

EM&V Report: 2012 Residential Direct Load Control Program

Prepared for FirstEnergy Ohio Companies:

The Cleveland Electric Illuminating Company

Ohio Edison Company

The Toledo Edison Company

May 2013

Prepared by:



ADM Associates, Inc.

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Executive Summary

For 2012, the Ohio operating companies The Cleveland Electric Illuminating Company (CEI), Ohio Edison (OE), and The Toledo Edison Company (TE) (collectively “Companies”) offered the Residential Direct Load Control (DLC) program. Under contract with the Companies, ADM Associates, Inc. (ADM) is performing evaluation, measurement and verification (EM&V) services to confirm the savings (kWh) and demand reduction (kW) being realized through the energy efficiency programs that the Companies are implementing in Ohio in 2012. This report presents and discusses results from an evaluation of the Companies’ 2012 Direct Load Control Program (“DLC”).

This evaluation focuses on determining the achieved peak demand reduction and energy savings attributed to the DLC program in 2012. The evaluation included one-way UtilityPro Programmable Control Thermostats (PCTs). These devices functioned to cycle the Central Air Conditioner based on the typical runtime for each unit during that hour. The devices were “trained” based on hours when the temperature was greater than 85 degrees. The runtime reductions were calibrated to that level of usage.

Program participation levels, Ex Ante and Ex Post values are listed in Table ES-1 below. kW and kWh savings calculations are detailed in Chapter 4. It should be noted that the DLC program savings for 2012 have a lifetime of just one year, and that the pro-rata savings are equal to the full year savings since they are event based. Therefore lifetime, pro-rata and annualized savings all equal the same number.

Table ES-1 Program Savings Summary

Utility	Participating Residential Households with DLC Device	Ex Ante Expected Pro-Rata Savings		Ex Post Pro Rata Savings		kW Realization Rate
		kWh	kW	kWh	kW	
Ohio Edison	9,995	61,981	7,299	58,225	4,755	65%
Illuminating Company	5,630	34,900	4,075	9,254	1,501	37%
Toledo Edison	1,319	8,135	958	13,257	655	68%
Total Program	16,944	105,016	12,332	80,736	6,912	56%

1. Introduction and Purpose of Study

Under contract with the Companies, ADM Associates, Inc. (ADM) is performing evaluation, measurement and verification (EM&V) services to confirm the savings (kWh) and demand reduction (kW) being realized through the energy efficiency programs that the Companies are implementing in Ohio in 2012. ADM prepares an EM&V report for each program for which EM&V is required. This document is the EM&V report for the 2012 Direct Load Control (DLC) Program in Ohio.

1.1 Objectives of the Study

The scope of ADM's EM&V work for the DLC project includes 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 2012.
- Determine the program level kWh Savings
- Determine the system wide MW Impacts at the EDC level
- Perform analysis of DLC events in the summer of 2012 to assess hourly load reductions

1.2 Overview of Study Methodology

Data for the study was collected and analyzed through the following procedures.

1.2.1 Data Collection

ADM, as the M&V Contractor, was not responsible for physically collecting data on runtime of controlled ACs or whole-house meter data. However, as part of the evaluation, ADM did consult on sample design, in order to ensure that all sampling meets program requirements of 90% confidence and 10% precision (90/10). ADM obtained Wattnode logger data at 2 minute intervals for the entire summer cooling season (May-Oct). ADM performed checks on each logger to ensure that the data being recorded was accurate.

2. 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 Company to reduce compressor operation by a variable load control percentage (e.g., 50%) during load control “events”. The demand control events will begin in the summer of 2012. The events themselves will be initiated to reduce electric energy consumption during peak hours. This program is strictly for residential customers, and is targeted at customers with AC units who are willing to accept reduced cooling capacities during event hours.

Honeywell is contracted with the Companies to provide DLC services. Load curtailment is enabled through special programmable thermostats that can receive radio frequency signals and curtail AC usage by reducing compressor operation during load control events.

Devices are equipped with an adaptive algorithm that will cut the runtime of the CAC compressor to 50% (or alternate percentage) of what it would have been otherwise, based on the normal operation of the unit. For example, if a particular unit would have normally run 30 minutes during a given hour, the program will limit that unit to only 15 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 2012 Cooling Season the Companies ran the following whole-system events:

- (1) July 17th, 2 – 4 PM, 50% Cycling
- (2) July 18th, 1 – 5 PM, 50% Cycling
- (3) July 26th, 12 – 4 PM, 70% Cycling
- (4) August 3rd, 1 – 5 PM, 50% Cycling
- (5) August 31st, 3 – 5 PM, 70% Cycling
- (6) September 6th, 2 – 5 PM, 70% Cycling

From these event days, ADM calculated the average kW Factor by Company and number of enrolled participants. The device count was measured just before the first

curtailment event on July 17th, 2012. Any participant who requested to be removed from the program before that date was not included.

3. 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 MW impacts.

3.1 Impact Evaluation Methodology

The impact evaluation addressed the following questions:

- Determine the kW reduction per event and snapback hour, for all program participants.
- Determine the operability rate of devices in the field through field inspections.

3.2 Sampling Strategy

The sample size is determined to 10% error at a 90% confidence level using a two-tailed test. For M&V purposes, the minimum sample size (MSS) which meets regulatory requirements can be achieved by applying the 90/10 requirements at the program level. The MSS for a particular group is determined as the number of sample points required to meet the 90/10 requirements times a factor of 1.10 for contingency purposes. This sample size will provide adequate confidence and precision levels to exceed Ohio SWE requirements.

