Residential Direct Load Control Program Evaluation, Measurement, and Verification Report 2015

Prepared for FirstEnergy Ohio Companies:

Ohio Edison Company
The Cleveland Electric Illuminating Company
The Toledo Edison Company

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1. Executive Summary

For 2015, the Ohio Operating Companies, The Cleveland Electric Illuminating Company (CE), Ohio Edison Company (OE), and The Toledo Edison Company (TE) (collectively "Companies") offered the Residential Direct Load Control (DLC) program, also known as Easy Cool Rewards. Under contract with the Companies, ADM Associates, Inc. (ADM) performed evaluation, measurement and verification (EM&V) services to confirm the savings (kWh) and demand reduction (kW) realized through the energy efficiency programs that the Companies implemented in Ohio. This report presents results from the evaluation of the Companies' DLC program.

This evaluation focuses on determining the achieved peak demand reduction and energy savings attributed to the DLC program in 2015. The program included one-way UtilityPro Programmable Control Thermostats (PCTs) used to reduce central air conditioner (CAC) runtime to a specified percentage of the runtime (cycle time) that would have occurred in the absence of the Load Control Event.

Program participation levels, Ex Ante, and Ex Post values are listed in the following table. Demand and energy savings calculations are detailed in Chapter 4. Demand savings represents average hourly kW reduction during Load Control Events, while energy savings represents the average hourly kW over the duration (hours) of all Load Control Events.

Table 1-1: Program Savings Summary

Utility	*Participating Residential Households with DLC Device*[1]	*Ex Ante Expected Savings*		*Ex Post Savings*		*kWh Realization Rate*	*kW Realization Rate*
		kWh	*kW*	*kWh*	*kW*		
OE	10,573	47,328	6,767	29,980	6,767	63%	100%
CE	5,992	26,817	3,835	18,712	3,835	70%	100%
TE	1,500	6,684	960	4,028	960	60%	100%
Total Program	18,064	80,829	11,561	52,720	11,561	65%	100%

[1] Average participation count recorded for each event based on FE OH DLC tracking data.

Ex Ante savings for energy savings and demand reductions were based on the average kW factors for each company for the previous year (i.e., for energy, the product of last year's kW results times the hours of the events). It is important to note that some of the events in 2014 and 2015 were run as program test events and not during particularly hot, late afternoon periods, as had been the case in prior years. This is the primary reason for the low kWh savings. Ex Post demand reductions are based on results consistent with PJM deemed savings protocols for DLC programs[2] and substantially consistent with prior year results.

DLC program savings are assumed to have a measure life of one year.

Key findings from the process evaluation of the 2015 Direct Load Control program include:

- **The established methods of communication between the Companies' staff and Honeywell staff continue to work well.** The Companies and Honeywell both noted that there are no outstanding communication issues with respect to implementing the 2015 Easy Cool Rewards program. The communication processes remain the same, where Honeywell receives email communication from the Companies to confirm that the Companies want to call an air conditioner cycling event, and Honeywell responds with documentation that the event has been called. The two parties continue to maintain a standing biweekly call with program staff to address any issues that arise. While these check-ins are not always necessary, they do happen regularly.

- **Program participants continue to express high levels of satisfaction with the Companies' Easy Cool Rewards program.** Participant satisfaction with the overall program experience was high across operating companies, with an overall mean score of 4.4. Broken down by territory, means varied slightly from 4.4 in the Ohio Edison service area, 4.3 in Illuminating Company, and 4.2 in Toledo Edison territory (using a scale of 1 to 5, with 1 being "very dissatisfied" and 5 being "very satisfied").

- **Customers' lowest levels of understanding are for how to know when a cycling event occurs and how to reduce electricity use during cycling events.** Among all program aspects, survey respondents reported the lowest levels of understanding for two items related to cycling events – how to know when an event is occurring and what customers can do to reduce electricity use during an event.

[2] http://www.pjm.com/~/media/markets-ops/dsr/deemed-savings-report.ashx

2. Introduction and Purpose of the Study

Under contract with the Companies, ADM performed evaluation, measurement and verification (EM&V) services to confirm the energy and demand savings realized by the energy efficiency programs implemented by the Companies in 2015.

The impact evaluation component of this report estimates annual gross energy savings and peak demand reduction through the following activities.

- Develop a load reduction research plan, including a measurement and sampling strategy to establish kW per unit impacts.
- Perform analysis of load data collected in 2015.
- Determine the program level kW and kWh Savings
- Determine the system wide kW savings at the EDC level

The goal of the process evaluation component was to determine how effective the program is in terms of customer satisfaction, customer awareness, and stakeholder interaction. The process evaluation included the following activities.

- Conduct Implementation Staff Interviews
- Perform Program Manager Interviews
- Conduct Participant and Drop-Out Surveys
- Perform cross-sectional analysis between participants and non-participants.
- Identify potential behavioral differences between populations.
- Provide recommendations aimed at increasing program retention.

3. Description of Program

The Companies have designed the DLC Program to reduce peak demand for electricity during the summer months. Customers who opt into the program will have a radio-controlled thermostat installed that will allow the Companies to reduce CAC compressor operation by a variable load control percentage (e.g., 50% cycling) during load control "events". The demand control events occurred in the summer of 2015 and were initiated to reduce electric energy consumption during peak hours. This program is strictly for residential customers, and was targeted at customers with CAC units who are willing to accept reduced cooling capacities during event hours.

