Final

Process and Impact Evaluation of the 2013-2014 Residential Neighborhood Program in Ohio and Kentucky

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Duke Energy
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This section presents the key findings and recommendations identified through the evaluation of Duke Energy's Residential Neighborhood Program in Ohio and Kentucky. This evaluation covers program participation from April, 2013 through August, 2014 (n= 2,097 participants). A billing analysis was conducted to estimate the net energy savings by partcipants in the program. The billing analysis employs a statistical analysis of actual customer-billed monthly electricity usage of customers participating in the program. The statistical model used for the billing analysis produces estimates of the monthly electricity savings resulting from participation in the program, and Table 1 presents the estimated overall ex post energy impacts from the billing analysis. The billing analysis approach used to assess energy savings provides a direct net (net of short-term freeridership, short-term participant spillover, and participation in other Duke Energy programs) energy impact estimate[1] by employing a quasi-experimental analysis design.

Table 1. Estimated Overall Impacts

	Net Savings
Annual Savings Per Participant Per Year	
kWh	375
kW	0.1106

The billing analysis gives the estimated overall net kWh savings per participant, but is incapable of estimating coincident kW reduction. As a result, the kWh results from the billing analysis are utilized in the DSMore model which employs a residential load shape analysis to produce the estimate of savings. Additionally, program per participant savings as reported in Table 1 include an adjustment made to CFL savings over the effective useful life of a bulb. The adjustment factor is computed in the course of the engineering analysis. The purpose of the adjustment factor is to account for the decrease in baseline wattage over time due to the phase out of standard wattage incandescent bulbs as stipulated in the Energy Independence and Security Act (EISA) of 2007. See *Appendix K: EISA Schedule and CFL Baseline* for a detailed description of baseline adjustments by year. See *Billing Analysis EISA Effects* for the calculation of the adjustment factor.

Significant Process Evaluation Findings

From the Participant Surveys

- When asked for reasons they chose to participate in this program, the most common answer is saving money on utility bills (60.9%), followed by receiving energy efficiency measures (35.9%) and weatherization and repair services (35.2%).

[1] The net long-term spillover or short and long-term market effects savings were not documented in this evaluation. These savings are in addition to those identified in this report, but are beyond the researchable issues associated with this evaluation.

- Nearly half of participants (44.5%) had to wait less than two weeks from enrollment to audit, including 28.1% who waited a week or less. Only one participant (0.8% of customers surveyed in the Midwest) thought the length of time between enrollment and audit was too long. Only one participant (0.8%) thought the amount of time the auditor spent in the home was too long, while 3.1% thought the auditor's visit was too short and 95.3% thought it was "about right".
- About a quarter of surveyed participants in Ohio (25.7%) attended the community meeting kick-off event in their neighborhood, however only 6.9% of Kentucky participants attended a community meeting. Customers who attended meetings were very satisfied with the staff and presenters at the meeting (mean satisfaction rating 9.5 or higher on a ten-point scale in both states) and the information presented at the meeting (mean satisfaction rating 9.75 or higher in both states).
- Participants are generally quite satisfied with the measures they received during the audit; the most highly-rated measures in Ohio are the HVAC filters and calendar, door sweeps, foam insulation spray and water heater tank wrap, while for Kentucky customers the highest rated measures also include CFLs, faucet aerators, water heater pipe wrap, hot water temperature adjustment and caulking doors and windows (all 9.5 or higher on a ten-point scale). The lowest-rated measures are vinyl weather stripping for doors (8.8 out of 10 in both states) and the low-flow showerheads (8.6 out of 10 in both states); while these are not low satisfaction scores, there is room for improvement relative to customer satisfaction with the other measures.
- Program satisfaction is quite high, with the program receiving a mean satisfaction rating of 9.7 out of 10 in the Midwest (9.6 from Ohio participants and 9.8 from Kentucky participants). The program also receives high scores for convenience of enrollment, the knowledge of the auditors, and the helpfulness of the auditors (all 9.7 out of 10 with no significant differences between states). Relative to the Residential Neighborhoods program, participants' satisfaction with Duke Energy is about one point lower at 8.7 in Ohio and 8.9 in Kentucky.
- Nearly two-thirds of surveyed participants in the Midwest (64.8%) report that this program has made their attitude towards Duke Energy more positive, while none (0.0%) say it has made their attitude towards Duke Energy more negative. Two-thirds (66.4%) also report that the program has increased their knowledge of how to save energy.
- Nearly half of surveyed participants (47.7%) report that their utility bills have decreased since they participated in this program, though another 9.3% report that their bills have increased. Midwestern customers' median estimate for their utility bill savings since participating in the program is $9 per month.
- Some participants report that auditors left measures behind for customers to install themselves; in particular, 34.4% of customers who received program CFLs report that the auditor left some uninstalled bulbs behind; most of these bulbs have since been installed by the customers themselves, although at least 122 CFLs out of 1,525 confirmed received by participants (8.0%) remained uninstalled at the time of this survey. The winter kits for window HVAC units were also mostly installed by customers (56.5% of confirmed installations), because this measure is meant for wintertime use and the audits are often performed during other times of year. The impact section of this report does not count savings for measures that are not installed.

- When asked for their suggestions to improve the program, the top suggestions are about including additional measures and services in the program (17.2%), followed by more or better advertising to increase awareness (5.5%) and ideas for providing bill credits through the program (4.7%). Most of the suggestions for adding measures to the program involve insulation and sealing leaks.

From the Non-Participant Surveys

- A majority of Kentucky non-participants contacted (59.3%) are aware of this program's existence, however only about a third of Ohio non-participants are aware of the program (36.6%). Non-participants were only invited to complete the remaining parts of the survey if they were aware of the Residential Neighborhoods program.
- When asked what they understood the Residential Neighborhoods program to be about, non-participants are most likely to mention receiving free measures (35.4%) and the home audit (23.2%). Although receiving free measures was the top response for customers from both states, in absolute terms Kentuckians are much more likely to mention this aspect of the program (54.8%) compared to Ohio customers (23.5%). About one in ten Ohio customers mentioned the community meeting (9.8%) though none of the Kentucky customers did (0.0%). Only 12.2% of non-participants who are aware of the program were unable to answer this question.
- Three-quarters of surveyed non-participants (73.2%) are certain that they would have been eligible to participate in the program, while one in five (19.5%) are not sure and 7.3% believe that they would not have been eligible. There are no significant differences between Ohio and Kentucky customers.
- When asked for their suggestions for improving program participation, non-participants' top responses are improving communications about the program (19.5%) and giving customers more information about the program (17.1%), followed by concerns involving landlord and renter issues (11.0%). Kentucky customers are more likely to mention security and privacy issues (12.9%, compared to 2.0% of Ohio customers).
- Non-participants' mean satisfaction rating with Duke Energy overall is 7.3 on a ten-point scale (7.8 in Kentucky and 7.0 in Ohio), which is significantly lower than the 8.8 mean rating given by program participants in the Midwest. This may indicate that having a lower opinion of Duke Energy is a barrier to participation in Duke Energy programs, even when they are free to all customers.

Recommendations

- Suggestions for improving program participation were provided in the evaluation report completed for the program in the Carolina System[2]. Those recommendations have been incorporated. This program is operating well; therefore the evaluation team has no further recommendations.

[2] TecMarket Works et al. "Process and Impact Evaluation of the 2013-2014 Residential Neighborhood Program in the Carolina System". November 14,2014.

Introduction and Purpose of Study

Summary Overview

This document presents the process and impact evaluation report for Duke Energy's Residential Neighborhood program as it was administered in Ohio and Kentucky. The evaluation was conducted by TecMarket Works, BuildingMetrics, and Integral Analytics.

Summary of the Evaluation

TecMarket Works performed a process evaluation comprised of management interviews to review program operations and administration, and a participant and non-participant survey to determine satisfaction levels and identify any program implementation issues.

Program impacts were evaluated using a billing analysis together with engineering estimates for the purpose of determining individual measure contributions to savings as well as coincident peak demand reduction.

Table 2. Evaluation Date Ranges

Evaluation Component	Dates of Analysis
Participant Surveys	Surveyed from August 15, 2014 to September 16, 2014
Non-Participant Surveys	Surveyed from February 24, 2014 to March 10, 2014
Management Interviews	Conducted in February and May of 2014
Engineering Estimates	September through November 2014
Billing Analysis	September through October 2014

Evaluation Objectives

The objective of this evaluation is to determine the effectiveness of and customer satisfaction with Duke Energy's Residential Neighborhood program as it was administered in Ohio and Kentucky.