The equation for determining MSS is as follows:

$$n_0 = \frac{z^2 cv(y)^2}{p^2}$$

where n is required sample size (i.e., number of devices); z is the x value from a standard normal curve for a specified confidence level (e.g., 1.645 for 90% confidence level); CV(y) is coefficient of variation for CAC compressor kW draw during a typical control event time-frame; and p is required precision. The conditions under which the CV will be estimated are as follows:

- Between the hours of 10AM – 7PM
- THI Index is above 78 for each hour
- Day is a non-Event Day, non-holiday and non-weekend

Given the confidence interval and precision requirements, the size of the sample depends primarily on the coefficient of variation (CV) for runtime reduction in the

population of devices to be sampled. Table 3-1 shows the number of sample sites required to achieve the overall sampling precision for different CV levels when this sample size formula is applied.

Table 3-1 Sample Sizes by Coefficient of Variation

Desired Precision	Desired Confidence	Z Value	CV	Calculated Sample Size	Sample Size with Contingency
10%	90%	1.645	0.50	68	74
10%	90%	1.645	0.75	152	167
10%	90%	1.645	1.00	271	298
20%	90%	1.645	0.50	17	19
20%	90%	1.645	0.75	38	42
20%	90%	1.645	1.00	68	75

In the absence of historical, Ohio-specific values for the CV, ADM used a default value of 0.50 based upon findings in other sources. Given a CV of 0.50, the required sample size is 74 sites including an extra 10% for contingency sites. Note that this sample size exceeds the required number for $\pm 20\%$ precision and 90% confidence with a CV of 0.50. The empirical foundation for this choice comes from the following sources:

From the California Evaluation Framework (2004), any homogenous by measure, residential program can be assumed to have a CV of 0.5 for sample design procedures.

ADM conducted a study to evaluate the CVs from hourly kW data from AC compressors in Nevada. This study utilized only eligible baseline days, and calculated the CV from hourly runtime data to be equal to 0.43 for the hours of 10AM – 7PM.

In order to ensure that the sample adequately covered each the three operating company's territories, the follow sub-sampling procedure was conducted as detailed in Table 3-2 75 Sites spread equally over the three operating companies.

- Two cities per operating company, specifically: Strongsville (CE), Cleveland (CE), Akron (OE), Youngstown (OE), Toledo (TE), and Sylvania (TE).

Table 3-2 Sample Sites by City and Company

City/EDC	Sample Sites
CEI	
<i>Cleveland</i>	12
<i>Strongsville</i>	13
OE	
<i>Akron</i>	13
<i>Youngstown</i>	12
TE	
<i>Sylvania</i>	12
<i>Toledo</i>	13
Total	75

3.3 Data Collection and Conversion Procedures

For the households recruited for the sample, data was collected to measure changes in the energy use of the AC unit. The fields of interest to the evaluation collected by Honeywell are listed below:

- 2-minute interval usage data
- Unit tonnage
- Install date

Having the unit tonnage from the sample allows there to be a control mechanism to account for any difference in the average tonnage by operating company versus the entire program population. This procedure will be explained in the next section.

Honeywell conducted the Wattnode Logger installation and data retrieval during 2012. 50 amp current transformers (CTs) were used with the Wattnode loggers. ADM received data files for each of the 75 Wattnode loggers with 2-Minute Interval Pulse data for the

entire summer cooling season (May-Oct). Wattnode loggers sum the number of pulses over the measurement period to determine the recorded interval reading. The measurements from the Wattnode loggers were converted into kW by employing the following formula:

$$kW = \text{Pulses} \div 800(\text{Pulses/kWh}) \times 30(\text{kWh/kW})$$

The 800 Pulse/kWh factor comes from the Wattnode reference manual documentation based on the 50 amp CT used. Multiplying by 30 simply converts from kWh to kW.

3.3.1 Data Quality Checks

As an integral part of the M&V effort, ADM investigated each customer's logger data to ensure that their usage profile was being accurately described by the Wattnode devices. In order to determine the capacity of each individual AC unit, AMD calculated the MAX kW reading over all 2-minute intervals. For a majority of units this value was in a normal range (1.5-4), however for 21 of the 75 units in the sample a max kW reading of 0.5 or below was found. This indicates some issue in the way the Wattnode recorded the data and those sites were dropped from the sample. The resulting sample of 53 units was used for the analysis.

The data are then converted to an hourly load shape by averaging the kW readings for all 30 readings within each hour. This procedure was conducted in SAS/SQL with the following program:

```
*Converting from Pulses to kW;
Data OHDLC.Combined3;
set OHDLC.combined2;
kW = (pulses/800*30);
kW_Ton = kW/tons;
Drop Data_Logger_SN Pulses city var6;
Run;

*Aggregating from 2Min Interval Data to Hourly Data;
Data OHDLC.Combined5;
set OHDLC.combined4;
IDSASDate2 = cats(of ID SASdate2);
drop kW_Ton tons age;
run;
Proc SQL;
    Create table OHDLC.Combined6 as
```

```
Select *, Mean(kW) Label = "Hourly Average" as HourlykW
From OHDLC.Combined5
group by IDSasdate2;
Quit;
Data OHDLC.Combined7;
Set OHDLC.Combined6;
Drop kW kW_ton;
run;
Proc sort nodupkey data=OHDLC.Combined7;
by ID SasDate2;
run;
```

3.3.2 Program-Level Tracking Database

ADM received information on each program participant from the Companies including:

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

Table 3-3 compares the participation tonnage values and unit age for the program versus the sample. Any participant who had a removal date before 7/17/2012 (The first called event) was removed from the enrolled participant count and the average tonnage calculation. The dataset was subcategorized by Company. This procedure was also undertaken for our sample of 75 sites to compare average tonnage by operating company. There is not a statistically significant difference in terms of unit tonnage or age when comparing the total sample of 75 sites to the program population. There is however a statistically significant difference in age when looking at TE. This will be considered when looking at the Company level results.