Honeywell is contracted with the Companies to provide DLC program services. Load Control Events are enabled through special programmable thermostats that can receive radio frequency signals and interrupt CAC unit compressor operation during load control events.

Thermostats are equipped with an adaptive algorithm that will reduce the runtime of the CAC compressor by 50% (or desired percentage) of what it would have been otherwise, based on the normal operation of the unit. During a 70% cycling event for example, if a particular unit would have normally run 40 minutes during a given hour, the program will limit that unit to only 12 minutes of run time in that hour. Given that an event will likely last a number of consecutive hours, that same control limit will be applied to each hour of the event. The actual usage schedule that achieves the desired control limit will be unique for each program participant and will depend upon the physical characteristics of the home and behavioral patterns during conditions similar to the actual events.

During the 2015 Cooling Season the Companies ran the following events, all at 50% cycling for the entire system:

(1) July 29th, 3 – 5 PM
(2) September 3rd, 3 – 5 PM
(3) September 8th, 3 – 5 PM
(4) September 15th, 2 – 3 PM

From these event days, ADM calculated the average kW factor by EDC and number of enrolled participants. The device count is based on data provided to ADM from the Companies.

4. Evaluation Methodology

This chapter discusses the M&V approach for designing the sampling plan, calculating the kW impact per unit, program level kWh savings and program kW impacts.

4.1 Impact Evaluation Methodology

The impact evaluation addressed the following questions:

- Determine the kW peak demand reduction consistent with PJM protocols.
- Determine the kW reduction per event hour, for all program participants to support energy savings.
- Determine the operability rate of devices in the field through field inspections.

Demand reductions for each event hour and associated weighted temperature humidity index (WTHI) were based upon the predicted savings values listed in the "Deemed Savings Estimates for Legacy Air Conditioning and Water Heating Direct Load Control Programs in PJM Region" report dated April 3, 2007.

An operability rate of 88.6% was used in the calculations, based upon ADM's 2013 Operability Study.

4.2 Data Collection and Conversion Procedures

ADM received the following information on each program participant:

- Full Name
- Address
- Install Date
- Account Number
- System Size (Tons)
- System Type (Conventional, Package Unit, Heat Pump, 2-Stage Unit)
- Removal Date (If Applicable)

The following table provides a comparison of participation tonnage values and unit age for the program.

Table 4-1 Participation, Average Tonnage and System Age

Company	Participants	Average Tonnage	Average Age
CEI	5,992	2.7	12.1
OE	10,573	2.8	12.4
TE	1,500	2.7	11.8
Total	**18,064**	**2.8**	**12.3**

Weather Data

ADM compiled historical weather data from the National Oceanic and Atmospheric Administration for each EDC from May 15th – Sept 30th for the following cities:

- Akron (OE)
- Cleveland (CEI)
- Toledo (TE)

PJM design conditions of 80.7 WTHI were used for peak demand reductions.

4.3 kW Factors by EDC

Using the regression baseline model specified in Section 3.4, ADM calculated hourly kW factors for the following event days:

(1) July 29th, 3 – 5 PM
(2) September 3rd, 3 – 5 PM
(3) September 8th, 3 – 5 PM
(4) September 15th, 2 – 3 PM

4.4 Energy Savings

Annual energy (kWh) savings for the 2015 DLC Program can be calculated as a function of kW reductions, Total Devices, and the number and length of curtailment events. Energy savings for an individual event is calculated as:

$$kWh\ Savings = \sum_{j}^{M} \sum_{i}^{N} kW_{i,j} \times Total\ Devices_{i,j}$$

Where:

i = the event hour

j = the Company

$kW_{i,j}$ = the kW factor for Company *i* during hour *j*.

And M, N denote the total number of device populations (i.e. three, one for each EDC) and DR event hours, respectively. The quantity $kW_{i,j}$ is calculated for every event hour and every Company based on the time of day and the weighted temperature humidity index and the associated lookup values in the Appendix F in the PJM Deemed Savings Estimates document.

4.5 Process Evaluation Methodology

The process evaluation for the Direct Load Control program assessed the following program components to determine initial and post program implementation effectiveness:

- Program awareness;
- Participating customer characteristics;
- Customer participation experience;
- Customer satisfaction.

5. Detailed Impact Evaluation Findings

This chapter presents the findings of the impact evaluation of the 2015 DLC Program, including kW factors and kWh Savings.

Verified peak demand reductions are calculated based on PJM protocols. PJM guidelines specify design weather conditions (WTHI) of 80.7 degrees, and provide tables of applicable kW per device. Resulting kW per device are 0.64 for the EDCs.

For kWh Savings, kW factors were calculated across all EDCs as detailed in Chapter 4. The kW factors are reported by event in the following tables. The averages are weighted by the number of participants in each EDC and adjusted for operability.

Table 5-1 Average Combined Event kW Factors by Hour

Date	*Time*	*Average Event Hour Temp.*	*Average WTHI*	*Event Hour kW Factor*
7/29/15	3-4 PM	86.2	79.1	0.50
	4-5 PM	85.8	78.8	0.54
9/03/15	3-4 PM	88.7	79.1	0.45
	4-5 PM	84.2	77.9	0.37
9/08/15	3-4 PM	89.0	80.0	0.48
	4-5 PM	88.1	79.6	0.54
9/15/15	2-3 PM	79.4	70.7	0.04

5.1 kW Factors by EDC

The kW factors were calculated independently by EDC as detailed in Chapter 4. Each set of kW factors are reported separately in the following three tables.

