.3%
Dining room	5	7.7%
Kitchen	8	12.3%
Bathroom	12	18.5%
Hall	5	7.7%
Other Bedroom	14	21.5%

Basement	0	0.0%
Other	2	3.1%
Total	65	

The survey asked the participant the watts of the incandescent lamp removed and the watts of the CFL installed. These data provided a distribution of the CFL sizes installed and the ratio of the baseline watts to the CFL watts. These data are shown below.

Table 26. NC CFL Redeemer Survey: Self Reported CFL Replacement Watts, n=229

Watts Replaced	Count	Average CFL Size	Ratio
40	10	13.50	1.96
60	178	13.45	3.46
75	21	20.00	2.75
100	20	21.85	3.58
Total	229		

Table 27. SC CFL Redeemer Survey: Self Reported CFL Replacement Watts, n=65

Watts Replaced	Count	Average CFL Size	Ratio
40	13	13.27	2.01
60	51	15.31	2.92
75	0	20.00	2.75
100	1	21.85	3.58
Total	65		

Note, due to small samples in South Carolina, the wattage ratio from North Carolina was used for the 75 and 100 watt lamps in South Carolina.

Lighting Logger Study

In conjunction with the surveys, a lighting logger study was performed with a subset of customers who returned the CFL redeemer survey. The purpose of this logger study was to determine how customers who redeem Duke Energy coupons are using CFL bulbs (i.e., what room or fixture are the bulbs installed in), as well as to determine the actual hours of use of these CFL bulbs. Customers who indicated on their survey that they were interested in participating in the lighting logger study were contacted by an outside market research firm to determine the customers' interest and availability to participate in the study. Duke Energy field technicians then set up appointments with the customer to install the lighting loggers.[6] The loggers remained in place for approximately three weeks during the month of September[7], and then were removed

[6] The technicians were identified as Duke Energy representatives by their Duke Energy badges, Duke Energy clothing, and the Duke Energy magnets on their vehicles. All field technicians received proper employment screening prior to conducting this field work.
[7] Since the loggers were installed near the autumnal equinox, no daylength adjustment was made.

by the field technicians at follow up appointments. Customers received a $50 incentive for participating in the study. In total, 156 lighting loggers were installed across 34 homes. Logger installations were limited to homes in North Carolina.

The average daily hours of operation by room and daytype are shown in Table 28.

Table 28. Logger Study: Hours of Use by Room and Daytype

Room Type	Weekday Hours	Weekend Hours	Average
Living room	4.30	4.12	4.24
Master bedroom	1.71	1.81	1.74
Dining room	4.46	5.09	4.66
Kitchen	3.95	4.19	4.03
Bathroom	2.20	2.18	2.19
Hall	0.34	0.72	0.46
Other Bedroom	1.71	1.81	1.74
Basement	1.50	1.50	1.50
Other	2.03	2.18	2.07

The operating hours by room type were projected into the survey data showing quantity of lamps installed in each room to estimate the overall average CFL operating hours. Since the distribution of lamps across the room types varied by state, the average operating hours by state are shown in Table 29. With the exception of basements, every room type's hours of use are associated with the appropriate logger study data. Self reported values were used for basements because no logger data was present. The "other" room type's hours of use is defined as the household average.

Table 29. Logger Study: Average Hours of Use by State

State	Average Hours per Day
North Carolina	2.54
South Carolina	2.67

Load Shape

The average load shape for CFL use by daytype is shown in Figure 10. The average fraction of the CFLs that are in operation during each hour is plotted for weekdays and weekends. Note: the scale for hours is based on an "hours ending" convention, so hour 1 represents the average fraction of lamps in the hour that ends at 1am (e.g. midnight to 1am).

The coincidence factor is defined as the fraction of CFLs in operation during the hour coincident with the utility peak. At 4pm on a weekday, the percent of lamps in operation is 12.3%, thus the CFL coincidence factor is 0.123.