Table 3-3 Participation and Average Tonnage Summary

Company	Program Pop. Size	Average Tonnage (Program Pop.)	Average Tonnage (Sample)	P-Value For Tonnage Diff	Average Age (Program Pop.)	Average Age (Sample)	P-Value for Age Diff
CEI	5,630	2.92	2.69	0.271	13.50	12.67	0.313
OE	9,995	2.77	2.65	0.294	12.07	12.38	0.387
TE	1,319	2.69	2.75	0.366	13.34	16.13	0.004
Total	16,944	2.81	2.69	0.235	12.64	13.72	0.109

3.3.3 Weather Data

ADM compiled historical weather data from NOAA for each Company in Ohio from May 15th – Sept 30th for the following cities:

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

3.4 Baseline Determination

ADM employed two independent counter-factual baseline methodologies in order to compare and ultimately determine which should be used for the evaluation. The methodologies employed were:

1. Day-Matching with SAA
2. Auto-Regressive (AR) Regression Modeling with Temperature/Humidity Index (THI)

Each technique utilizes an aggregated loadshape (averaged across all sites in the sample).

ADM calculated three separate models of baseline estimation to ensure that the model with the lowest error margin was being applied to the data. This was checked by calculating the Relative Root Mean Square Error (RRMSE) for each model on “Test Event Days”. These test days were picked as Non-M&V event days, non-weekend and non-holiday, where the temperature was greater than 82 degrees for 6 hours. The list of days used for the calibration include: 5/28, 6/19, 6/20, 6/21, 7/6, 7/13, 7/16, 7/23, 7/25 and 8/16. The hours of 12 – 6PM were used as the calibration period since that fully encompasses the time period of all events that were called in the 2012 season. The RRMSE is calculated as follows:

$$RRMSE = \sqrt{\frac{1}{n \sum_{i=1}^N \left(\frac{Baseline_t - Actual_t}{Baseline_t} \right)^2}}$$

Where:

- (1) N is the number of hours during which the RRMSE is calculated (12 – 6PM, weekday, non-event/non-holiday).

These calculations were conducted individually by operating company. Before presenting the results of the comparison, each of the baseline methodologies will be explained in detail.

Table 3-4 RRMSE by Baseline Model and Company

Company	Day Matching with SAA	Regression model with THI
CEI	48.75%	9.18%
OE	48.24%	17.57%
TE	42.58%	12.74%

3.4.1 Day Matching with SAA

The baseline kW is determined by examining the 5 days prior that were:

- (1) Weekdays
- (2) Non-holidays
- (3) Non-curtailement days

Of these five eligible baseline days, the four days with the highest average hourly kW between the hours of 2:00 PM – 6:00 PM are selected as the baseline days. The baseline for the curtailment interval is then the average kW across the four dates for each hourly curtailment interval. This baseline is then adjusted by the Symmetric Additive Adjustment (SAA) Factor. The SAA Factor normalizes the baseline kW to the loading conditions observed on the curtailment day, as the kW that would have been observed during curtailment hours may be higher or lower than the simple mean of the four baseline days. This is because a primary determinant of the need for curtailment is weather, so that curtailment periods are not directly comparable across dates. The Offset Factor is calculated as:

SAA Factor

- Avg Event Day kW of the 4 hrs preceding curtailment ending 1 hr prior to the event
- Avg Baseline kW of the 4 hrs preceding curtailment ending ending 1 hr prior to the event

This SAA factor is then added to every event hour used in the analysis to create the “SAA baseline”.

The kW reduction can then be calculated as SAA Baseline kW – Observed Post kW (the Observed Post kW is the kW observed during the event).

3.4.2 Auto-Regressive Model with THI

ADM estimates kW reduction for participants in the DLC program through statistical regression analysis of hourly energy use data for those participants. Regression analysis relies on historical information about customer loads and focuses on understanding the relationship between loads, or load impacts, during hours of interest and other predictor variables.

The Weather-Sensitive Model (WSM) is a regression model that describes the CAC unit's power (the dependent variable) as a response to outdoor temperature, humidity¹, time of day, and the previous hour's predicted usage. This is known as an auto-regressive model, in that the model is based upon previous observations of the dependent variable (kW usage). The WSM defines a relationship between outdoor ambient conditions and CAC kW that is piecewise continuous depending on the

¹ Weather data will come from the operating company at is specific to the zip code of the customer. For details on the WSA, see PJMDOCS #621890

temperature range. This model will be specified for each hour of the day. It has two distinct ranges for each hour:

- (1) Temperatures below the set-point (~70 degrees) should have minimal or no call for cooling.
- (2) Temperatures above the set-point up to a certain temperature (~95 degrees) will be modeled by a linear regression with increasing power consumption at higher temperatures.

The regression utilizes the same baseline days as are used for the Day-Matching model. In order to calculate the demand reduction for each hour of a particular event, we calculate the model's predicted value and subtract the actual kW draw during that hour to determine the kW reduction value. The regression model is specified below:

$$\text{Hourly kWh} = \beta_0 + \beta_1 \text{Lag1kWh} + \beta_2 \text{THI} + \epsilon$$

As a graphical illustration of the methodologies on a comparable non-event day (THI > 80), Figure 3-1, Figure 3-2, and Figure 2-3 below show the two potential baselines and the actual load during that hour.