Table 5-2 OE Event kW Factors

Date	*Time*	*Event Hour Temp.*	*WTHI*	*Event Hour kW Factor*
7/29/15	3-4 PM	91.0	80.6	0.52
	4-5 PM	90.0	80.0	0.56
9/03/15	3-4 PM	88.1	79.3	0.45
	4-5 PM	76.0	75.1	0.26
9/08/15	3-4 PM	90.0	80.0	0.49
	4-5 PM	89.1	79.7	0.54
9/15/15	2-3 PM	79.0	70.8	0.04

Table 5-3 CEI Event kW Factors

Date	Time	Event Hour Temp.	WTHI	Event Hour kW Factor
7/29/15	3-4 PM	91.9	80.5	0.51
	4-5 PM	91.9	80.3	0.58
9/03/15	3-4 PM	88.0	79.8	0.48
	4-5 PM	87.6	79.5	0.53
9/08/15	3-4 PM	87.1	79.5	0.46
	4-5 PM	87.1	79.4	0.53
9/15/15	2-3 PM	78.1	70.2	0.04

Table 5-4 TE Event kW Factors

Date	Time	Event Hour Temp.	WTHI	Event Hour kW Factor
7/29/15	3-4 PM	75.6	76.2	0.27
	4-5 PM	75.4	76.0	0.31
9/03/15	3-4 PM	90.0	78.3	0.40
	4-5 PM	89.1	79.0	0.50
9/08/15	3-4 PM	90.0	80.4	0.51
	4-5 PM	88.0	79.6	0.54
9/15/15	2-3 PM	81.0	71.2	0.04

In order to capture the impact of the DLC program during event hours, the kW factors for each EDC were aggregated and scaled up by the total number of active DLC devices in the field (average participation count of 18,064) measured in the summer of 2015. These results are captured in *Table 5-5*.

Table 5-5 Hourly Load Impact All Companies in MW

Date	Time	Average Event Hour Temp.	Average WTHI	Event Hour MW Factor
7/29/15	3-4 PM	86.2	79.1	9.00
	4-5 PM	85.8	78.8	9.83
9/03/15	3-4 PM	88.7	79.1	8.20
	4-5 PM	84.2	77.9	6.63
9/08/15	3-4 PM	89.0	80.0	8.67
	4-5 PM	88.1	79.6	9.69
9/15/15	2-3 PM	79.4	70.7	0.72

5.2 kWh Savings by EDC

kWh Savings are calculated as the sum of the kW factors for each EDC and event and hours multiplied by quantity of devices in the field. Total program savings for 2015 are 52.7 MWh. Results per event are listed in Table 5-6 below.

Table 5-6 kWh Savings by Event Hour

Date	*Time*	*kWh CE*	*kWh OE*	*kWh TE*	*kWh All*
7/29/15	3-4 PM	3,077	5,516	409	9,001
	4-5 PM	3,466	5,898	461	9,825
9/03/15	3-4 PM	2,850	4,752	593	8,195
	4-5 PM	3,170	2,702	754	6,626
9/08/15	3-4 PM	2,753	5,149	763	8,666
	4-5 PM	3,157	5,723	808	9,687
9/15/15	2-3 PM	240	240	240	719
Totals		18,712	29,980	4,028	52,720

6. Detailed Process Evaluation Findings

This chapter provides the findings of the process evaluation component of this report. The process evaluation was informed by participant telephone survey data and in-depth interviews with program staff at Honeywell and the Companies.

6.1 Program management, Implementation and Oversight

The evaluation team conducted interviews with the Companies and Honeywell program staff in February 2016. These interviews focused on investigating program administration processes during the 2015 program year. Both the Companies and Honeywell staff described the communications and processes as functioning smoothly. There is a clear process in place for coordinating events and a clear chain of communication between the two companies.

The Easy Cool Rewards Program reached its participation target in 2015 and did not have significant numbers of customers drop out. The Companies report the dropout rate is less than 2 percent per year. It was noted that some customers forget they are participating in the program, which is a testament to how smoothly program operations are functioning.

Marketing and Outreach Efforts

For the 2015 participants, over half of all survey respondents first learned about Easy Cool Rewards through a utility bill insert or direct mailing from their utility. Conversely, very few individuals learned about the program through media such as newspaper, radio advertising, and door hangers.

Table 6-1 How Participants Learned About Easy Cool Rewards Program

Response	*CE*	*OE*	*TE*	*Total*
Utility bill insert	35%	37%	61%	39%
Utility direct mailing	31%	22%	11%	24%
Telephone call	8%	11%	11%	10%
Word of mouth: Friend/Relative/Neighbor/Co-worker	12%	7%	6%	8%
Utility website	5%	8%	6%	7%
Newspaper	2%	4%	0%	3%
Easy Cool Rewards email	2%	2%	0%	1%
Other event (home and garden show/Earth Day)	2%	1%	0%	1%
Radio advertising	0%	1%	0%	0%
Door hanger	2%	0%	0%	0%
Other	3%	8%	6%	6%
Total	**65**	**129**	**18**	**212**

The established methods of communication between the Companies' staff and Honeywell staff continue to work well. The Companies and Honeywell both noted that there are no outstanding communication issues with respect to implementing the 2015 Easy Cool Rewards program. The communication processes remain the same, where Honeywell receives email communication from the Companies to confirm that the Companies want to call an air conditioner cycling event, and Honeywell responds with documentation that the event has been called. The two parties continue to maintain a standing biweekly call with program staff to address any issues that arise. While these check-ins are not always necessary, they do happen regularly.