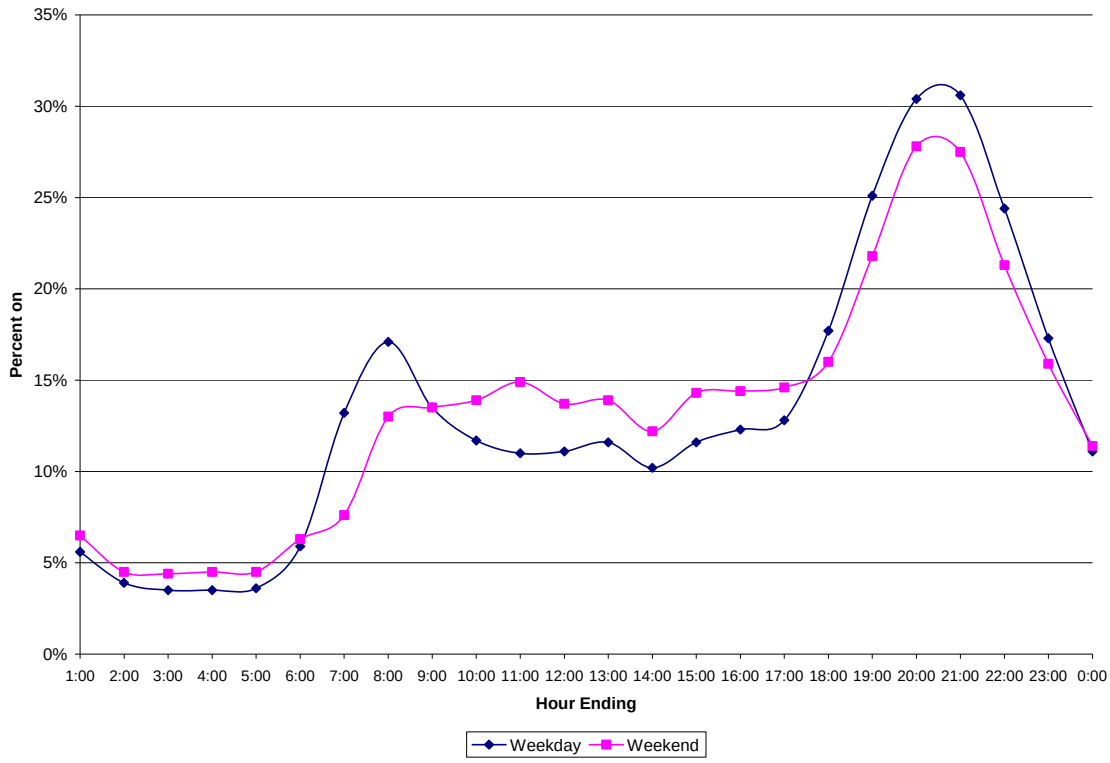

Figure 10. Average Daily Load Shape by Daytype

Program Savings

The total gross kWh savings for the sample was calculated as follows:

$$\Delta kWh = \sum_{i=1}^{room\ size} \sum_{j=1} \left[quantity_{i,j} \times \left(Watts_{base,j} - Watts_{cfl,j} \right) \times hr_i \times 365 \right]$$

where:

ΔkWh	= total kWh savings for sample
i	= index on room type
j	= index on base lamp size
$quantity_{i,j}$	= quantity of lamps of size j installed in room type i
$Watts_{base,j}$	= base lamp watts (40, 60, 75, 100)
$Watts_{cfl,j}$	= cfl watts corresponding to each base lamp watt
hr_i	= average hours per day by room type

The total gross kW savings for the sample was calculated as follows:

$$\Delta kW = \sum_{j=1}^{size} quantity_j \times (Watts_{base,j} - Watts_{cfl,j}) \times CF$$

where:

CF = coincidence factor (0.123)

The average savings per lamp was calculated simply by dividing the total kWh and kW savings by the number of lamps in the sample:

$$\Delta kWh / lamp = \frac{\Delta kWh}{quantity}$$

$$\Delta kW / lamp = \frac{\Delta kW}{quantity}$$

The total gross program savings were estimated from the average savings per lamp, the total number of rebated lamps, and the in-service rate. Since some lamps are put into storage, and others are used to replace other CFLs, the in-service rate is an estimate of the fraction of total lamps purchased that ultimately replace an incandescent lamp.

$$\Delta kWh_{gross,program} = \Delta kWh / lamp \times quantity\, redeemed \times ISR$$

$$\Delta kW_{gross,program} = \Delta kW / lamp \times quantity\, redeemed \times ISR$$

The in-service rate is estimated from the initial fraction of lamps installed, the lifetime number of lamps that are installed and the fraction of lamps initially in storage that are used to replace incandescent lamps:

$$ISR = F_{initial} + (F_{lifetime} - F_{initial}) \times F_{incand}$$

where:

$F_{initial}$ = fraction of purchased lamps initially installed
$F_{lifetime}$ = fraction of lamps ultimately installed
F_{incand} = fraction of stored lamps used to replace an incandescent

The in-service rate for North Carolina and South Carolina participants is shown in Table 30.