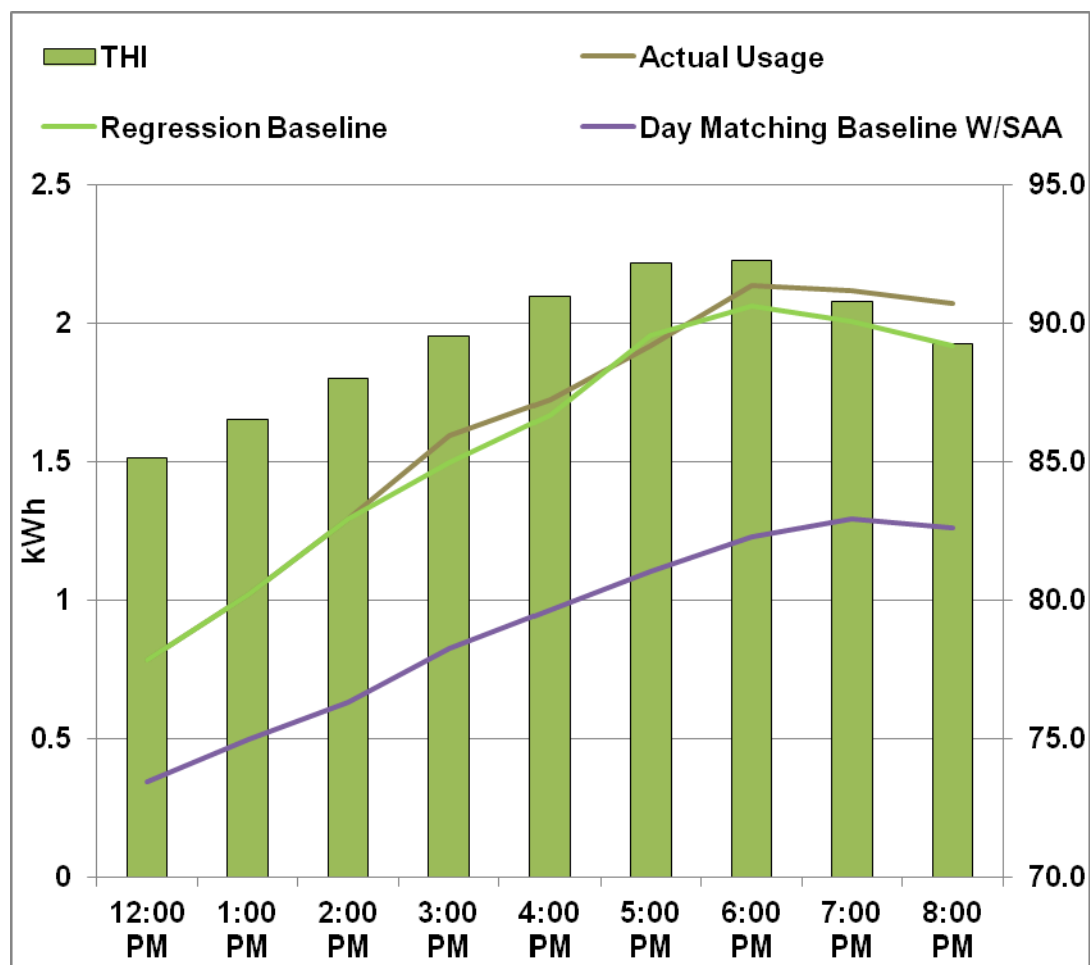
Figure 3-1 TE June 28th: Baseline Comparison