Description of Program

The program assists customers in reducing energy costs through energy education and by installing or providing energy conservation measures for each customer's residence. Areas targeted for participation in this program have approximately 50% of the households with income equal to or less than 200% of the federal poverty level. Once a neighborhood is identified, all participants within the boundaries will qualify for the program, regardless of income status. Under this program, participating customers will receive an energy assessment to identify energy efficiency opportunities in the customer's home, one-on-one education on energy efficiency techniques and measures, and a package of energy conservations measures installed or provided to the extent the measure is identified as an energy efficiency opportunity (based on the results of the energy assessment). Energy conservation measures, up to $210, may include the following energy efficiency starter items:

- AC/Heat (HVAC) Filters
- Change Filter Reminder
- Aerators
- Caulking
- Weatherstripping
- Clear Glass Patch Tape
- 13W CFLs
- 18W CFLs
- Door Sweeps
- Foam Insulation Spray
- HVAC Winterization Kit
- Low Flow Showerhead
- Water Heater Tank Insulation
- Water Heater Pipe Wrap
- Water Heater Temp Adjustment
- Switch Plate Wall Thermometer

Methodology

Overview of the Evaluation Approach

The process evaluation has three components: management interviews, participant surveys and non-participant surveys. The impact evaluation has engineering and billing analysis components.

Study Methodology

Management Interviews

Interviews were conducted with the Duke Energy product managers and with the program vendor (GoodCents) manager.

Participant Surveys

TecMarket Works fielded a phone survey with randomly selected participants in order to measure satisfaction and to identify areas for program improvement. One hundred and twenty-eight (128) surveys were completed with Residential Neighborhoods participants in Ohio and Kentucky whose home audits were completed between July 10, 2013 and July 1, 2014 according to auditor records. Roughly half of the participants surveyed live in Ohio (54.7% or 70 out of 128) and roughly half live in Kentucky (45.3% or 58 out of 128).

Non-Participant Surveys

TecMarket Works fielded a phone survey with randomly selected non-participants in order to identify barriers to program participation. Eighty-two (82) surveys were completed with Residential Neighborhood non-participants in Ohio and Kentucky. Thirty-one surveys (37.8% of 82) were completed with non-participants in Kentucky and 51 surveys (62.2% of 82) were completed with non-participants in Ohio.

Engineering Estimates

Engineering algorithms taken from the Draft Ohio and New York Technical Reference Manuals (TRMs) along with DOE-2 simulations were used to estimate savings. These unit energy savings values were applied to customers in the engineering analysis sample.

Billing Analysis

For this analysis, billing data were obtained for all participants in the program between April 2013 and August 2014. There were a total of 2,097 usable accounts after processing. 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, the effect of impact from other Duke Energy offers, the effect of normal non-program induced energy use changes, 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).

Data collection methods, sample sizes, and sampling methodology

Management Interviews

All contacts provided by Duke Energy for the management interviews were contacted and interviewed for this evaluation.

Participant Surveys

Duke Energy provided TecMarket Works with a list of 1,862 records of program participants in the Midwest (1,059 from Ohio and 803 from Kentucky). After removing records with missing contact information, duplicate records, "do not contact" numbers and customers who have recently been surveyed about other programs, the sample list consisted of 958 contactable customers. The survey was conducted by telephone by TecMarket Works staff from the list of 958 participant customers, and 128 respondents completed the survey (70 from Ohio and 58 from Kentucky). The survey instrument can be found in *Appendix E: Participant Survey Instrument.*

Non-Participant Surveys

Duke Energy provided TecMarket Works with a list of 2,797 records of non-participants in the Midwest (1,771 from Ohio and 1,026 from Kentucky) that lived in targeted neighborhoods but did not participate in the program. After removing records with missing contact information, duplicate records, "do not contact" numbers and customers who have recently been surveyed about other programs, the sample list consisted of 1,539 contactable customers. The survey was conducted by telephone by TecMarket Works staff from the list of 1,539 non-participant customers in the Midwest, and 82 respondents completed the survey (51 from Ohio and 31 from Kentucky).

Engineering Estimates

The engineering analysis relied on primary data collected through the participant phone survey, which was conducted with a random sample of 128 participants.

Billing Analysis

The billing analysis used consumption data from all complete data provided for the participants in Ohio and Kentucky that participated between April, 2013 and August 2014. The billing analysis used data of all participation homes with reliable data.

Number of completes and sample disposition for each data collection effort

Management Interviews

All contacts provided by Duke Energy for the management interviews were contacted and interviewed for this evaluation.

Participant Surveys

From the sample list of 958 participating customers, all 958 were called between April 4, 2014 and May 9, 2014, and a total of 128 usable telephone surveys were completed, yielding a response rate of 13.4% (128 out of 958).

Non-Participant Surveys

From the sample list of 1,539 non-participants, 1,099 customers were called between February 22 and March 10, 2014, and a total of 82 usable telephone surveys were completed, yielding a response rate of 7.5% (82 out of 1,099).

Engineering Estimates

The engineering analysis relied on primary data collected through the participant phone survey, which was conducted with a random sample of 128 participants.

Billing Analysis

The billing analysis used consumption data from all complete data provided for the participants in Ohio and Kentucky that participated between April, 2013 and August 2014. There were a total of 2,097 usable accounts after processing.

Table 3. Summary of Data Collection Efforts

Residential Neighborhoods Program			
Data Collection Effort	Size of Population in Sample for Surveys	# of Successful Contacts	Sample Rate
Management Interviews	4	4	100%
Participant Surveys	958	128	13.4%
Non-Participant Surveys	1,539	82	5.3%
Engineering Estimates	958	128	13.4%
Billing Analysis	2,097 participants		

Expected and achieved precision

Participant Surveys

The survey sample methodology had an expected precision of 90% +/- 8.8% and an achieved precision of 90% +/- 6.8%.

Non-Participant Surveys

The survey sample methodology had an expected precision of 90% +/- 9.0% and an achieved precision of 90% +/- 8.8%.

Billing Analysis

The savings estimates for this program that were estimated from the billing analysis and presented in this report are statistically significant at the 95% confidence level unless otherwise noted.

Description of baseline assumptions, methods and data sources

Baseline assumptions for CFLs were determined through phone surveys with customers providing self-reported values of baseline lamp watts and operating hours. Baseline assumptions for other measures were taken from the Draft Ohio TRM.

The HVAC system interaction factors are the result of a series of DOE-2 simulations and represent the weighted average value across all HVAC system types according to their prevalence.

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

The audits may provide the following measures, depending on customer needs:

- Up to fifteen 18-watt CFLs
- Up to fifteen 13-watt CFLs
- Up to two low flow showerheads
- Up to three faucet aerators
- One switch plate wall thermometer
- One year supply of HVAC filters and filter change calendar
- Door sweeps for up to two doors
- Vinyl weatherstripping for up to two doors
- Caulking for up to two doors
- Caulking for up to three windows
- Clear glass patch tape for up to two windows
- Vinyl weatherstripping for window HVAC units
- Winterization kits for window HVAC units
- Spray foam insulation
- Water heater pipe wrap
- Water heater tank wrap
- Water heater temperature check and adjustment

Use of TRM values

Algorithms were selected from the Draft Ohio and New York TRMs to make the best use of primary data collected through the participant survey. DOE-2 simulations of prototypical building models were used to estimate savings for infiltration measures. The HVAC interaction factors were developed from prototypical building simulations conducted across several HVAC system types. The results were weighted according to HVAC system type weights developed from Duke Energy's appliance saturation survey.

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

Engineering Analysis

The participant responses are self-reported and therefore may be affected by self-selection bias, false response bias or positive result bias. If these biases are present, the savings achieved can be expected to be higher than those reported in the impact evaluation. The effects of any bias in the participant responses is expected to be minimal as all measures distributed and installed were recorded by an auditor at the premise.

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, as well as other Duke Energy offers. Moreover, the interaction of temperature (cooling degree days and heating degree days) and monthly variables were also taken consideration to further control for differences in how consumption responds to weather in different months. The model did not correct for self-selection bias because there is no need as long as the program remains voluntary.

Impact Evaluation: Engineering Analysis

Measure and program impacts were calculated using a combination of engineering and billing analysis. The engineering analysis was based on a combination of standard engineering assumptions and self-reported information from a sample of participants. Overall program savings are based on a pre/post billing data analysis results conducted on a near-census of participants. The engineering estimates were developed to provide insight into individual measure contributions to overall savings as well as a way to measure the effects of the Federal EISA standards on lifecycle program savings.

Table 4 shows the estimated energy savings per measure unit distributed adjusted downward for the ISR computed from participants' survey responses. The savings per measure distributed are shown for each energy saving item offered through the program and, in the final row, savings resulting from the all measures together. For this table, the in service rate (ISR) has been factored into the gross kWh/unit so that the product of the measure quantity and the gross savings per unit is total gross savings.