Table 30. Data for In-Service Rate Calculation

Parameter	Value	Source
$F_{initial}$	0.86 (NC)	Survey data on number of CFLs

	0.87 (SC)	purchased and number of CFLs stored
$F_{lifetime}$	0.97	Ohio TRM[8]
F_{incand}	0.43	Ohio TRM[9]
ISR	0.91 (NC) 0.91 (SC)	Rounded result from calculation above

This analysis indicates that 42% of the lamps that initially went into storage will be used to replace an incandescent lamp, 3% will permanently remain in storage, and the remaining 55% will be used to replace a failed CFL.

The total program savings for North Carolina and South Carolina are shown in Table 31. Total coupon redemption and lamps per coupon data were obtained from Duke Energy. Net savings were estimated using the free rider and spillover fractions described in the preceding section.

Table 31. Total Program Savings for North Carolina and South Carolina

Metric	North Carolina	South Carolina
Total lamps redeemed	1,619,990	490,670
ISR	0.9053	0.9102
Gross kWh per lamp redeemed	42.4265	36.6900
Gross kW per lamp redeemed	0.0445513	0.0378810
Coincidence Factor	0.123	0.123
Gross Coincident kW per lamp redeemed	0.0055	0.0047
Total Gross Program MWh Savings	68,731	18,003
Total Gross Program kW Savings	72,173	18,587
Total Gross Program Coincident kW Savings	8,877	2,286
Free rider adjustment	0.81	0.81
Spillover adjustment	1.32	1.32
Net to gross ratio including spillover	1.07	1.07
Total Net Program MWh Savings (free riders only)	55,672	14,582
Total Net Program kW Savings (free riders only)	58,460	15,056
Total Net Program Coincident kW Savings (free riders only)	7,191	1,852
Net kWh per lamp redeemed (free riders only) (A)	34.37	29.72
Net kW per lamp redeemed (free riders only)	0.0361	0.0307
Net Coincident kW per lamp redeemed (free riders only)	0.0044	0.0038
Total Net Program MWh Savings (free riders plus spillover)	73,542	19,263
Total Net Program kW Savings (free riders plus spillover)	77,225	19,888
Total Net Program Coincident kW Savings (free riders plus spillover)	9,499	2,446
Net kWh per lamp redeemed (free riders plus spillover) (B)	45.40	39.26
Net kW per lamp redeemed (free riders plus spillover)	0.0477	0.0405
Net Coincident kW per lamp redeemed (free riders plus spillover)	0.0059	0.0050

[8] The Ohio Technical Reference Manual (TRM) references a study by Nexus Market Research, RLW Analytics and GDS Associates; "New England Residential Lighting Markdown Impact Evaluation," January 20, 2009.
[9] Ibid.

Measure life	5	5
Lifetime net MWh savings (free riders only)	278,359	72,911
Lifetime net MWh savings (free riders plus spillover)	367,708	96,314

(A): Net kWh per lamp redeemed, for the free riders only, is calculated using the total net program MWh savings (free riders only) divided by the total lamps redeemed.
(B): Net kWh per lamp redeemed, including both free riders and spillover, is calculated using the total net program MWh savings (free riders plus spillover) divided by the total lamps redeemed.
* While the advertised expected life of the installed CFLs is greater (10 years), recent research in California has indicated that CFL bulbs installed in typical rooms have switching behaviors that erode about half the advertized effective useful life. The adjustment approach for reducing the effective useful life to 5 years is presented in Appendix E: Effective Useful Life Adjustment Factor for Installed CFLs.

Appendix A: CFL Coupon Redeemer Survey

Duke Energy

Survey T. Est
123456 Does This Layout Work Rd.
Seems Like It Is, OK 55555

Dear Customer,

Duke Energy is continuously trying to improve our services for you. To help us improve the **Compact Fluorescent Light bulb** program, we would like your input. Please let us know what you think about the compact fluorescent light bulbs (CFLs) you purchased through our coupon promotion. Some examples of CFLs are in the pictures below. If you have any questions, please contact Duke Energy at mresearch@duke-energy.com.

WE WOULD LIKE YOUR OPINION ABOUT OUR COMPACT FLUORESCENT LIGHT BULB (CFL) COUPON PROGRAM. PLEASE FILL IN THE CIRCLES COMPLETELY USING BLUE OR BLACK INK.