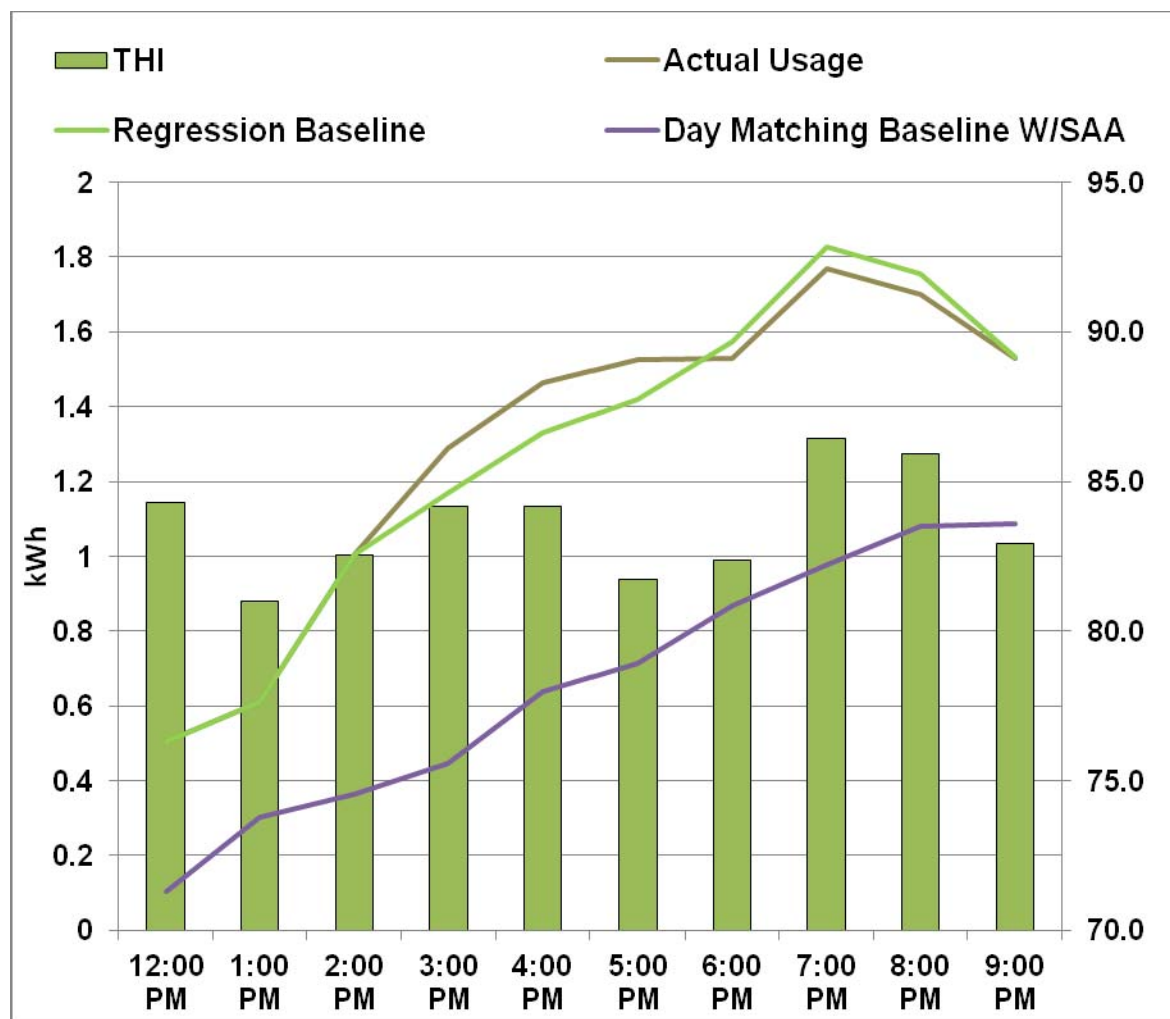
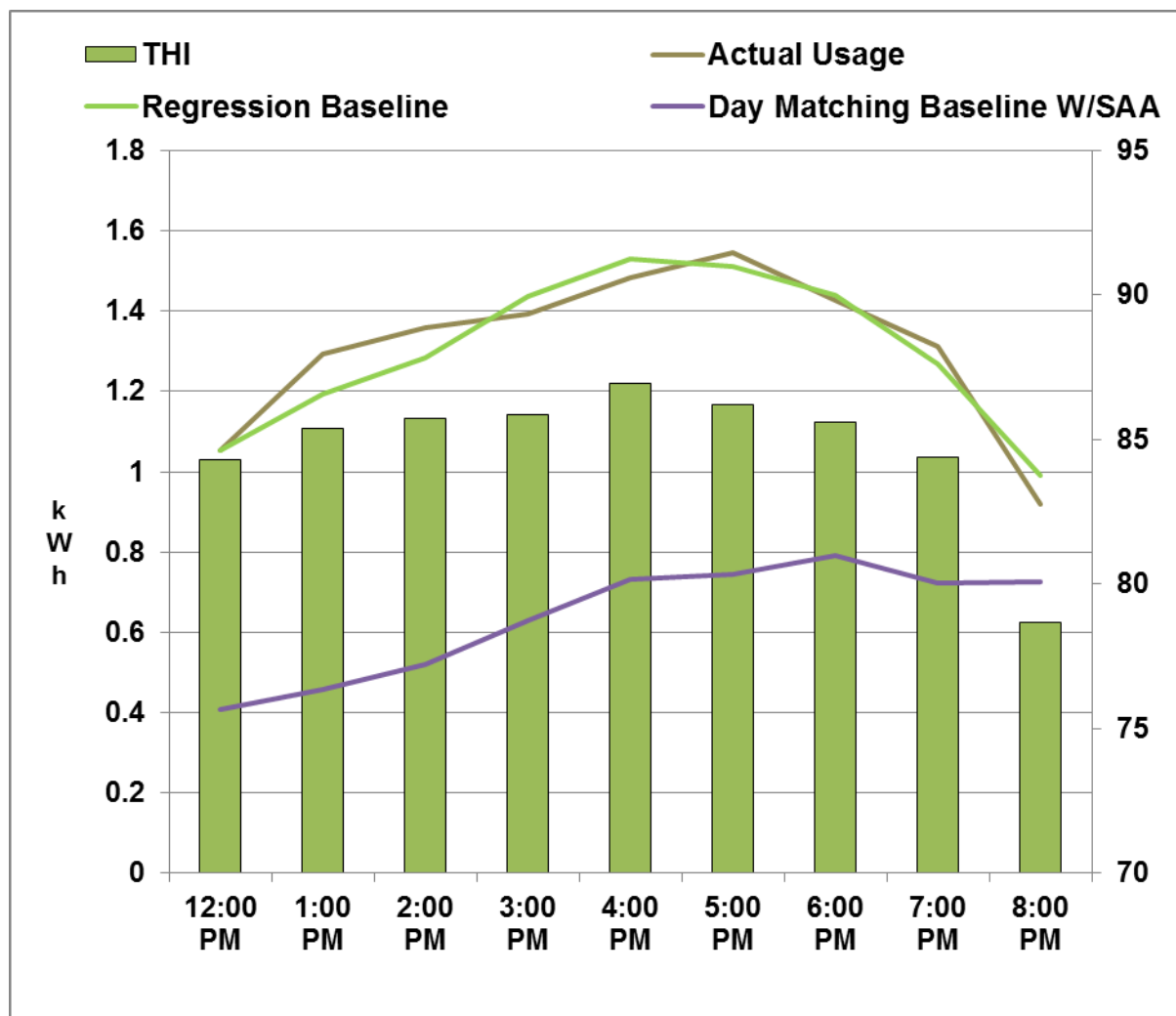
Figure 3-2 OE June 28th Event: Baseline Comparison

Figure 3-3 CEI June 21st Event: Baseline Comparison

The RRMSE values are minimized when using the Auto-Regressive baseline model. As such it will be used to estimate the kW factors for the Companies.