Table 4. Gross Program kWh and Coincident kW Savings by Measure

Measure	Quantity	Units	ISR	Gross kWh/unit	Gross kW/unit	Gross kWh	Gross kW
CFL	1,525	Bulb	91.8%	35.40	0.00397	53,980	6.057
Low-Flow Showerhead	80	showerhead	93.8%	149.4	0.01127	11,954	0.902
Faucet Aerator	170	Aerator	98.8%	11.96	0.00150	2,034	0.254
Weather Stripping	1,446	linear foot	96.5%	0.40	0.00014	574	0.203
Caulking	2,496	linear foot	97.1%	0.21	0.00007	526	0.186
Door Sweep	70	Each	94.3%	1.31	0.00046	91	0.032
Foam Insulation Spray	165	Sink	97.9%	2.71	0.00096	446	0.158
DHW Pipe Insulation	903	linear foot	100.0%	26.70	0.00305	24,111	2.752
DHW Tank Wrap	10	tank wrap	100.0%	136.2	0.01555	1,362	0.156
DHW Temp Adjust	72	adjustment	100.0%	90.23	0.01030	6,496	0.742
HVAC Filters/Calendar	114	participant	93.0%	36.38	0.00153	4,147	0.175
Overall Savings	**128**	**Survey participant**		826	0.09075	105,722	11.616

Effective Useful Life (EUL) Calculation

The EUL of program savings is a weighted average derived from the effective useful lives of the individual measures weighted based on their contribution to overall gross kWh savings. The overall EUL for the program is eight years as seen in Table 5.

Table 5. Effective Useful life of Program Measures

Measure	Weight	EUL
CFL	51.1%	5
Low-Flow Showerhead	11.3%	10
Faucet Aerator	1.9%	10
Weather Stripping	0.5%	5
Caulking	0.5%	15
Door Sweep	0.1%	5
Foam Insulation Spray	0.4%	15
DHW Pipe Insulation	22.8%	15
DHW Tank Wrap	1.3%	5
DHW Temp Adjust	6.1%	4
HVAC Filters/Calendar	3.9%	1
Overall Effective Useful Life		**8**

In Service Rate (ISR) Calculation

Survey respondents were asked to report whether or not any of the energy saving measures installed through the program had been subsequently removed. As Residential Neighborhood program measures are directly installed by auditors, rather than afterward by participants, auditors' accounts of measure installations are considered to be the most accurate. Baseline ISR was set to 100% for each measure with reductions made for subsequently uninstalled units. The ISR for the HVAC filters that were left behind for customer installation is determined through the participant survey, where respondents were asked if they had been installing the filters monthly as suggested by the calendar.

For CFLs, an allowance is made for program bulbs that are left behind by the auditor, placed into storage, and subsequently used to replace an incandescent bulb, thereby yielding energy savings. At the time of the phone survey, 89.8% of 13-watt and 86.5% of 18-watt bulbs distributed to respondents were installed and operable; this is the first year ISR.

The final ISR value is calculated, using 18-Watt CFLs as an example, with the following formula as presented in the Draft Ohio TRM:

ISR = first year ISR + (43% * remainder) = **86.5% + (43% * 10.5%) = 91.0%**

The remainder is the percentage of bulbs that are not installed in the first year (100% - 86.5% = 13.5%) less 3% for the 97% lifetime ISR[3]. In this case, the remainder is 10.5%. The 43% represents the percentage of the remainder that will replace an incandescent bulb rather than a CFL[4]. The ISR for each wattage of CFL is assigned a weight that represents its prevalence in the participant population and a weighted average ISR is calculated (91.8%).

[3] As established in the Nexus Market Research, RLW Analytics, and GDS Associates study, dated January 20, 2009: "New England Residential Lighting Markdown Impact Evaluation".
[4] As established in the Nexus Market Research, RLW Analytics, dated October 2004: "Impact Evaluation of the Massachusetts, Rhode Island, and Vermont 2003 Residential Lighting Programs", table 6-4 where 24 out of 56 respondents indicated that they did not purchase the CFLs as spares.

The ISR for the other program measures were taken from the customer survey responses regarding the fraction of initially installed measures that were subsequently removed. The ISR assumptions for each program measure can be seen in Table 4.

CFL Impact Calculation and EISA Application

Average daily hours of use, replaced wattage, and the room in which the bulb was installed were included in data collected from survey participants. Customers were asked if they had increased or decreased their lighting usage since installing the CFLs they received through the program. This enabled the detection of a slight decrease in hours of use going from an incandescent bulb to a CFL.

Table 6 shows the unadjusted weighted average daily hours of use values along with the updated values after the self-reporting bias is applied. Previous studies that have included both customer surveys and lighting loggers have shown that, comparing customers' self-reported hours of operation to the actual hours of operation, customers responding to the survey overestimated their lighting usage by about 27%[5]. As this study did not employ lighting loggers, there is no data with which to make a comparison for this program specifically. Consequently, the self-reported hours of use obtained from the survey were reduced by the 27% shown in Table 6.

Table 6. Adjusted Average Daily Hours of Use

Adjustment	Magnitude of Adjustment	Average Daily Hours of Use (Incandescent)	Average Daily Hours of Use (CFL)
Unadjusted	N/A	4.26	4.15
Self-Reporting Bias	27%	3.11	3.03

The adjusted average daily hours of use by room type are shown in Table 7. The row labelled "Overall" represents the weighted average across all room types.

Table 7. Adjusted Average Daily Hours of Use by Room Type

Room Type	Number of Installations	Mean Daily Hours of Use (Old)	Mean Daily Hours of Use (New)
Bathroom	59	3.06	2.93
Kitchen	69	4.61	4.50
Living/Family Room	86	3.24	3.18
Dining Room	24	2.81	2.74
Master Bedroom	68	2.01	2.00
Other Bedroom	16	1.75	2.11
Closet	2	0.23	0.23
Hall	10	2.06	1.83
Other	25	3.47	3.07
Overall	**359**	**3.11**	**3.03**

[5] The adjustment for the self-reporting bias used in this study was determined using paired lighting logger and customer self-reported data from Kentucky, Ohio, Indiana, North Carolina, and South Carolina.

As described in *Appendix K: EISA Schedule and CFL Baseline*, it is assumed that a baseline incandescent lamp will be replaced several times during the life of a CFL. Due to EISA legislation which limits the wattage of an incandescent lamp, the baseline lamp wattage decreases during each replacement. The baseline wattage by room type and by year is shown in Table 8 with the average in the final column and the overall weighted average in the highlighted cell in the bottom right, the numbers used for the savings calculations. Baseline estimates for each room type are based on small sample sizes and have limited statistical reliability at the individual room type level. Gross savings for the program are presented in the same manner in Table 9 and Table 10.

Table 8. Baseline Wattage by Room Type and Year

Room Type	2014	2015	2016	2017	2018	Average
Bathroom	58	47	45	44	43	48
Kitchen	59	48	46	45	44	49
Living/Family Room	58	48	46	45	44	48
Dining Room	67	54	52	50	49	54
Master Bedroom	61	50	48	47	46	51
Other Bedroom	55	46	45	43	42	46
Closet	70	56	53	52	52	57
Hall	62	51	49	48	47	51
Other	65	53	50	49	48	53
Overall	**60**	**49**	**47**	**46**	**45**	**49**

Applying these adjustments to each individual room type shows estimated bulb savings by room type. As described above, calculations by room type have limited statistical reliability. Only the weighted mean across all room types, in the bottom rows of these tables, were used in the calculations. The overall averages in the bottom right corners of Table 9 and Table 10 below are the numbers reported as per unit savings for the engineering analysis seen in Table 4.

Table 9. Gross kWh Savings by Room Type and Year

Room Type	2014	2015	2016	2017	2018	Average
Bathroom	43.4	32.7	30.7	29.7	28.8	33.1
Kitchen	67.5	50.7	47.5	45.9	44.7	51.3
Living/Family Room	46.2	35.0	33.0	31.7	30.7	35.3
Dining Room	48.2	36.2	34.0	32.9	31.9	36.6
Master Bedroom	30.7	23.2	22.0	21.1	20.4	23.5
Other Bedroom	21.2	15.7	14.9	14.1	13.5	15.9
Closet	4.1	3.1	2.9	2.8	2.7	3.1
Hall	32.8	25.3	24.2	23.3	22.4	25.6
Other	59.1	44.8	42.2	40.9	39.8	45.4
Overall	**46.4**	**35.0**	**33.0**	**31.8**	**30.8**	**35.4**

Coincident peak demand savings were calculated based on the lamp wattage difference across each room and parameters from *Appendix C: Engineering Algorithms*. The results are shown in Table 10 below.