Do you recall receiving Compact Fluorescent Light bulb (CFL) coupons from Duke Energy? ○ Yes ○ No

Did you give away any of your coupons to someone else to use? ○ Yes ○ No

Did you use at least one coupon yourself? ○ Yes – Continue this survey ○ No – Thank you. Please return survey.

How influential were the following in your decision to purchase CFL(s)?

	Very Influential	Somewhat Influential	Not at all Influential
The coupon from Duke Energy	○	○	○
In-store CFL displays and signs	○	○	○
Non-in-store advertising (TV, radio, newspaper, etc.)	○	○	○
Sales associates at the store	○	○	○
CFL Brand	○	○	○
Other advertising	○	○	○
Friends or family	○	○	○

At which store did you purchase your CFL bulbs using the Duke Energy coupons? _____

Did you purchase any of the following items at the same time you purchased the CFLs with the Duke Energy coupons? Mark all that apply.

○ Wall or ceiling insulation ○ Faucet aerators ○ Low flow showerhead ○ Weatherstripping

○ Caulking ○ Electric wall outlet gaskets ○ Programmable thermostat ○ None of these

In this section of the survey, we would like to understand how you have used the CFL packs you purchased with the coupon(s).

	0	1	2	3	4	5	6	7-11	12+
How many CFL bulbs did you purchase in TOTAL with the Duke Energy coupon(s)?		○	○	○	○	○	○	○	○
How many CFL bulbs would you have bought if you had not had the Duke Energy coupon(s)?	○	○	○	○	○	○	○	○	○
How many CFL bulbs have you since purchased without Duke Energy coupons?	○	○	○	○	○	○	○	○	○

Of the CFLs you bought with the Duke Energy coupons:

	0	1	2	3	4	5	6	7-11	12+
How many CFLs are now installed?	○	○	○	○	○	○	○	○	○

For each CFL purchased with coupons that is now installed, please write in WHERE each CFL was installed, WHAT wattage the CFL is, WHAT wattage the old bulb was, and on average, HOW MANY HOURS you use that light each day.

	WHERE CFL INSTALLED	CFL WATTAGE	OLD BULB WATTAGE	HOW MUCH LIGHT IS USED (Hours Each Day)
Example	Living Room Floor Lamp	13Watt CFL	60Watt Incandescent	6 Hours Per Day (average)
Example	Hallway Ceiling Fixture	15Watt CFL	20Watt CFL	1 Hour Per Day (average)
Bulb 1				
Bulb 2				
Bulb 3				
Bulb 4				
Bulb 5				
Bulb 6				
Bulb 7				
Bulb 8				
Bulb 9				
Bulb 10				
Bulb 11				
Bulb 12				
Bulb 13				
Bulb 14				
Bulb 15				

Have you changed the hours of use of any fixture in which you installed the CFLs? ○ Yes ○ No

If you answered yes, how did your average usage change? ○ Increased usage ○ Decreased usage

Have you removed 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
○ Burned out ○ Not working properly ○ Other

If other, please specify:_____

Did you have any CFLs installed in light sockets in your house before you bought the CFLs with the Duke Energy coupon? ○ Yes ○ No

	1	2	3	4	5	6	7-11	12+
If yes, about how many were already installed?	○	○	○	○	○	○	○	○

How long have you been using CFL light bulbs?

○ Never purchased a CFL until now ○ 1 year or less ○ 1 to 2 years ○ 2 to 3 years
○ 3 to 4 years ○ 4 or more years

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

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

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

Are you aware of the ENERGY STAR label? ○ Yes ○ No

Do you typically look for the ENERGY STAR label when purchasing an appliance? ○ Yes ○ No

Do you typically buy appliances with the ENERGY STAR label? ○ Yes ○ Some of the time ○ Never

CFL Purchasing

Considering future CFL purchases, how many CFL bulbs would you purchase in the next year if…

	0	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?	○	○	○	○	○	○	○	○

General Information About Your Home

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

○ Detached single-family ○ Townhouse ○ Condominium ○ Duplex/2-family
○ Apartment ○ Manufactured home ○ Multi-Family (3 or more units)

In what year was your home built?

○ 1959 or before ○ 1960 - 1979 ○ 1980 – 1989 ○ 1990 - 1997
○ 1998 – 2000 ○ 2001 – 2007 ○ 2008 or later

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

○ Less than 500 ○ 500-999 ○ 1,000-1,499 ○ 1,500-1,999
○ 2,000-2,499 ○ 2,500-2,999 ○ 3,000-3,499 ○ 3,500-3,999
○ 4,000 or more ○ Don't know

What range best describes your total annual household income?