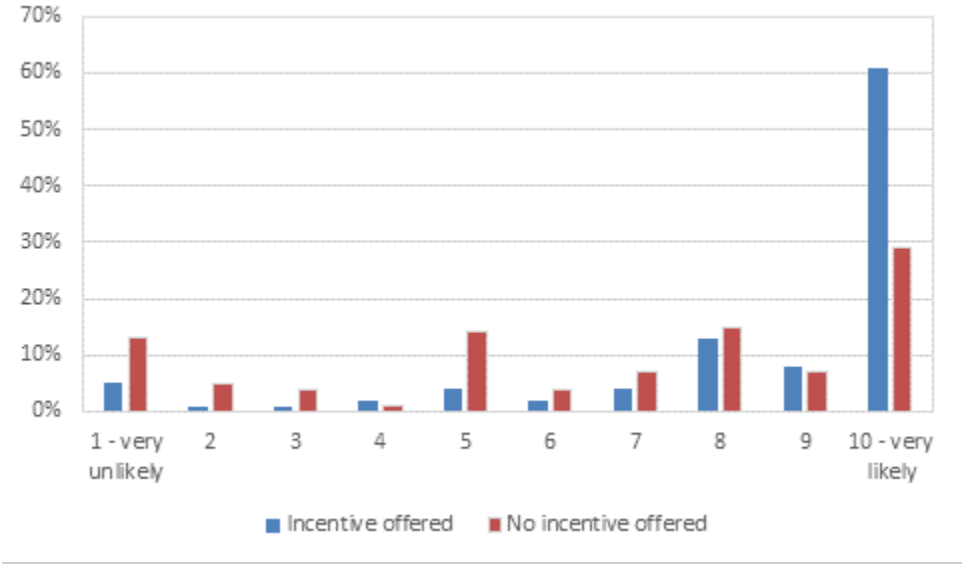
Program participants continue to express high levels of satisfaction with the Companies' Easy Cool Rewards program. Participant satisfaction with the overall program experience was high across operating companies, with an overall mean score of 4.4. Broken down by territory, means varied slightly from 4.4 in the Ohio Edison service area, 4.3 in Illuminating Company, and 4.2 in Toledo Edison territory (using a scale of 1 to 5, with 1 being "very dissatisfied" and 5 being "very satisfied").

Table 6-2 Mean Satisfaction with Specific Aspects of Easy Cool Rewards Program

Program Aspect	CE		OE		TE		Total	
	Avg.	Std. Dev	Avg.	Std. Dev	Avg.	Std. Dev	Avg.	Std. Dev
The receipt and installation of a new thermostat as compensation for participation in program	4.5	0.9	4.6	0.8	4.5	0.9	4.6	0.8
The service professional who installed the device	4.4	1.0	4.6	0.8	4.6	0.8	4.5	0.9
The enrollment process	4.5	0.8	4.5	0.9	4.6	0.8	4.5	0.9
Overall experience with program	4.3	1.0	4.4	1.0	4.2	1.2	4.4	1.0
The program information provided	4.2	1.0	4.3	1.0	4.2	1.0	4.3	1.0
Overall experience during energy reduction events	4.0	1.0	4.2	1.0	4.1	0.8	4.2	1.0

Current participants are likely to participate in the program in subsequent years. About 82 percent of customers indicated their likelihood of participating in the Easy Cool Rewards program in future years was 8 or higher (using a scale of 1 to 10, with 1 being “not at all likely” and 10 being “very likely”), if an incentive (no cost thermostat) was offered. Additionally, 61 percent of respondents rated the likelihood at 10. However, when asked if they would participate in the program if there was no incentive (no cost thermostat) offered, only 51 percent indicated their likelihood of participating in the Easy Cool Rewards program in future years as 8 or higher and only 29 percent rated the likelihood at 10.

Figure 6-1 Likelihood of Participating in Easy Cool Rewards Next Year



Customers' lowest levels of understanding are for how to know when a cycling event occurs and how to reduce electricity use during cycling events. Among all program aspects, survey respondents reported the lowest levels of understanding for two items related to cycling events – how to know when an event is occurring and what customers can do to reduce electricity use during an event.

Table 6-3. Number of Energy Reduction Events Recalled Summer 2015

Number of Events	*CE*	*OE*	*TE*	*Total*
Don't know	71%	67%	71%	68%
0	5%	9%	12%	8%
1	4%	4%	0%	4%
2	4%	7%	6%	6%
3	5%	5%	12%	5%
4	1%	2%	0%	2%
5	1%	2%	0%	2%
6	1%	0%	0%	0%
7	1%	0%	0%	0%
8	0%	1%	0%	0%
10	1%	2%	0%	2%
12	1%	0%	0%	0%
20	3%	0%	0%	1%
360	0%	1%	0%	0%

7. Recommendations

Overall, the program appears to be continuing to function without major issues. Interviewees reported that channels of communication between the Companies and Honeywell remained open and that meetings and telephone calls were productive throughout the program year. However, we provide a few recommendations for consideration.