3.5 kW Factors by Company

Using the regression baseline model specified in Section 3.3.2, ADM calculated hourly kW factors for the following event days:

- (1) July 17th, 2 – 4 PM, 50% Cycling
- (2) July 18th, 1 – 5 PM, 50% Cycling
- (3) July 26th, 12 – 4 PM, 70% Cycling
- (4) August 3rd, 1 – 5 PM, 50% Cycling

(5) August 31st, 3 – 5 PM, 70% Cycling

(6) September 6th, 2 – 5 PM, 70% Cycling

The formula for calculating hourly kW factors is as follows:

$$kW \text{ Factor} = \frac{\text{Regression Baseline kWh} - \text{Actual Event kWh}}{\text{Total Devices}}$$

3.6 Snapback Factor

It is commonly observed in the data that after the curtailment ends, AC usage rises to a level higher than observed in the same hour on baseline days. Even after applying the Offset Factor, there is a negative kW factor for these hours following curtailment, a factor referred to as the Snapback Factor.

In determining Snapback Factor, the data for the one or two hours following curtailment were examined for residential and commercial participants depending on the length of the event. Based on analysis of indoor temperature data, ADM concluded that the Snapback Period for residential Device Populations lasts for at least two hours following a two-hour or longer curtailment event, in other words, two hours is the length of time required for indoor temperature to return to the pre-curtailment level.

3.7 kWh Savings

Annual kWh savings for the 2012 DLC Program can be calculated as a function of kW reductions, Snapback, Total Devices, and the number and length of curtailment events. kWh savings for an individual event is calculated as:

$$kWh \text{ Savings} = \sum_{i=1}^M \sum_{j=1}^N kW_{i,j} \times Total \text{ Devices}_{i,j}$$

Where:

i = the event/snapback 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 (3) and DR event hours, respectively. The quantity $kW_{i,j}$ is calculated for every event hour, every snapback hour, and every Company. All events are evaluated with a two-hour snapback period.

3.8 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;
- the customer participation experience;
- and customer satisfaction.

4. Detailed Evaluation Findings

This chapter presents the results of the 2012 DLC Program, including kW factors, Snapback Factors, kWh Savings and process evaluation findings.

4.1 kW Factors and Snapback All Companies

The kW factors were calculated independently by Company as detailed in Chapter 3. Each set of kW factors are reported separately in *Table 4-1*, *Table 4-2*, and *Table 4-3*

Table 4-1 OE Event kW Factors

Date	Event Hour 1	Event Hour 2	Event Hour 3	Event Hour 4	Snapback 1	Snapback 2	Max THI
7/17/2012	0.31	0.48	n/a	n/a	-0.26	-0.30	89.73
7/18/2012	0.39	0.63	0.62	0.63	0.00	-0.24	87.21
7/26/2012	0.32	0.54	0.65	0.81	0.00	0.00	85.75
8/3/2012	0.00	0.30	0.32	0.43	-0.25	-0.20	85.56
8/31/2012	0.29	0.42	n/a	n/a	-0.22	-0.26	85.97
9/6/2012	0.33	0.36	0.26	n/a	-0.17	-0.36	81.66

Table 4-2 CEI Event kW Factors

Date	Event Hour 1	Event Hour 2	Event Hour 3	Event Hour 4	Snapback 1	Snapback2	Max THI
7/17/2012	0.01	0.06	n/a	n/a	-0.09	-0.16	87.16
7/18/2012	0.37	0.51	0.39	0.27	0.00	0.00	80.49
7/26/2012	0.06	0.23	0.19	0.10	-0.09	-0.05	81.47
8/3/2012	0.00	0.00	0.00	0.00	-0.53	-0.44	83.65
8/31/2012	0.00	0.00	n/a	n/a	-0.27	-0.28	82.91
9/6/2012	0.03	0.09	0.26	n/a	0.00	0.00	78.09

Table 4-3 TE Event kW Factors

Date	Event Hour 1	Event Hour 2	Event Hour 3	Event Hour 4	Snapback 1	Snapback 2	Max THI
7/17/2012	0.71	0.82	n/a	n/a	-0.04	0.00	91.41
7/18/2012	0.62	0.54	0.37	0.28	-0.24	-0.18	84.23
7/26/2012	0.33	0.35	0.40	0.37	-0.29	-0.27	82.75
8/3/2012	0.31	0.55	0.60	0.41	-0.06	-0.15	86.90
8/31/2012	0.35	0.95	n/a	n/a	0.00	0.00	86.86
9/6/2012	0.25	0.36	0.28	n/a	-0.23	-0.36	83.54

From an extensive examination of the logger data for CEI, ADM has determined that there must have been a malfunction of the devices in the sample for a number of events because they show no load reduction at all. For future program years a larger sample for each Company would be necessary to determine if this issue is population wide or just endemic to the small number of CEI sites sampled.

In order to capture the impact of the DLC program during event hour, the kW factors for each EDC were aggregated and scaled up by the total number of active DLC devices in the field (16,944) measured as of July 17th, 2012. This value removes accounts that had exited the program as of that date. These results are captured in *Table 4-4*.