○ Less than $25,000 ○ $25,000 to $49,999 ○ $50,000-$74,999 ○ $75,000-$100,000
○ Over $100,000 ○ Don't know ○ Prefer not to answer

How many people live in your home?

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 or more

Do you own or rent your home?

○ Own ○ Rent

Primary heating fuel? ○ Electric ○ Gas ○ Oil ○ Propane ○ Other ○ None

Type of heating system?

○ Central furnace ○ Electric baseboard ○ Heat pump
○ Geo-thermal heat pump ○ Hot water or steam boiler ○ Other ○ Do not have

Age of heating system in years?

○ 0-4 ○ 5-9 ○ 10-14
○ 15-19 ○ >19 ○ Don't know ○ Do not have

Primary cooling fuel? ○ Electric ○ Gas ○ Oil ○ Propane ○ Other ○ None

Type of cooling system?

○ Central air conditioner ○ Window/Room unit air conditioner ○ Heat pump (for cooling)
○ Geo-thermal heat pump ○ Other ○ No cooling system

Age of cooling system in years?

○ 0-4 ○ 5-9 ○ 10-14
○ 15-19 ○ >19 ○ Don't know ○ Do not have

HAVE A CHANCE TO PARTICIPATE IN THE DUKE ENERGY LIGHTING STUDY

Would you be interested in participating in a lighting study in July and August 2009?

A Duke Energy representative would place small lighting monitors on 4 or 5 light fixtures which would remain in place for 2 to 3 weeks. The monitors are smaller than the size of a bar of soap and help us measure how often lights are turned on and off during the week. The first 100 returned surveys indicating interest will be contacted. Eligible customers that are selected will receive $50 for participating.

If yes, you may receive a follow-up phone call about this lighting study in July.

○ **Yes, I am interested in participating. My phone number is: _____.**

○ **My address on the front page of this survey is correct.**

○ **My address is:**

_____

○ No, I am not interested in participating.

THANK YOU FOR YOUR RESPONSES

Appendix B: Smart $aver® CFL Management Interview Instrument

Name: _____

Title: _____

Position description and general responsibilities:

_____

_____

_____

We are conducting this interview to obtain your opinions about and experiences with the Smart $aver® CFLs program. We'll talk about the Smart $aver® CFLs Program and its objectives, your thoughts on improving the program, and the technologies the program covers. The interview will take about an hour to complete. May we begin?

Program Objectives

1. In your own words, please describe the Smart $aver® CFL Program's current objectives. How have these changed over time?

2. In your opinion, which objectives do you think are best being met or will be met?

3. Are there any program objectives that are not being addressed or not being addressed as well as possible or that you think should have more attention focused on them? If yes, which ones? How should these objectives be addressed? What should be changed?

4. Should the program objectives be changed in any way due to technology-based, market-based, or management based conditions? What objectives would you change? What program changes would you put into place as a result, and how would it affect the operations of the program?

Operational Efficiency

5. Please describe your role and scope of responsibility in detail. What is it that you are responsible for as it relates to this program? When did you take on this role? *If a recent change in management…*Do you feel that Duke Energy gave you enough time to adequately prepare to manage this program? Did you get all the support that you needed to manage this program?

6. Please review with us how the Smart $aver® CFL Program operates relative to your duties, that is, please walk us through the processes and procedures and key events that allow you do currently fulfill your duties.

7. Have any recent changes been made to your duties? If so, please tell us what changes were made and why they were made. What are the results of the change?

8. Describe the evolution of the Smart $aver® CFL Program. How has the program changed since it was it first started?

9. Do you have suggestions for improvements to the program that would increase participation rates or interest levels?

10. Do you have suggestions for improving or increasing energy impacts?

11. Do you have suggestion for the making the program operate more smoothly or effectively?

12. *(If not captured earlier)* Please explain how the interactions between the retailers, customers and the Smart $aver® CFL management team work. Do you think these interactions or means of communication should be changed in any way? If so, how and why?

13. Describe your quality control and tracking process.

14. Are key industry experts, trade professionals or peers used for assessing what the technologies or models should be included in the program? If so, how does this work?

15. Are key industry experts and trade professionals used in other advisory roles? If so how does this work and what kind of support is obtained?

16. Describe the Smart $aver® CFL retailer program orientation training and development approach. Are retailers getting adequate program information? What can be done that could help improve retailer effectiveness? Can we obtain any informational materials that are being used?

17. What market information, research or market assessments are you using to determine the best target markets or market segments to focus on?