Consider the costs and benefits of a thermostat enabling two-way communication. Currently, the thermostat installed for participants does not support two-way communication. As a result, the Companies have to rely on reports from customers to indicate when thermostats are not operating properly during cycling events. Two-way communication would provide better identification of problem thermostats and may also provide opportunities for near real-time feedback to participating customers. Two-way communication has been analyzed by the Companies in the past and found to be cost-prohibitive.

8. Appendix A: Required Savings Table

DLC program savings have a measure life of one year.

Table 8-1. Required Savings Table

Utility	*Annual Ex Post Savings*		*Measure Life*	*Lifetime Ex Post Savings*	
	kWh	*kW*		*kWh*	*kW*
OE	29,980	6,767	1	29,980	6,767
CEI	18,712	3,835	1	18,712	3,835
TE	4,028	960	1	4,028	960
Total Program	52,720	11,561		52,720	11,561

9. Appendix B: Survey Instrument

Ohio Edison, Cleveland Electric Illuminating, and Toledo Edison Companies' Residential Direct Load Control Survey

Q1. Hello, my name is [INTERVIEWER NAME], and I am calling on behalf of [EDC]. May I speak with [RESPONDENT NAME]?
1. Yes [CONTINUE]
2. No [SCHEDULE CALLBACK AND/ OR ATTEMPT TO CONVERT]

Q2. I'm with ADM, an independent research firm. We have been hired to assist [EDC] with review of their energy savings services by speaking with households that have signed up to participate in the Easy Cool Rewards (Thermostat) program. You will receive a $10.00 gift card for completing this survey. I'm not selling anything; I'd just like to ask you some questions about your decision to sign up for the Easy Cool Rewards (Thermostat) program offered by [EDC]. I'd like to assure you that your responses will be kept confidential and your name will not be revealed to anyone other than the evaluation team members. For quality and training purposes this call will be recorded.

The Easy Cool Rewards (Thermostat) program helps [EDC] to save energy during peak demand periods. As a part of this program, your central air conditioning system is remotely controlled by [EDC] by increasing the temperature setting to reduce energy usage when [EDC] predicts that electricity demand will be high. Do you recall enrolling for this program?
1. Yes [SKIP TO Q5]
2. No

Q3. Is there someone else in the household who may be familiar with the program?
1. Yes [ASK TO SPEAK TO THEM AND RECYCLE TO Q1]
2. No [THANK AND TERMINATE]

[DISPLAY Q4 IF Q3 = 1]
Q4. May I speak to that person?
1. Yes [RECYCLE TO Q2]
2. No [THANK AND TERMINATE]

Q5. Are you an employee of [EDC] or FirstEnergy?
1. Yes [THANK AND TERMINATE]
2. No
98. Don't Know
99. Refused

1. How did you FIRST learn about Easy Cool Rewards (Thermostat) program offered by [EDC]? (Do not read list; Record response]
    1. Utility bill insert
    2. Utility direct mailing
    3. Telephone call from [EDC] telemarketer
    4. Utility website
    5. Door hanger
    6. Word of mouth: Friend/ Relative/ Neighbor/ Co-worker
    7. Other event: Home and Garden show/ Earth day
    8. Easy Cool Rewards email
    97. Other (Specify)
    98. Don't know
    99. Refused

2. How would you prefer to receive information from [EDC] about programs like this in the future? (Do not read; select all that apply)
    1. Utility direct mailing such as a letter or postcard
    2. Telephone call from [EDC]
    3. Program website
    4. Email from [EDC]
    97. Other (Specify)
    98. Don't know
    99. Refused

3. For what reason or reasons did you decide to participate in the Easy Cool Rewards (Thermostat) program? (Do not read; Select all that apply)
    1. Concerned about saving energy in my home
    2. The opportunity to participate in an energy savings program
    3. Concerned about protecting the environment
    4. The program was recommended to me by [EDC]
    5. Reduce need for building new power plants
    6. Help [EDC] avoid power shortages (or brownouts or buying power at high prices)
    7. To get a new thermostat
    8. Not home when the AC is cycled
    97. Other (Specify)
    98. Don't know
    99. Refused

[DISPLAY Q5 IF > 1 SELECTED FOR Q4]

4. Of all the things that interested you about the program (Read list), what was the most compelling reason you decided to enroll in the program?
    1. Record verbatim response:
    98. Don't know
    99. Refused

5. Did you have concerns about participating in the Easy Cool Rewards (Thermostat) program?
    1. Yes
    2. No
    98. Don't know
    99. Refused

[DISPLAY Q6 IF Q5 = 1]

6. What concerns did you have? (Do not read; Select all that apply)
    1. Concerned about being uncomfortable during energy reduction events
    2. Concerned about the load control device damaging my air conditioning equipment
    3. Concerned about the utility being able to shut off my AC
    97. Other (Specify)
    98. Don't know
    99. Refused

[DISPLAY Q7-Q13 FOR DROPOUTS ONLY]

7. On a scale of 1 to 10, where 1 is very difficult and 10 is very easy, how easy or difficult did you find it to…(Read list; Record 1-10; 6 = Not applicable, 98 = Don't know, 99 = Refused)
    a. Understand the program requirements
    b. Sign up to participate in the program
    c. Schedule an appointment to have the Easy Cool Rewards device installed
    d. Interact with the program staff
    e. Understand how to operate the new thermostat