Table 4-4 Hourly Load Impact All Companies in MW

Date	Event Hour 1	Event Hour 2	Event Hour 3	Event Hour 4	Snapback 1	Snapback2	Max THI
7/17/2012	4.06	6.20	0.00	0.00	-3.15	-3.93	89.01
7/18/2012	6.80	9.93	8.92	8.19	-0.32	-2.64	84.76
7/26/2012	3.95	7.12	8.12	9.12	-0.90	-0.62	84.10
8/3/2012	0.40	3.74	3.95	4.84	-5.52	-4.65	85.03
8/31/2012	3.34	5.40	0.00	0.00	-3.69	-4.23	85.03
9/6/2012	3.79	4.56	4.48	0.00	-1.96	-4.10	80.63

4.2 MWh Savings

The MWh Savings are calculated as the sum of the kW factors for each Company and every event and snapback hour multiplied by the number of devices in the field. The total program Savings for the 2012 season are 80.74 MWh. The event by event results are listed in Table 4-5 below.

Table 4-5 MWh Savings by Event

Date	kWh CEI	kWh TE	kWh OE	kWh Combined
7/17/2012	0.00	1.97	2.24	4.22
7/18/2012	8.64	1.82	20.42	30.88
7/26/2012	2.47	1.17	23.14	26.78
8/3/2012	0.00	2.19	5.98	8.18
8/31/2012	0.00	1.71	2.22	3.92
9/6/2012	2.15	0.39	4.22	6.76
Total	13.26	9.25	58.23	80.74

4.3 Per Unit kW Factors versus THI

In order to plan for future program years and determine how to improve the program it is important to note what factors may increase or decrease the kW factor during an event. Two main impact variables are time of day and THI. In Table 4-6 ADM presents the average kW factors by Hour and by THI bin, which can be interpreted as the results at a 60% cycling strategy. As expected the kW factors increase as the event stretches later in the day and as the temperature increases (higher THI). As a recommendation for higher kW factors in future program years, ADM suggests targeting later hours in the day when the temperature is highest.

Table 4-6 kW Factors by Hour and Temp Bin at a 60% Cycling Strategy

THI	2PM	3PM	4PM
80	0.45	0.44	n/a
81	0.46	0.45	n/a

82	0.46	0.46	n/a
83	0.46	0.47	0.31
84	0.47	0.47	0.39
85	0.47	0.48	0.47
86	0.47	0.49	0.55
87	0.48	0.50	0.63
88	0.48	0.50	0.71 ²

4.4 PJM Required Coincidence Factor

In order to register the DLC load reduction capacity with PJM for 2013, ADM has calculated the AC Compressor coincidence factor (CF) for 2 – 6PM EDT during the cooling season (June 1st – August 31st). In order to calculate this, the aggregate loadshape of all units in the sample was created at the 2-minute interval granularity level. The maximum value recorded in one of those 2 minute intervals was taken as the average unit's maximum kW draw. The loadshape was then filtered to only include the hours of 2 – 6PM EDT for June, July and August 2012. The average system wide kW during those hours was then divided by the max connected load to determine the CF during each event hour. As an equation:

$$CF = \frac{\text{Average kW (2 – 6PM)}}{\text{Maximum AC Unit kW Draw}}$$

These CFs were then matched up with weighted THI weather data to create a relationship between WTHI and the CF for each Company. Those equations were then projected at 80.6 WTHI as defined by PJM for the Companies. The values by Company are thus:

- (1) TE CF = 0.6362
- (2) CEI CF = 0.6475
- (3) OE CF = 0.6864

² These values were aggregated for OE and TE only because of the issues with event kW reductions in the CEI sample.

Process Evaluation Findings

4.5 Introduction

In-depth interviews with program and implementation staff and online survey results addressed the following researchable issues:

- Problems and concerns associated with implementing the program in 2012.
- Lessons learned implementing the program in 2012.
- How well the Companies' and implementation staff worked together.
- Identifying changes to increase the overall effectiveness of the program.
- Effectiveness of various marketing methods.
- Participant satisfaction with the program.

4.6 Methodology

Tetra Tech, working in conjunction with ADM, conducted in-depth interviews with staff from the Companies and Honeywell. The objective of these interviews was to gather feedback from staff, determine how the program is operating and to collect suggestions for future program improvements. The survey provided 1,136 valid responses, consisting of 1,109 program participants and 27 former participants (non-participants).

Tetra Tech received a file consisting of survey results from ADM³ on March 25, 2013 from a web survey conducted between March 4th and March 15th. The file contained responses of 1,310 survey participants with each response being identified as a "complete" or "partial" record, as detailed in Table 4-7.

Table 4-7 Status of Survey Sample

Status	N	Percentage
Complete	1,136	86.7%
Partial	174	13.3%
Total	1,310	100.0%

All records identified as partially complete were removed from the analysis. Table 4-8 *Completed Surveys by* provides the number of completed surveys for each utility company and information on the number of Easy Cool Rewards program participants and non-participants completing the survey. A customer was considered a non-participant if the customer enrolled in Easy Cool Rewards but no longer participates in the program.

³ File name "2012 OH DLC Survey Gizmo Export.csv" provided by William Holleran.

Table 4-8 Completed Surveys by Company

Company	Participants	Non-participants	Total	Percent of Total
CEI	354	5	359	31.6%
OE	678	18	696	61.3%
TE	73	3	76	6.7%
Not Identified	4	1	5	0.4%
Total	1,109	27	1,136	100.0%

4.7 Detailed Findings⁴

Prior to the Easy Cool Rewards program, the Companies administered a thermostat program in Ohio between 2006 and 2009. After contracting with new implementer, FirstEnergy reached out to legacy customers when restarting the program under the Easy Cool Rewards brand, recognizing the increased likelihood these customers would participant in a new iteration of the program. Overall, estimates of the conversion rate of legacy participants into Easy Cool Rewards participants range between 50 and 70 percent, or between 5,500 and 7,700 individuals. In an effort to reach additional customers, the Companies marketed the program through various channels such as direct mail and utility bill inserts.