18. What market information, research or market assessments are you using to identify market barriers, and develop more effective delivery mechanisms?

19. Overall, what about the Smart $aver® CFL program works well and why?

20. What doesn't work well and why? Do you think this discourages participation or interest?

21. Can you identify any market, operational or technical barriers that impede a more efficient program operation?

22. In what ways can these operations or operational efficiencies be improved?

23. In what ways can the program attract more vendors?

24. In what ways can the program attract more consumer participation?

25. How do you make sure that the best information and practices are being used in Smart $aver® CFL operations?

26. *(If not collected above)* What market information, research or market assessments are you using to determine the best target markets and program opportunities, market barriers, delivery mechanisms and program approach?

27. If you could change any one thing about the program, what would you change and why?

28. Are there any other issues or topics you think we should know about and discuss for this evaluation?

Appendix C: Smart $aver® CFL Retailer Management Instrument

Name: _____

Title: _____

Position description and general responsibilities:

_____

_____

_____

We are conducting this interview to obtain your opinions about and experiences with the Smart $aver® CFL program. We'll talk about your understanding of the Smart $aver® CFL Program and its objectives, your thoughts on improving the program, and the technologies the program covers. The interview will take about 20-30 minutes to complete. May we begin?

Understanding the Program

We would like to ask you about your understanding of the Smart $aver® CFL program. We would like to start by first asking you to…

1. Please review for me how you are involved in the program and the steps you take in the participation process. Walk me though the typical steps you take to introduce the program to the customer, and what you do to help a customer become eligible for this program. What do you do to receive or help the customer receive the program incentive?

2. What kinds of problems or issues have come up in the Smart $aver® CFL program?

3. Have you heard of any customer complaints that are in any way associated with this program? Have callbacks increased due to the program technologies?

Program Design and Design Assistance

4. Do you feel that the proper technologies and equipment are being covered through the program?

5. Are the coupon levels appropriate?

6. Are there other technologies or energy efficient products that you think should be included in the program?

7. Are there components that are now included that you feel should not be included? What are they and why should they not be included?

Reasons for Participation in the Program

We would like to better understand why retailers/distributors become partners in the Smart $aver® CFL Program.

8. How long have you been a partner in the Smart $aver® CFL Program?

9. What are your primary reasons for participating in the program? Why do you continue to be a partner?…. *If prompts are needed*… Is this a wise business move for you, is it something you believe in professionally, is it that it provides a service to your customers, or other reasons?

10. Has this program made a difference in your business? How? Are your primary reasons for participation being met? Why/why not?

11. How do you think Duke Energy can get more distributors/retailers to participate in this program?

Program Participation Experiences

The next few questions ask about the process for participation.

12. Do you think the process could be streamlined in any way? How?

13. Do you have the right amount of materials such as information sheets, brochures or marketing materials that you need to effectively show and sell the CFLs covered by the coupons? What else do you need?

14. Overall, what about the Smart $aver® CFL Program do you think works well and why?

15. What changes would you suggest to improve the program?

16. Do you feel that communications between you and Duke's program staff is adequate? How might this be improved?

17. What specific benefits do you receive as a result of participating in Duke's Smart $aver® CFL Program or from selling Smart $aver® CFLs?

18. What do you think are the primary benefits to the people who buy Smart $aver® CFLs?

19. Are there other benefits that are important to a potential customer? What are these?

Market Impacts and Effects

21. How do you make customers aware of the CFL Program?

22. What percent of the customers are already aware of the program before you present it to them? What percent of the customers take advantage of the program after you present it and explain it to them?

23. Are customers more satisfied with this equipment? Why or why not?

24. Do you market or sell the Smart $aver® CFL differently than your other products? How?

25. What percent of your customers end up buying the CFL instead of an incandescent because of the coupon?

Recommended Changes from the Participating Contractors

27. Are there any other changes that you would recommend to Duke Energy for their Smart $aver® CFL Program that we have not already discussed?

28. If you could make any changes you wanted to the CFL program, what would you do differently?

Standard Practice vs. Smart $aver® CFL Practices

We would like to know what your presentation and sales practices were before your involvement in the Smart $aver® CFL program, and how you would offer your products without the program.

29. If the program were to be discontinued, would you still offer the CFLs? If yes, would you structure pricing differently? If yes, how?