[DISPLAY Q8 IF Q7a-Q7e = 1, 2, 3, or 4]

8. What could the program have done differently to make it easier for you to [INSERT A-E WORDING]?
    1. Record verbatim response:
    98. Don't know
    99. Refused

9. I understand that your household decided to participate and dropped out of the program. Can you tell me why that is? (Do not read; Prompt if needed)
    1. The temperature increase was/ would be uncomfortable
    2. Didn't want [EDC] to control my energy use
    3. Didn't understand how the program worked
    4. Did not understand the energy reduction events
    5. Didn't understand what the program was trying to accomplish
    6. Afraid it might damage my central air conditioner
    7. Didn't like the time periods when the energy reduction events would happen
    8. Didn't like the number of days a year when energy reduction events would occur
    9. Health reasons
    10. Problems with Easy Cool Rewards device installation (Specify)
    11. Did not receive enough notification
    97. Other (Specify)
    98. Don't know
    99. Refused

10. What could the program have done differently to encourage you to remain in the program? (Do not read; Prompt if needed)
    1. Nothing they could have done
    2. Better explained the program
    3. Offer an incentive/payment for participating (Specify Amount)
    4. Shorter event days
    5. Reduced the amount by which the temperature was increased
    6. Provide more advance notice
    7. Provide more information on the energy saving effect of the program
    97. Other (Specify)
    98. Don't know
    99. Refused

[DISPLAY Q11 IF Q9> 1 RESPONSE]

11. Of all the reasons you mentioned for deciding not to participate in the program, which reason was the most important?
    1. Record verbatim response:
    98. Don't know
    99. Refused

12. Now I would like to understand how your experience with Easy Cool Rewards (Thermostat) program has affected your satisfaction with [EDC] as your utility. Did it…(Read list)
    1. Greatly improve your satisfaction
    2. Somewhat improve your satisfaction
    3. Make no difference in your satisfaction
    4. Somewhat decrease your satisfaction
    5. Greatly decrease your satisfaction

13. Will you please tell me why you responded [RESPONSE FROM Q12]?
    1. Record verbatim response
    98. Don't know
    99. Refused

[DISPLAY Q14-Q22 FOR ENROLLED PARTICIPANTS ONLY]

14. Next, I would like to ask you some questions about your enrollment in the program. Thinking about the information you have received about participating in the program, on a scale of 1 to 10, where 1 is very difficult and 10 is very easy, how difficult or easy did you find it to…(Read list; Record 1-10; 6 = Not applicable, 98 = Don't know, 99 = Refused)
    a. Understand the program requirements
    b. Sign up to participate in the program
    c. Schedule an appointment to have the Easy Cool Rewards device installed
    d. Understand when and how you will be notified of an energy reduction event
    e. Understand what you can do to reduce your electricity use when energy reduction events are occurring
    f. Interact with the [EDC] staff during enrollment

[DISPLAY Q15 IF Q14a-14f = 1, 2, 3, or 4]

15. What could the program have done differently to make it easier for you to [INSERT A-F WORDING]?
    1. Record verbatim response:
    98. Don't know
    99. Refused

16. Have you called the Easy Cool Rewards (Thermostat) toll free number with any questions about enrollment?
    1. Yes
    2. No
    98. Don't know
    99. Refused

[DISPLAY Q17 IF Q16 = 1]

17. Were your questions sufficiently answered?
    1. Yes
    2. No (Record verbatim response: What was not answered?)
    98. Don't know
    99. Refused

[DISPLAY Q18 IF Q16 = 2, 98, or 99]

18. Were you aware that there is a toll free number you can call with questions about the program?
    1. Yes
    2. No
    98. Don't know
    99. Refused

19. Did you have any initial questions about the participating in the program?
    1. Yes
    2. No
    98. Don't know
    99. Refused

[DISPLAY Q20 IF Q19 = 1]

20. What questions or concerns did you have? (Do not read; Prompt if needed)
    1. Didn't know how to reduce my energy consumption during energy reduction events
    2. Didn't understand how the program worked
    3. Didn't like the potential time periods when the energy reduction events would happen
    4. Problems with installation of Easy Cool Rewards device (Specify)
    97. Other (Specify)
    98. Don't know
    99. Refused

21. Can you tell me in your own words your understanding of what occurs during an energy reduction event? (Record verbatim response)

22. What information did you find helpful? (Do not read; Select all that apply)
    1. Information about savings periods/events
    2. Information about rebate
    3. Information about how to save and/or reduce energy usage during savings periods
    4. Information about how savings period/event notifications will be sent
    5. Information about what to do when notification is received
    6. Information about penalties
    7. Information about how savings are calculated
    8. Information about how savings will be communicated
    9. Information about what number to call if there are questions
    10. Information about how to opt out of events
    97. Other (Specify)
    98. Don't know
    99. Refused

Next I would like to ask you some questions about your experience during the energy reduction events that occurred during the summer.