Table 10. Gross Coincident kW by Room Type and Year

Room Type	2014	2015	2016	2017	2018	Average
Bathroom	0.0049	0.0037	0.0035	0.0034	0.0033	0.0037
Kitchen	0.0051	0.0038	0.0036	0.0035	0.0034	0.0039
Living/Family Room	0.0050	0.0038	0.0036	0.0034	0.0033	0.0038
Dining Room	0.0060	0.0045	0.0042	0.0041	0.0040	0.0046
Master Bedroom	0.0054	0.0041	0.0038	0.0037	0.0036	0.0041
Other Bedroom	0.0047	0.0036	0.0034	0.0032	0.0031	0.0036
Closet	0.0064	0.0047	0.0044	0.0043	0.0042	0.0048
Hall	0.0054	0.0041	0.0039	0.0038	0.0036	0.0042
Other	0.0058	0.0044	0.0041	0.0040	0.0038	0.0044
Overall	**0.0052**	**0.0039**	**0.0037**	**0.0036**	**0.0035**	**0.0040**

Low-Flow Showerheads and Faucet Aerators

A total of 75 low-flow showerheads and 168 faucet aerators were installed in the homes of survey respondents. According to customer self-reported data, nearly all of these units (93.8% and 98.8% respectively) remain installed.

To determine impacts for low-flow showerheads, survey respondents were asked how many showers per week on average were taken using the showerhead provided by the program, which is rated at 1.75 GPM. Faucet aerators provided by the program are rated at 1.5 GPM. The baseline showerhead flow rate is assumed to be 2.87 GPM and the baseline faucet flow rate is assumed to be 2.2 GPM per the Draft Ohio TRM. This reduction in hot water usage was converted into kWh savings using the algorithm shown in *Appendix C: Engineering Algorithms*. This measure produces zero kW or kWh savings in households that use gas water heaters. Approximately 42% of households in Ohio and Kentucky have electric water heaters per Duke Energy's appliance saturation survey data. This is reflected in the unit savings values in Table 11.

Table 11. Unit Savings Estimation for Low-Flow Showerheads and Faucet Aerators

Measure	Quantity	ISR	Base Flow Rate (GPM)	EE Flow Rate (GPM)	Gross kWh/unit	Gross Coincident kW/unit
Low-Flow Showerhead	80	93.8%	2.87	1.75	149.4	0.0113
Faucet Aerator	170	98.8%	2.20	1.50	12.0	0.0015

Air Sealing – Reduce Infiltration Measures

Program measures aimed at infiltration reduction include weather stripping, caulking, foam insulation spray, and door sweeps. Savings are calculated using kWh and kW per unit cfm reduction factors (5.37 kWh/cfm and 0.00237 kW/cfm). These values were based on DOE-2 simulations of a set of prototypical residential buildings. The unit infiltration airflow rate reduction for each measure were determined using the ASHRAE tables, equations, and calculation methods described in the 2005 ASHRAE Fundamentals Handbook, Chapter 27, "Ventilation and Infiltration." Tables S3.1, S3.2, S3.3, and S3.4. The equation used can be seen in *Appendix C: Engineering Algorithms*. Unit savings estimates described above were applied to installed measure quantities from the installing contractors. Note, according to Duke Energy program staff, the foam insulation spray was used to seal pipe penetrations under sinks.

Table 12. Unit Savings Estimation for Infiltration Reduction Measures

Measure	Quantity	Units	ISR	cfm Reduction per unit	Gross kWh/unit	Gross kW/unit
Weather Stripping	1,446	linear foot	96.5%	0.0766	0.40	0.0001
Caulking	2,496	linear foot	97.1%	0.0404	0.21	0.0001
Door Sweep	70	each	94.3%	0.2580	1.31	0.0005
Foam Insulation Spray	165	sink	97.9%	0.5161	2.71	0.0010

Water Heater Measures

Water heater measures available through the program include hot water pipe insulation, water heater tank wrap, and a tank temperature turn-down. The pipe insulation and tank wraps were only available to participants with electric water heaters. As such, no adjustment to unit savings, similar to that made for low-flow showerheads and faucet aerators to exclude gas water heater participants, is necessary.

Algorithms for calculating impacts are shown in *Appendix C: Engineering Algorithms*. The equation and parameters used for pipe insulation were taken from the Draft Ohio TRM. Tank wrap calculations use the New York TRM as the Draft Ohio TRM offers only deemed savings for this measure. This same algorithm was used for the tank temperature adjustment, holding tank insulation constant and varying the temperature difference assuming a 20 degree turn-down from 140 to 120 degrees Fahrenheit.

Table 13. Unit Savings Estimation for Water Heater Measures

Measure	Quantity	Units	ISR	Gross kWh/unit	Gross kW/unit
DHW Pipe Insulation	903	linear foot	100.0%	26.70	0.0030
DHW Tank Wrap	10	tank wrap	100.0%	136.2	0.0156
DHW Temp Adjust	72	adjustment	100.0%	90.23	0.0103

HVAC Filters and Calendar

Participants were left with a year's supply of HVAC filters and a calendar instructing them to replace their filter monthly. As dirt accumulates on the air filter, more energy is required to move air through the filter. Changing the filter monthly reduces the amount of time the unit is operated with a dirty filter, and therefore, lowers fan energy consumption for both the heating and cooling seasons.

Table 14. Increased Power Use over Time

Month	Percent Increase in Power Due to Dirty Filter
0	0.00%
1	0.33%
2	0.66%
3	0.98%
4	1.31%
5	1.64%
6	1.97%
7	2.30%
8	2.63%
9	2.95%
10	3.28%
11	3.61%
12	3.94%

Table 14, taken from Southern California Edison Company's work paper on air filter alarms dated April 27, 2012, summarizes the linear increase over a 12 month average air filter replacement interval. Savings are estimated using a yearly change out as a baseline. Annual fan energy consumption was estimated at 1,096 kWh/yr., based on the prototypical building simulations. The maximum percentage increase in power due to a dirty air filter was estimated as 3.94%, compared to 0.33% after one month.

Measure	Quantity	Units	ISR	Gross kWh/unit	Gross kW/unit
HVAC Filters/Calendar	114	Participant	93.0%	36.38	0.0015

Net to Gross Analysis

Typically, net to gross ratio (NTGR) for low income programs is simply deemed at 1.0. This is common practice in the industry. Since this program operates at the neighborhood level, low income and standard income households are free to participate once the neighborhood as a whole has qualified. Freeridership for the program is thus calculated based only on phone survey responses given by standard income respondents (those over 200% of the Federal Poverty Level). Low income participants are assumed to have 0% freeridership and assigned a NTGR of 1.0. The overall program NTGR is the weighted average of both populations.

Using the participant survey responses, we have found that:

- 13.3% (17 out of 128) of the surveyed participant households are above the 200% Federal Poverty Level,
- 39.1% (50 out of 128) of the surveyed participant households are below the 200% Federal Poverty Level, and
- 47.7% (61 out of 128) are unknown (refused to answer, etc.).

Freeridership and spillover are calculated based on survey responses for households that are identified as standard income according to the participant's description of their household income and the number of residents in the home. Standard income household freeridership is calculated for each measure and then weighted by the percentage of standard income households identified among surveyed participants to calculate the freeridership level for all program participants. The methods used to calculate freeridership in standard income households are all based on survey responses, but the specific questions and calculations differ by measure.[6]

Of the 128 program participants surveyed in Ohio and Kentucky, 67 participants gave responses to the income and household composition questions which allowed them to be categorized as low-income or standard income (defined as being at or below 200% of the federal poverty income level). The other 61 participants could not be definitively categorized, including 35 participants who did not answer the question about household income. Thus the ratio of standard-income households in the program population is estimated at 25.4% (17 out of 67 customers whose survey responses allowed their income category to be determined).

[6] Examples of freeridership calculations for measures such as those in the Residential Neighborhood program can be found in *Process and Impact Evaluation of the Residential Energy Assessments Program in the Carolina System*, TecMarket Works on behalf of Duke Energy, March 29, 2013.

Table 15 shows the freeridership levels for measures confirmed to be installed in the seventeen households identified as standard income (over 200% of federal poverty level), and the estimated freeridership level for the measure among all program participants based on weighting standard income freeridership (25.4% of program population) with low income freeridership (74.6% of the program population who are assigned zero freeridership).