30. How did the Smart $aver® CFL program change how you present and sell energy efficient light bulbs?

31. In your opinion is the Smart $aver® CFL program still needed? Why?

Appendix D: Spillover Algorithm Table

North and South Carolina Spillover Algorithm Table				
Survey ID	Number of additional bulbs purchased	Spillover confidence factor mmc=.5, mc=.25,	Spillover Influence factor: mmc=.5, mc=.25	Net Spillover effect
1	0	0.5	0.5	0.0
2	0	0	0	0.0
3	0	0	0.25	0.0
4	0	0.25	0.25	0.0
5	0	0.5	0.5	0.0
6	9	0.5	0.5	9.0
7	2	0.5	0.25	1.5
8	0	0.5	0	0.0
9	8	0.25	0.25	4.0
10	1	0	0	0.0
11	0	0.5	0.5	0.0
12	12	0.5	0.5	12.0
13	0	0	0	0.0
14	0	0	0	0.0
15	0	0.25	0.25	0.0
16	0	0.25	0.25	0.0
17	0	0.5	0.5	0.0
18	4	0.25	0.25	2.0
19	9	0.5	0.5	9.0
20	0	0.5	0.5	0.0
21	2	0.5	0.25	1.5
22	0	0	0	0.0
23	0	0.25	0.5	0.0
24	0	0.5	0.5	0.0
25	0	0	0.25	0.0
26	9	0.5	0.5	9.0
27	2	0.25	0.25	1.0
28	0	0	0	0.0
29	3	0.25	0.25	1.5
30	0	0.5	0.5	0.0
31	3	0.5	0.5	3.0
32	0	0	0.25	0.0
33	0	0	0	0.0
34	4	0.25	0.5	3.0
35	0	0	0	0.0
36	0	0	0	0.0
37	0	0.25	0	0.0
38	6	0.25	0.5	4.5
39	4	0	0.25	1.0
40	4	0.5	0.5	4.0
41	0	0.5	0.5	0.0
42	1	0	0.25	0.3
43	4	0	0.25	1.0

44	0	0	0	0.0
45	6	0.5	0.5	6.0
46	0	0.5	0.5	0.0
47	0	0	BLANK	0.0
48	0	0.5	0.5	0.0
49	0	0.5	0.5	0.0
50	0	0.25	0.5	0.0
51	0	0	0	0.0
52	4	0.5	0.5	4.0
53	0	0.5	0.5	0.0
54	0	0	0.25	0.0
55	5	0.5	0.5	5.0
56	0	0.5	0.5	0.0
57	9	0.25	0.25	4.5
58	0			0.0
59	0	0	0.25	0.0
60	0	0	0	0.0
61	9	0.5	0.5	9.0
62	0	0	0	0.0
63	0	0	0	0.0
64	0	0	0.25	0.0
65	4	0	0	0.0
66	0	0	0.25	0.0
67	0	0	0	0.0
68	0	0	0	0.0
69	4	0.25	0.25	2.0
70	0	0	0	0.0
71	0	0.25	0.5	0.0
72	2	0.5	0.5	2.0
73	0	0.5	0.5	0.0
74	0	0.25	0.25	0.0
75	4	0.25	0.25	2.0
76	0	0.5	0.5	0.0
77	0	0	0.25	0.0
78	0	0.25	0.25	0.0
79	2	0	0.25	0.5
80	9	0.5	0.5	9.0
81	0	0.5	0.5	0.0
82	0	0	0	0.0
83	0	0.5	0.5	0.0
84	9	0.5	0.5	9.0
85	0	0	0	0.0
86	0	0.25	0.5	0.0
87	4	0	0.5	2.0
88	0	0	0.25	0.0
89	0	0.5	0.5	0.0
90	3	0	0.25	0.8
91	0	0.25	0.25	0.0
92	0	0.25	0.25	0.0