23. How many reduction events do you think [EDC] issued this past summer?
    1. Number of days
    2. Never
    98. Don't know
    99. Refused

24. Were you at home during any of the energy reduction events?
    1. Yes
    2. No
    98. Don't know
    99. Refused

[DISPLAY Q25 IF Q24 = 1]

25. How could you tell that [EDC] AC was cycling during an event? (Select all that apply)
    1. The house got uncomfortably warm
    2. I didn't hear the air conditioner run as often
    3. I looked at the thermostat and saw that the temperature had been increased
    4. I called the program customer service line to see if they had adjusted the temperature
    5. I received a notification via my thermostat
    97. Other (Specify)
    98. Don't know
    99. Refused

26. Thinking about the events that occurred when you were home, on a scale of 1 to 10, where 1 is very uncomfortable and 10 is very comfortable, how uncomfortable or comfortable was it for you?
    1. Record 1-10:
    98. Don't know
    99. Refused

27. Were you aware that energy reduction events had occurred when you were not at home?
    1. Yes
    2. No
    98. Don't know
    99. Refused

[DISPLAY Q28 IF Q27 = 1]

28. How did you know that energy reduction events had occurred when you were not home during the event? (Select all that apply)
    1. The house was uncomfortably warm when I returned home
    2. The air conditioning ran more than usual
    3. I called the program customer service line to see if they had adjusted the temperature
    4. I received a notification via my thermostat
    97. Other (Specify)
    98. Don't know
    99. Refused

29. Have you called the Easy Cool Rewards (Thermostat) toll free number with any questions about energy reduction events?
    1. Yes
    2. No
    98. Don't know
    99. Refused

[DISPLAY Q30 IF Q29 = 1]

30. Were your questions sufficiently answered?
    1. Yes
    2. No (Record verbatim response: What was not answered?)
    98. Don't know
    99. Refused

[DISPLAY Q31 IF Q28 = 3

31. You mentioned in a previous question that you had called the program customer service line to ask if an energy reduction event had occurred. Were your questions answered?
    1. Yes
    2. No
    98. Don't know
    99. Refused

32. On a scale of 1-5 where, Very dissatisfied = 1, Somewhat dissatisfied = 2, Neither satisfied nor dissatisfied = 3, Somewhat satisfied = 4, Very satisfied = 5, Don't know = 98, and Refused = 99, how unsatisfied or satisfied are you with…
    a. The enrollment process?
    b. The program provided?
    c. The service professional who installed the Easy Cool Rewards device?
    d. The receipt and installation of a new thermostat as compensation for your participation in the program?
    e. Your overall experience during energy reduction events?
    f. Your overall experience with the program?

[DISPLAY Q33 IF Q32a-Q32f = 1, 2, 3, or 4]

33. What can the program do differently to make you more satisfied with [INSERT A-F WORDING]? (Record verbatim response)

34. On a scale of 1 to 10, where 1 is not at all likely and 10 is very likely, how likely are you to participate in an Easy Cool Rewards (Thermostat) program in the future?
    1. Record 1-10:
    98. Don't know
    99. Refused

[DISPLAY Q35 IF Q34 = 1, 2, 3, or 4]

35. What can the program do differently to make you more likely to participate in the future?
    1. Record verbatim response:
    98. Don't know
    99. Refused

36. On a scale of 1 to 10, where 1 is not at all likely and 10 is very likely, how likely are you to participate in an Easy Cool Rewards (Thermostat) program in the future if [EDC] did not offer an incentive (i.e. a free thermostat) to participate?
    1. Record 1-10:

98. Don't know
99. Refused

37. What effect, if any, has the program had on how you will use energy in the future?
    1. Record verbatim response:
    98. Don't know
    99. Refused

38. Now I would like to understand how your experience with Easy Cool Rewards (Thermostat) program has affected your satisfaction with **[**EDC] as your utility. Did it… (Read list)
    1. Greatly improve your satisfaction with [EDC]
    2. Somewhat improve your satisfaction with [EDC]
    3. Make no difference in your satisfaction with [EDC]
    4. Somewhat decrease your satisfaction with [EDC]
    5. Greatly decrease your satisfaction with [EDC]

39. Will you please tell me why you responded [RESPONSE FROM Q38]
    1. Record verbatim response:
    98. Don't know
    99. Refused

I would now like to ask you some questions about how you would like to receive information about your electricity use and updates about the program from [EDC].

40. Do you have internet access?
    1. Yes
    2. No
    98. Don't know
    99. Refused

[DISPLAY Q41 IF Q40 = 1]

41. Have you ever visited [EDC] or FirstEnergy's website?
    1. Yes
    2. No
    98. Don't know
    99. Refused

[DISPLAY Q42 IF Q41 = 1]

42. Have you ever used the [EDC] or FirstEnergy Home Energy Analyzer to assess your home energy usage?
    1. Yes
    2. No
    98. Don't know

99. Refused

43. Other than the FirstEnergy website or the Home Energy Analyzer, are there other methods that [EDC] should consider using to provide feedback information about your performance during energy reduction events? (Do not read; Select all that apply)
    1. Text message
    2. Email
    3. Cell phone call
    4. Home phone call
    5. Mail
    6. In home display
    97. Other (Specify)
    98. Don't know
    99. Refused

44. Have you been to the [EDC] website to review the energy savings tips they provide online?
    1. Yes
    2. No
    98. Don't know
    99. Refused

[DISPLAY Q45 IF Q44 = 1]

45. Please rate the usefulness of the energy efficiency tips provided on the website using a scale of 1 to 10, where 1 is "not at all useful" and 10 is "very useful".
    1. Record 1-10:
    98. Don't know
    99. Refused

46. What types of additional information would you like on the website?

Next, I want to better understand the types of energy using equipment you have in your home.