Table 15. Freeridership for Measures Installed in Standard Income Households

	Homes with Measures Installed, Standard Income households (valid N = # households)	Standard Income Freeridership	Population-weighted Freeridership
CFLs	14	23.9%	6.1%
Low-flow showerheads	8	0.0%	0.0%
Faucet aerators	11	0.0%	0.0%
Foam insulation spray	0	NA[7]	0.0%
Weather stripping	4	50.0%	12.7%
Window AC kit	1	0.0%	0.0%
Caulking doors	1	0.0%	0.0%
Caulking windows	1	0.0%	0.0%
Door sweeps	4	0.0%	0.0%
Glass patch tape	0	NA	0.0%
Water pipe wrap	7	7.1%	1.8%
Water tank wrap	2	50.0%	12.7%
Water temp adjustment*	N/A	0%	0.0%
Filter changes/calendar*	N/A	0%	0.0%

*Freeridership for these measures is assumed to be 0%.

Two of the seventeen survey participants who are identified as standard income households gave responses indicating program spillover, purchasing a total of ten energy efficient bulbs (8 CFLs and 2 LEDs). However, installation of these bulbs was not confirmed and thus program-level spillover is assumed to be zero. This is based on low income spillover being assigned zero percent and standard income household spillover being estimated at zero percent.

Table 16. Gross and Net Program Savings by Measure

Measure	Gross kWh	Gross kW	Net kWh	Net kW
CFL	53,980	6.0573	50,687	5.6878
Low-Flow Showerhead	11,954	0.9019	11,954	0.9019
Faucet Aerator	2,034	0.2542	2,034	0.2542
Weather Stripping	574	0.2026	501	0.1768
Caulking	526	0.1856	526	0.1856
Door Sweep	91	0.0323	91	0.0323
Foam Insulation Spray	446	0.1576	446	0.1576
DHW Pipe Insulation	24,111	2.7524	23,677	2.7029
DHW Tank Wrap	1,362	0.1555	1,189	0.1358
DHW Temp Adjust	6,496	0.7416	6,496	0.7416
HVAC Filters/Calendar	4,147	0.1749	4,147	0.1749
Overall Savings	**105,722**	**11.6158**	**101,749**	**11.1513**

[7] Since no surveyed standard income households received the foam insulation spray or glass patch tape measures, program-level freeridership for these measures is based on low income households only (zero freeridership).

The final overall freeridership for the program is set at 3.8% (1-101,749/105,722) for a program NTGR of 0.962.

Impact Evaluation: Billing Analysis

This section of the report presents the results of a billing analysis conducted among the participants in the Residential Neighborhood Program in Ohio and Kentucky. Billing data were obtained for all participants in the program between April, 2013 and August, 2014 that had accounts with Duke Energy (after processing, there were a total of 2,097 accounts from OH/KY)[8]. A panel model was used to determine program impacts, where the dependent variable was monthly electricity consumption from February 2011 to August 2014.

The estimated savings obtained from the billing data analysis are presented below.

Table 17. Estimated Impacts: Billing Analysis

	95% Confidence Interval		
	Lower Bound	Mean Estimate	Upper Bound
Per Participant Annual Savings kWh	238	425	597

This table shows that the Residential Neighborhood Program produced statistically significant savings for participants.

Note that the billing data analysis includes variables to capture effect of participation in other Duke Programs. This is to explicitly control for any impact from other program participation.

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 that provides net savings estimates that are already adjusted for freeridership and participant spillover that occur during the analysis period. The approach does not include the program induced savings that are associated with short and longer term non-participant spillover or market effects. As a result, these savings should be considered conservative for an estimate of actual achieved savings. 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). That is to say, the fixed effects model is 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. 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. The model does control for what would have been done without the program within the participants' homes.

[8] Useable accounts are those accounts which have billing data for at least a year of the pre- and a portion of the post-participation period, as well as monthly kWh greater than 10 and less than 10,000 kWh. It was not required that the data covers the complete evaluation period, only that there is at least one observation in each period.

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 the comparison group 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 comparison group, thus eliminating the need for a non-participant comparison or control 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.

In essence, because the model is analyzing the impacts at a monthly level, the model requires an adequate sample of monthly data to estimate the savings for each month. As a result, there is no need to have a full year of post-participant data for all participants. With past methods, the impact evaluations used annual data which required a full year of post-participation data to account for seasonal variations. With the monthly model, this is no longer required since each month is treated independently.

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

$$y_{it} = \alpha_i + \beta(x_{it} * T) + \varphi P_t + \delta DP_{it} + \varepsilon_{it}$$

Where:

y_{it} = energy consumption for home i during month t
α_i = constant term for site i (the fixed-effect)
T = indicator variables for each month in the analysis
P = indicator for the treatment for the program in question
DP = indicators for other utility-sponsored programs
β, φ, δ = vectors of estimated coefficients
x = vector of non-program variables that represent factors causing changes in energy consumption for home i during month t (i.e., weather)
$x*T$ = *interaction of temperature and monthly indicator*
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 Residential Neighborhood 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 Residential Neighborhood program is presented in Table 18.

Table 18. Estimated Savings Model – dependent variable is daily kWh usage, February 2011 through August 2014 (savings are negative).

Independent Variable	Coefficient (Daily kWh Savings)	t-value
Participation	-1.16	-4.96
Sample Size	68,077 observations (2,097 homes)	
R-Squared	65%	

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

Billing Analysis EISA Effects

As the billing analysis does not span the entire EUL of a CFL, it does not take into account the future effects of EISA (See *Appendix K: EISA Schedule and CFL Baseline*). From Table 9, first year annual CFL savings is 46.4 kWh per bulb. As this is the first year of counted savings, no adjustment is made to the baseline wattage. The average annual CFL savings is 35.4 kWh per bulb, a reduction of 23.7%. [(46.4-35.4)/46.4].

From Table 20, engineering estimates show that CFLs contribute 49.8% of net program kWh savings. In terms of the unadjusted billing analysis savings of 425 kWh per participant, from Table 17, this represents 212 kWh (0.498 * 425). This portion of the billing savings is adjusted downward 23.7% to account for EISA, resulting in the overall net savings from the billing analysis of 375 kWh per participant seen in Table 20 (425 – 0.237* 212).

Table 19. EISA Adjustments to Billing Analysis by year

Billing Analysis	2014	2015	2016	2017	2018	Average
Adjustment	0.0%	24.5%	28.9%	31.4%	33.6%	23.7%
kWh	425	373	364	358	354	375

Table 20. Breakdown of Per Participant Savings Contributions by Measure from Engineering Estimates Extrapolated to Billing Analysis

Measure	Net kWh Contribution from Engineering	Net kW Contribution from Engineering	Billing Analysis kWh Allocation	Billing Analysis kW Allocation
CFLs	49.8%	51.0%	187	0.0564
Low-Flow Showerhead	11.7%	8.1%	44	0.0089
Faucet Aerator	2.0%	2.3%	7	0.0025
Weather Stripping	0.5%	1.6%	2	0.0018
Caulking	0.5%	1.7%	2	0.0018
Door Sweep	0.1%	0.3%	0	0.0003
Foam Insulation Spray	0.4%	1.4%	2	0.0016
DHW Pipe Insulation	23.3%	24.2%	87	0.0268
DHW Tank Wrap	1.2%	1.2%	4	0.0013
DHW Temp Adjust	6.4%	6.7%	24	0.0074
HVAC Filters/Calendar	4.1%	1.6%	15	0.0017
Overall Savings			**375**	**0.1106**

The billing analysis approach used to assess energy savings provides a direct net (net of short-term freeridership, short-term participant spillover, and participation in other Duke Energy programs) energy impact estimate by employing a quasi-experimental design. Therefore, it is necessary to apply a net to gross ratio to the engineering estimates for comparison to the billing analysis.

Management Interviews

Program Operations

Duke Energy's Residential Neighborhood Program supplies eligible Duke Energy customers with home energy audits, one-on-one education during the audit, and the installation of energy efficiency measures as appropriate[9]. Duke Energy provides administrative oversight for the program, including vendor management, and confirmation of eligible neighborhoods. GoodCents handles day-to-day program activities including marketing, customer enrollment, measure ordering, oversight of installations and timelines, data collection and database management, and reporting.

The neighborhoods are served one at a time and selected using U.S. Census Tract data showing the percent of residents that live at or below 200% of the federal poverty level (FPL). If at least 50% of the residents are at or below 200% of the FPL, the neighborhood is considered. The program managers conduct additional research on the area to determine if it is a good selection for the program. For example, they consider safety issues (inquiring with the local police department), the size of the area (number of homes), and other factors. After a neighborhood is selected, the boundaries are set to include approximately 500-800 homes, however some neighborhoods have been as large as 2,000 homes.