93	0	0	0	0.0
94	0	0.5	0.5	0.0
95	0	0.5	0.5	0.0
96	0	0.25	0.5	0.0
97	0	0	0	0.0
98	6	0.25	0.25	3.0
99	15	0.25	0.25	7.5
100	9	0.25	0.25	4.5
101	0	0.5	0.5	0.0
102	0	0	0	0.0
103	0	0.5	0.5	0.0
104	1	0.5	0.5	1.0
105	0	0.25	0.25	0.0
106	0	0.25	0.25	0.0
107	9	0.5	0.5	9.0
108	2	0.5	0.5	2.0
109	2	0.5	0.5	2.0
110	0	0.25	0.25	0.0
111	9	0.25	0.5	6.8
112	6	0.5	0.5	6.0
113	0	0	0	0.0
114	8	0.5	0.5	8.0
115	0	0	0.25	0.0
116	0	0	0	0.0
117	3	0	0	0.0
118	0	0.5	0.5	0.0
119	0	0.25	0	0.0
120	6	0.25	0.5	4.5
121	4	0.5	0.5	4.0
122	0	0	0.25	0.0
123	0	0	0	0.0
124	4	0.5	0.5	4.0
125	4	0.25	0.5	3.0
126	9	0.5	0.5	9.0
127	6	0.5	0.5	6.0
128	5	0.5	0.5	5.0
129	9	0.25	0.25	4.5
130	1	0.25	0.25	0.5
131	0	0.5	0.5	0.0
132	4	0.25	0.5	3.0
133	0	0	0	0.0
134	4	0.5	0.5	4.0
135	0	0.5	0.5	0.0
136	0	0	0	0.0
137	6	0.25	0.5	4.5
138	0	0.25	0.25	0.0
139	6	0.25	0.25	3.0
140	0	0	0	0.0
141	2	0.25	0.25	1.0

142	0	0.25	0	0.0
143	2	0.25	0.25	1.0
144	0	0.5	0.5	0.0
145	4	0.5	0.5	4.0
146	0	0.5	0.5	0.0
147	0	0	0	0.0
148	0	0.5	0.5	0.0
149	0	0.5	0.5	0.0
Gross spillover	307		Net spillover	233.75

Appendix E: Effective Useful Life Adjustment Factor for Installed CFLs

The energy savings calculated in this study use a reduced effective useful life (EUL) for the program-incented CFLs instead of the period advertised by the manufactures. The reduction in the EUL is consistent with the results of the EUL of CFLs used in switched environments representative of the typically residential in-door installations. The adjustment used in this report is 0.523 of the advertised EUL for the installed bulbs. This adjustment is presented in the Excel spreadsheet table below for each of the rooms in which the bulbs have been reported to be installed by the customers and the adjusted hours of use of those bulbs as indicated by the Duke Energy lighting logger study.

It is anticipated that this adjustment may be less dramatic in the future as additional studies of newly manufactured (more reliable technologies) bulbs are conducted, if the newer generation of CFLs are less impacted by in-house switching behaviors. However, at this time, the results of the California DEER Effective Useful Life Study and other research (see references below) indicate that advertised EULs are about twice what can be expected from the CFLs once installed in homes and turned on and off consistent with typical applications.

Room	Self Reported	Actual Daylength Adjusted	Difference (Self Rep - Actual)	%	Weight (from # of self reports)	Weighted Percentages		wt * actual hours	EUL = Rated Life of Lamp (10000 hours) * Switching Degredation Factor (indoor only) / Annual usage
Basement	3.157	2.681	0.476	17.77%	0.104222	1.85%		0.279419182	
Bathroom	2.27	0.877	1.393	158.84%	0.097625	15.51%		0.085617125	
Bedroom	2.134	1.955	0.18	9.19%	0.216359	1.99%		0.422981845	
Den	4	0.685	3.315	483.54%	0.015831	7.66%		0.010844235	
Dining Roo	1.76	2.538	-0.778	-30.65%	0.040897	-1.25%		0.103796586	
Entryway	1.167	2.099	-0.932	-44.42%	0.011873	-0.53%		0.024921427	
Garage	1.289	1.105	0.185	16.71%	0.025066	0.42%		0.02769793	
Hallway	2.358	3.522	-1.164	-33.04%	0.067282	-2.22%		0.236967204	
Kitchen	4.735	3.415	1.319	38.63%	0.151715	5.86%		0.518106725	
Living Roo	3.622	3.85	-0.228	-5.92%	0.242744	-1.44%		0.9345644	
Office	3.294	9.001	-5.707	-63.40%	0.022427	-1.42%		0.201865427	
Stairway	3.5	0.538	2.962	550.99%	0.003958	2.18%		0.002129404	
			Average	91.52%	0.999999	28.60%		2.84891149	
						rated life	10000		Rated life varies from 8000 (Lowes) to 12000 (Wallmart). Use average of 10000
						Hr/day	2.85		Wt average from table above
						hr/yr	1040.25		
						adj facto	0.523		From California DEER EUL study
						EUL	5.027638		

References:
www.deeresources.com (California's deemed database and database resource site, CFL EUL multiplier for in-door residential applications).

Proceedings of the ACEEE Summer Study, 2008, *The Dark and the Bright: Effectiveness Issues for CFL Programs*, Corina Jump, Jane Peters, Dulane Moran, James Hirsh, Shahana Samiullah.