47. How many plasma TV's do you have?
    1. Record response:
    98. Don't know
    99. Refused

48. How many LCD/LED TV's do you have?
    1. Record response:
    98. Don't know
    99. Refused

49. How many conventional (tube-based) TV's do you have?
    1. Record response:
    98. Don't know
    99. Refused

50. How many projection TV's do you have?
    1. Record response:
    98. Don't know
    99. Refused

51. How many other TV's do you have?
    1. Record response:
    98. Don't know
    99. Refused

52. What type of stove do you have?
    1. Natural Gas
    2. Electric
    3. Propane
    97. Other (Specify)
    98. Don't know
    99. Refused

53. What type of water heater do you have?
    1. Natural Gas
    2. Electric
    3. Propane
    97. Other (Specify)
    98. Don't know
    99. Refused

54. What type of clothes dryer do you have?
    1. Natural Gas
    2. Electric
    3. Propane
    97. Other (Specify)
    98. Don't know
    99. Refused

55. Which of the following best describes your home/residence?
    1. Single-family home, detached construction (Not a duplex, townhome, or apartment; attached garage is ok)
    2. Single family home, factory manufactured/modular
    3. Single family, mobile home
    4. Row House

5. Two or Three family attached residence—traditional structure
6. Apartment (4 + families)---traditional structure
7. Condominium---traditional structure
97. Other (Specify)
98. Don't know
99. Refused

56. Do you own or rent this residence?
    1. Own
    2. Rent
    98. Don't know
    99. Refused

57. Approximately when was your home constructed? (Do not read list)
    1. Before 1960
    2. 1960-1969
    3. 1970-1979
    4. 1980-1989
    5. 1990-1999
    6. 2000-2005
    7. 2006 or later
    98. Don't know
    99. Refused

58. How many square feet is the above-ground living space (If necessary, this excludes walk-out basements)?
    1. Numerical open end (Range 0-99,999)_____
    98. Don't know
    99. Refused

[DISPLAY Q59 IF Q58 = 98 or 99]

59. Would you estimate the above-ground living space is about:
    1. Less than 1,000 sqft
    2. 1,001-2,000 sqft
    3. 2,001-3,000 sqft
    4. 3,001-4,000 sqft
    5. 4,001-5,000 sqft
    6. Greater than 5,000 sqft
    98. Don't know
    99. Refused

60. How many square feet of conditioned living space is below- ground (If necessary, this excludes walk-out basements)?
    1. Numerical open end (Range 0-99,999)_____
    98. Don't know
    99. Refused

[DISPLAY Q61 IF Q60 = 98 or 99]

61. Would you estimate the below-ground living space is about:?
    1. Less than 1,000 sqft
    2. 1,001-2,000 sqft
    3. 2,001-3,000 sqft

4. 3,001-4,000 sqft
5. 4,001-5,000 sqft
6. Greater than 5,000 sqft
98. Don't know
99. Refused

62. What kind of air conditioning does your home have? (Select all that apply)
    1. Central Air Conditioning
    2. Heat Pump
    3. Window A/C (Number)
    4. None
    98. Don't know
    99. Refused

63. How many window A/C units does your home have?
    1. Record response:
    98. Don't know
    99. Refused

Finally, I would like to ask you a few questions to better understand your household.

64. How many years have you lived at your current address? (Do not read list)
    1. 1 year or less
    2. 2 to 5 years
    3. 6 to 9 years
    4. 10 to 20 years
    5. More than 20 years
    98. Don't know
    99. Refused

65. I'm going to read several age groups. Please stop me when I come to the group in which your age belongs. (Read list)
    1. Under 24
    2. 25 to 34
    3. 35 to 44
    4. 45 to 54
    5. 55 to 64
    6. 65 to 74
    7. 75 or over
    98. Don't know
    99. Refused

66. How many people were living in your home during the summer of 2015?
    1. Number of people:
    98. Don't know
    99. Refused

[DISPLAY Q67IF Q66 > 0]

67. On average, how many of these people were home during week during the hours of [Savings period] during the summer?
    1. Number of people:
    98. Don't know
    99. Refused

END: Thank you, those are all the questions I have for you today.

10. Appendix C: Temperature Humidity Index

For the cooling season (June, July, August, and September), Temperature-Humidity Index (THI) is used as the weather variable:

If DB ≥ 58, THI = DB - 0.55 * (1 – HUM) * (DB – 58)

If DB < 58, THI = DB

Where: THI = Temperature humidity index;

DB = Dry bulb temperature (°F),

HUM = Relative Humidity (where 100% = 1).

For shoulder months (March, April, May, October and November), the average daily dry bulb temperature serves as the weather variable.

The weighted temperature-humidity index (WTHI) is constructed by incorporating "lag terms" in the THI. The WTHI as calculated as:

$WTHI = 1/14 \times (10 \times THI_n + 3 \times THI_{(n-24)} + THI_{(n-48)})$

Where: THI_n = Temperature humidity index for hour *n.*

$THI_{(n-24)}$ = THI for hour *n-24* (same hour from the previous day)

$THI_{(n-48)}$ = THI for hour *n-48* (same hour from the previous previous day)