Marketing and Outreach

After the neighborhood and the 6-8 week period of time the program will operate are selected and confirmed, the program managers and GoodCents initiate more detailed planning for that neighborhood. The first outreach effort is targeted to all homes by mail two weeks prior to the neighborhood kick-off event. The purpose of the mailing is to inform the residents about the program, encourage them to learn more about it, and invite them to the program's kick-off event. The kick-off event provides more information about the program and how it operates and provides an opportunity for residents to meet the auditors. The event serves a catered dinner for the household to encourage participation and attendance. About a week before the kick-off event, postcards are sent as reminders to attend and learn more. Door hangers are also left on the doors of residents in the neighborhood throughout the 6-8 week period in which auditors are in the area. Residents are encouraged to RSVP for the event to help the managers order the correct amount of food for the dinner; however a response is not required to attend. Currently GoodCents and Duke Energy are reaching out to the residents six or seven times over the 6-8 week period they are in the neighborhood to encourage participation.

Kick-off Event

The kick-off event is held at a place familiar to the neighborhood such as a school or community center. There are signs directing residents to the event on major streets close to the event (see Figure 1). During the first hour, residents are encouraged to sign up for an audit, informed of the program and its benefits to their homes, their utility bills, and to Duke Energy. GoodCents staff including all of the auditors that will be working in the neighborhood attend so that residents can

[9] Not all items are installed during the audit. For instance, a year's supply of furnace filters are left at the residence for future filter changes.

meet the people that will be entering their home and conducting the audit. All GoodCents and Duke Energy staff wear the same blue colored shirt that matches the program marketing materials and the vehicles that will be in the neighborhood. In addition, Duke Energy program managers invite trusted community members to attend and speak, encouraging residents to participate. TecMarket Works attended one of these events which included the mayor, a community center director, the Duke Energy liaison for the area, and a church leader. Attendees are provided with a catered dinner, and everyone is entered to win one of four $25 Visa gift cards which are awarded after the presentation. The events are very well organized and effective. Many residents sign up for their audit before they leave the event. A flyer that is displayed at the entrance of the kick-off event is shown in *Appendix J: Flyer at Kick-off Event*.

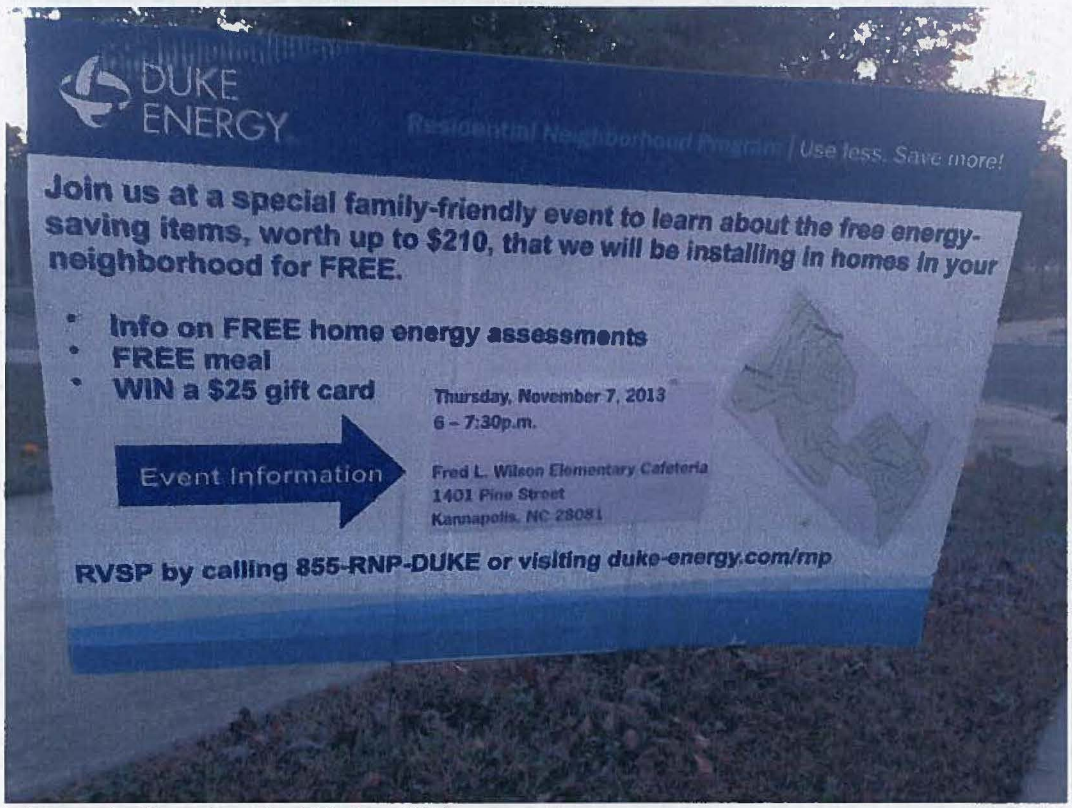

Figure 1. Sign for the Kick-off Event

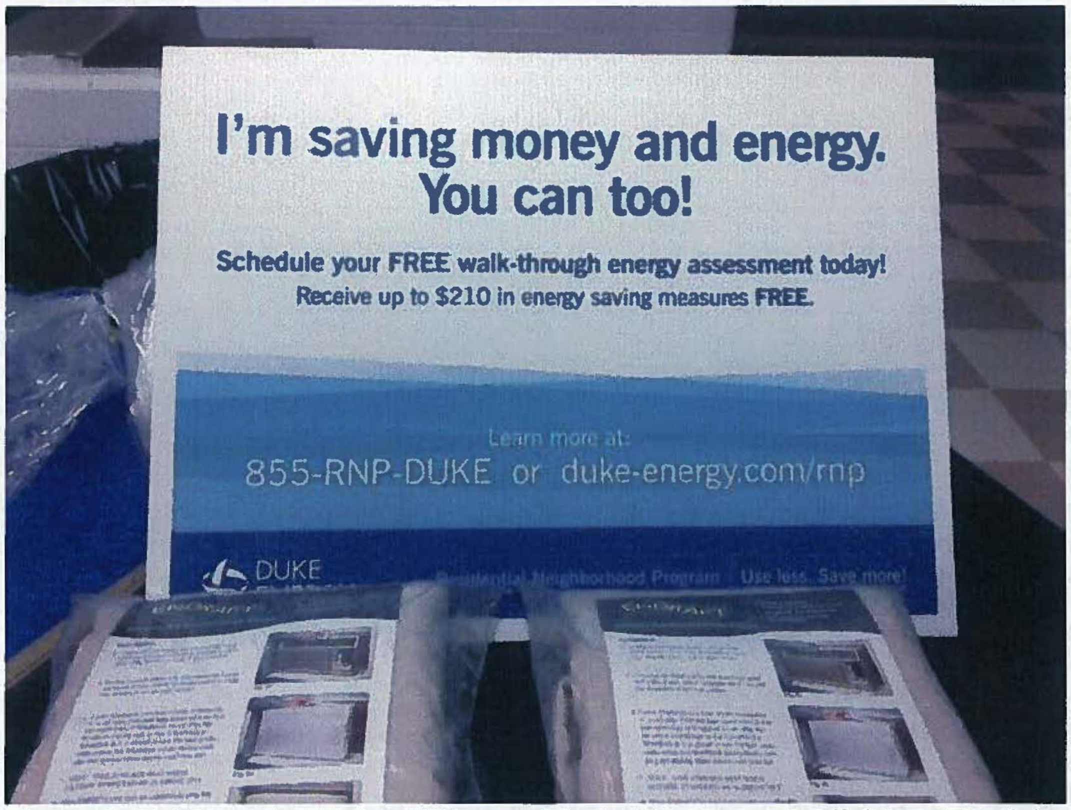

Figure 2. Table at the Kick-off Event with the Measures Available to Participants

Post-Event Activities

After the event, the auditors are in the neighborhood for eight to ten weeks conducting audits and approaching residents encouraging them to participate. The trucks, shown in Figure 3, are parked in conspicuous areas so that the residents are aware of and reminded of their presence and the services they are offering. Audits generally take from one to two hours to complete and the auditors are available from 8am to 7pm Monday through Friday, and from 10am to 3pm on Saturdays. The auditors are available to make appointments at any time for the following week (auditors found that some appointments scheduled more than one week in advance are not kept by the customer).

Figure 3. Residential Neighborhood Vehicle

During the audit, participants are provided with one-on-one education about what the auditor is doing, and what measures they are installing. Each of the GoodCents auditors are provided with training specific to this program (see training guide in *Appendix I: Auditor Training Guide*). GoodCents hires auditors that have carpentry, weatherization, or some HVAC-related job history. Then they attend an internal training for this program, followed by one week of supervised on-site work. GoodCents also conducts safety training for carbon monoxide so that they can discuss carbon monoxide levels with the customers and its effects on health. Auditors also undergo quality assurance training which includes driving safety, in-home safety, and are required to review all training materials regularly (weekly, monthly or quarterly, depending on measure).

Eligibility

This program is available to Duke Energy customers that live in the defined neighborhood. The neighborhood is selected as described above. However, residents from outside of the neighborhood borders have attended events and tried to participate. None are turned away from the event, however, customers from outside the targeted neighborhood are informed that when the auditors will be in their area, that they will be in contact to enroll them in the program.

While the eligibility rules are clearly defined and explained, non-participant surveys reveal some confusion about the hours that audits are available. This is discussed in more detail the section *Non-Participants' Understanding of the Program.*

Management Communication and Coordination

All parties interviewed for this evaluation reported positive working relationships between Duke Energy and GoodCents. Representatives from the two entities meet to review progress toward goals, discuss challenges or discrepancies, adjust strategies, and coordinate marketing and field activities. All communications are reported to be effective and timely.

Key Findings and Conclusions from Management Interviews

Duke Energy and its key vendor, GoodCents, work well together with no issues in communications or operational effectiveness.

All parties agree that all of the managers are open to discussing and trying out new marketing ideas, hoping to improve program participation.

Participant Surveys Results

Awareness and Understanding of the Program

A plurality of surveyed program participants in Kentucky first learned about the Residential Neighborhoods program from letters and postcards in the mail (mentioned by 39.7% or 23 out of 58 Kentucky customers), as seen in Figure 4; this is a larger percentage than the number of Ohio customers learning about the program through mailings (15.7% or 11 out of 70, significantly different from Kentucky customers at $p<.05$ using Student's t-test). The most common sources of program awareness for Ohio customers are representatives visiting their home (24.3%) and door hangers (18.6%). All other sources of awareness were mentioned by fewer than 10% of customers surveyed in the Midwest.

In addition to the statistically significant difference of Kentucky customers being more likely to learn about the program through mailings, there are also two channels for awareness that are significantly more likely to be mentioned by Ohio customers: visits to their home ($p<.10$ using Student's t-test) and attending a community meeting ($p<.05$ using Student's t-test; all surveyed participants who learned about the program from attending community meetings are Ohio customers). Only one surveyed participant learned about the program online, and only one customer mentioned traditional media outlets (see a summary of customer comments following Figure 4).

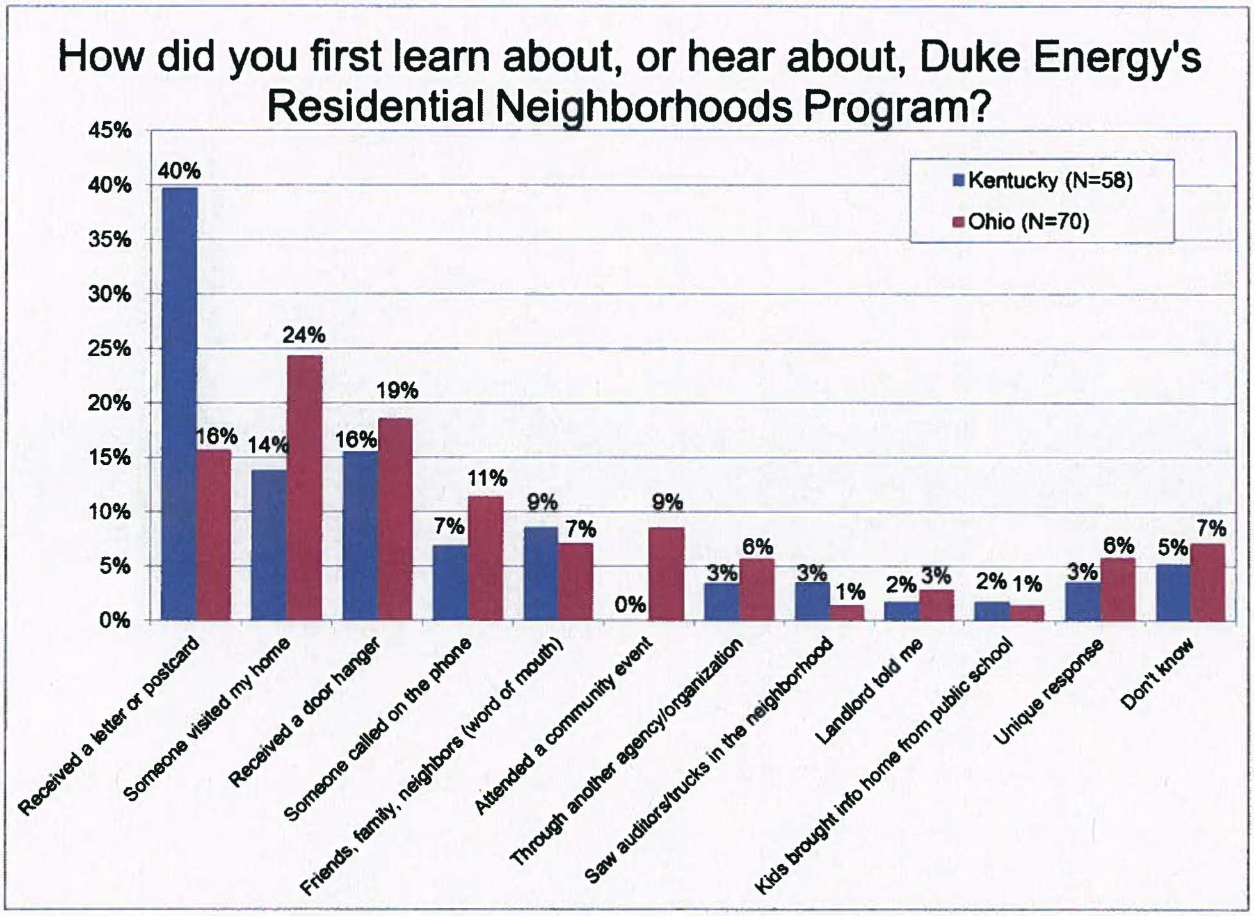

Figure 4. Source of Program Awareness for Residential Neighborhood Participants in Ohio and Kentucky (N=128)
Percentages total to more than 100% because participants could name multiple sources of awareness.

Among customers who mentioned finding about the program through the mail, 91.2% identified Duke Energy as the organization that sent the mailings (including three customers who said they received a notice with their bill[10]). One Ohio customer said their mailing came from "*People Working Cooperatively, I think*", and two customers could not recall the source of their mailings.

Among customers who learned about this program when someone visited their home, 88.0% identified Duke Energy as the organization that sent the representatives to their home, while one Ohio customer said their visitors were "*sub-contractors maybe*", one Ohio customer was visited by "*my building manager*" and a third Ohio customer could not recall. Among customers who learned about the program from door hangers, 86.4% identified Duke Energy as the source of these communications while the rest were not sure.

[10] The program used bill inserts to market to participants in the People Working Cooperatively Home Weatherization Assistance Program.

Among customers who received phone calls about the program, 66.7% identified Duke Energy as the organization calling, while 25.0% were not sure. One customer in Kentucky said their call came from "*The Community Action Commission.*"

Six customers heard about the program from assistance agencies and organizations, including the Home Energy Assistance Program, People Working Cooperatively, Housing Opportunities of Northern Kentucky and the Middleton Area Senior Center.

Six participants mentioned unique methods of learning about the program: these include through word-of-mouth from other members of the community and from newspaper reports, church bulletins, and online resources.

Participants were asked to describe in their own words what they understood was required of them as a participant in the program, and what they would receive in return for their participation; these responses are summarized in Table 21. A majority mentioned that they would receive measures such as light bulbs, showerheads and HVAC filters (58.6% of 128), and more than a quarter mentioned the home audit (29.7%) and saving energy (28.1%), followed by saving money on bills (18.0%).

There are a few statistically significant differences (highlighted in bold) between Ohio and Kentucky responses: Ohio customers are more likely to mention saving energy, saving money on bills and attending a community meeting, while Kentucky customers are more likely to mention that they had to be home during their audit (significant at p<.10 or better using Student's t-test).

Table 21. Participants' Understanding of the Program (N=128)

	Ohio customers (N=70)	Kentucky customers (N=58)	Total customers (N=128)
Install measures	57.1%	60.3%	58.6%
Home audit	28.6%	31.0%	29.7%
Save energy	***34.3%***	***20.7%***	28.1%
Save money on bills	***22.9%***	***12.1%***	18.0%
Information / education about saving energy	17.1%	15.5%	16.4%
Must be present during home audit	***11.4%***	***22.4%***	16.4%
Weatherize home	11.4%	19.0%	14.8%
Participation is free	14.3%	10.3%	12.5%
Must be a Duke Energy customer	2.9%	6.9%	4.7%
Attend a community meeting	***8.6%***	***0.0%***	4.7%
Make home more comfortable / fix things	1.4%	1.7%	1.6%
Renters must notify landlord	2.9%	0.0%	1.6%
Everyone in the neighborhood is eligible	1.4%	1.7%	1.6%
Must be a home owner to participate	1.4%	1.7%	1.6%
Good for the environment	0.0%	1.7%	0.8%
Unique comments, listed below	***12.9%***	***5.2%***	9.4%
Don't know	15.7%	8.6%	12.5%

Percentages total to more than 100% because respondents could mention multiple aspects of the program. Statistically significant differences between states are marked in bold italics (p<.10 or better using Student's t-test).

Twelve participants gave unique comments when asked to describe the program; at least half of these comments mention enrollment requirements that do not apply to, and/or benefits that are not offered by, the Duke Energy Residential Neighborhoods program. These responses include having to provide documentation of income, having to take classes about energy efficiency, and being provided with attic insulation, CO2 detectors and credit toward utility bills. It is likely that these customers have participated in multiple energy assistance programs in the past and are confusing aspects of the different programs they have participated in, such as LIHEAP and the Payment Plus Program.

Factors Motivating Participation

Participants were asked to list all of the reasons that they participated in the Residential Neighborhoods program, including the main reason for their participation; these results are shown in Figure 5. The most-mentioned reason overall is to save money on utility bills, which is the main reason for participation for 28.1% of customers and a secondary reason for participating for another 32.8%, and thus is the only reason for participation mentioned by a majority of surveyed customers (overall 60.9%). The next most-mentioned reasons for participating in the program are for the efficiency measures (mentioned by 35.9% overall), for the weatherization and repair services (overall 35.2%) and to save energy in the home (overall 31.3%).

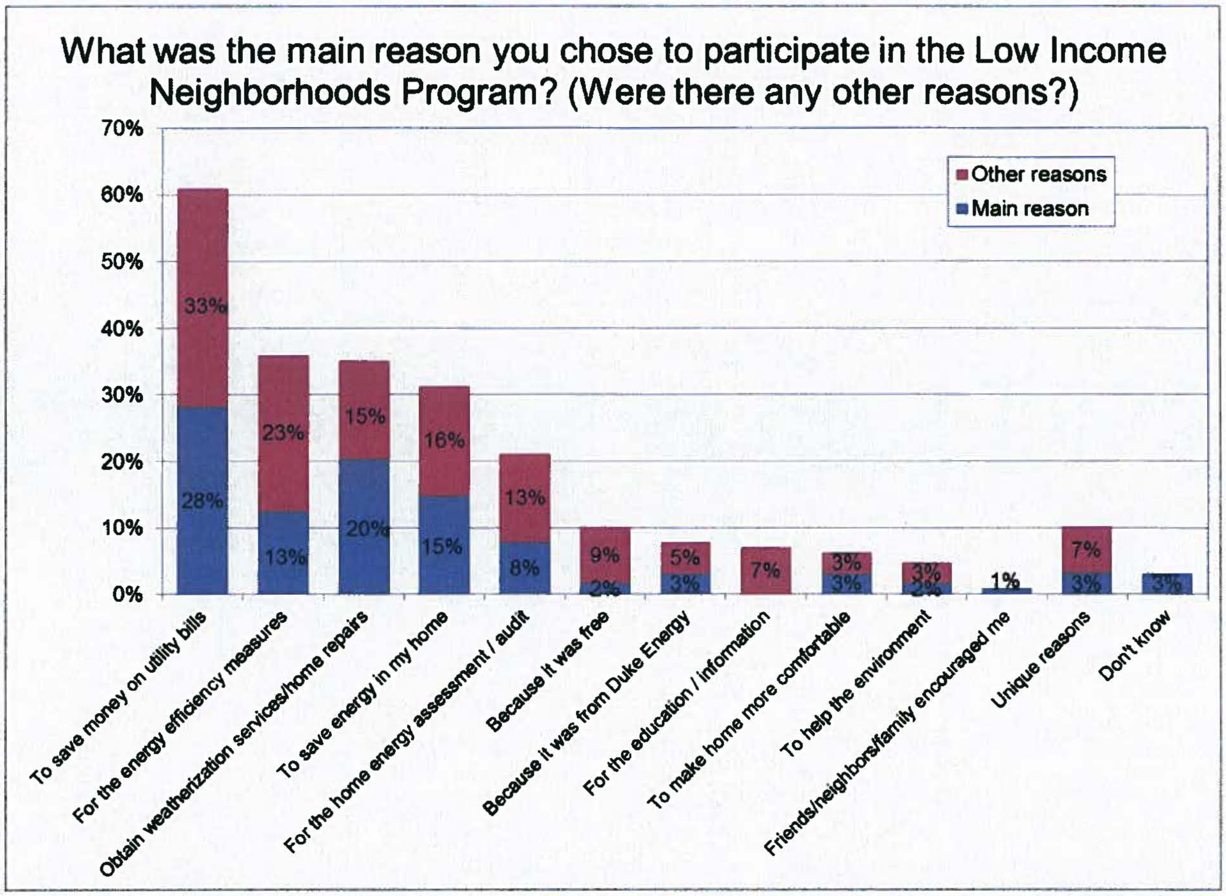

Figure 5. Factors Motivating Participation in the Residential Neighborhoods Program in the Midwest (N=128)

"Other reason" percentages total to more than 100% because participants could name multiple "other" reasons. "Main reason" percentages total to 100% because participants could only name one main reason.

Thirteen participants gave unique reasons for participating in the Residential Neighborhoods program; three of these participants mentioned that they require assistance with home repairs and weatherization due to age and/or disability, three mentioned the community meetings held to announce the program, one said their landlord made the arrangements for them and the rest merely expressed curiosity about the program's offerings.

Enrollment and Participation

Participants were asked how long they waited between signing up for the Residential Neighborhoods program and receiving the home audit. As seen in Table 22, almost half of surveyed participants waited less than two weeks (44.5%) and about a third cannot recall (36.7%). Only 10.2% reported that they had to wait for three weeks or longer. TecMarket Works considers this "service wait time" to be a best practice in the field of energy efficiency audit service offerings. Few utilities provide audits to customers with so few days between enrollment and service delivery.

Table 22. Length of Time between Sign-up and Audit (N=128)

	Ohio customers (N=70)	Kentucky customers (N=58)	Total customers (N=128)
Same day	1.4%	6.9%	3.9%
Next day up to one week	28.6%	19.0%	24.2%
One week up to two weeks	18.6%	13.8%	16.4%
Two weeks up to three weeks	5.7%	12.1%	8.6%
Three weeks up to six weeks	7.1%	5.2%	6.3%
Six weeks or longer	4.3%	3.4%	3.9%
Don't know / can't recall	34.3%	39.7%	36.7%

Participants were asked if the length of time they waited between signing up and receiving the audit was too long, too short or about right. Table 23 indicates that more than three-quarters (79.7%) feel that the time from sign-up to audit is "about right" though 19.5% are not sure; only one customer in Kentucky (0.8% of 128 surveyed overall) thought the time they waited was too long, and no surveyed participants said the time was too short.

Participants were asked a similar question about the length of time the auditor was in their home, and 95.3% reported that this was also "about right." Only one customer in Ohio (0.8% of 128 surveyed overall) felt that the auditor spent too long in their home. However, four Kentucky customers (6.9% of 58) reported that the auditor's visit was too short, which is significantly higher than for Ohio customers (0.0% of 70; this difference is significant at $p<.05$ using Student's t-test).

Table 23. Customer Perception of Home Audit Timing (N=128)

	Ohio customers (N=70)	Kentucky customers (N=58)	Total customers (N=128)
Time between signing up and audit was....			
Too long	0.0%	1.7%	0.8%
About right	81.4%	77.6%	79.7%
Too short	0.0%	0.0%	0.0%
Don't know	18.6%	20.7%	19.5%
Length of time auditor was in the home was....			
Too long	1.4%	0.0%	0.8%
About right	97.1%	93.1%	95.3%
Too short	0.0%	6.9%	3.1%
Don't know	1.4%	0.0%	0.8%

Attending the Community Meeting

Before auditing teams begin to install measures in customers' homes, there is a kick-off meeting to inform customers about the program and what participation entails. About one in four Ohio participants (25.7%) attended the meeting in their area, compared to only 6.9% of Kentucky participants (this difference is significant at $p<.05$ using Student's t-test). Participant ratings of satisfaction with the staff and presenters and the information presented the meetings are included in the *Program Satisfaction* section of this report.