4.7.1 Marketing and Outreach Efforts

A majority of 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 door hangers, newspaper or radio advertisements, although these methods were not used to market the program. Table 4-9 provides details on how respondents indicated they *first* heard about the program.

Table 4-9 How First Heard of Program

Response	N	Percentage
Utility bill insert	478	42.1%
Utility direct mailing	320	28.2%

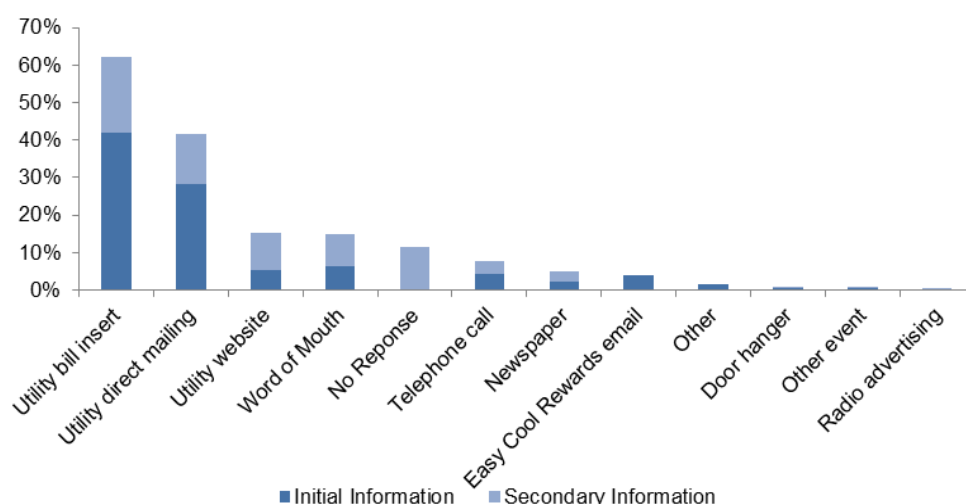
⁴ Survey data was also analyzed at the Company level, but no significant differences were identified.

Word of mouth	71	6.3%
Utility website	61	5.4%
Don't know	55	4.8%
Telephone call	50	4.4%
Easy Cool Rewards email	43	3.8%
Newspaper	25	2.2%
Other	19	1.7%
Door Hanger	6	0.5%
Other event	5	0.4%
Radio advertising	1	0.1%
Total	1,136	100.0%

Importantly, when asked how *e/se* they heard about the program, respondents reported utility bill inserts and direct mailings as their secondary source of information.

Figure 4-1, below, combines respondents' responses to show which methods of marketing and outreach were identified as both a primary and secondary source of information. As displayed in the chart, 62.1 percent of survey respondents recalled learning about the program through a utility bill insert at some point, while 41.5 percent indicated they learned about the program through a utility direct mailing.

Figure 4-1 How Learned About Easy Cool Rewards Program



Based on survey results, participants demonstrated a preference for direct mail from the utility (54.3 percent) and email (42.1 percent) as methods of outreach. Participants mention these methods as their preferred method of receiving information about energy efficiency program like the Easy Cool Rewards program. Other methods include program website, mentioned by 4.5 percent of survey respondents and by telephone call (2.2 percent).

4.7.2 Participant Motivation

The Companies' customers participate in Easy Cool Rewards for various reasons – some have environmental motivations to participate while others simply want to reduce their monthly electric bill. A large number of participating and nonparticipating respondents identified concerns about saving energy in their home as a main reason for

participating in the program, while almost 40 percent indicated the incentive of a professionally installed programmable thermostat enticed them to enroll. Table 4-10 below summarizes respondents' motivations for participating in the program.

Table 4-10 Reasons for Participation in the Easy Cool Rewards Program (n=1,136)

Reason	Responses	Percentage*
Concerns about saving energy in my home	854	75.2%
Opportunity to participate in energy savings program	550	48.4%
To get a new thermostat	446	39.3%
Help avoid power outages	279	24.6%
Concerned about protecting environment	251	22.1%
Reduce need for building new power plants	92	8.1%
Not home when air conditioner is cycled	70	6.2%
Program was recommended to me	40	3.5%
*Respondents can select more than one reason		

4.7.3 Non-Participants

Less than three percent of completed survey respondents identified themselves as non-participants – a segment of the sample that formerly participated in the Easy Cool Rewards program but have since ended their participation. In an effort to gauge why customers chose to leave the program, non-participants rated the ease/difficulty of various aspects of the program, from enrolling in the program to operating their new programmable thermostat. The results indicate that non-participants had difficulty operating the programmable thermostat as well as understanding the program requirements after enrollment. Conversely, nonparticipants identified the enrollment process, including scheduling the installation and interacting with program staff, as relatively straightforward (providing an average rating of 9.1 and 8.7, respectively). Table 4-11 summarizes the results.

Table 4-11 Mean Ratings for Program Aspects (n=26)

Selection	Average	Standard Deviation
Sign up to participate in the program	9.1	1.2
Schedule an appointment to have the device installed	8.7	2.0
Interact with program staff	8.0	2.4
Understand the program requirements	7.3	2.6
Understand how to operate the new thermostat	6.9	2.9

*Using scale of 1 to 10, with 1 being very difficult and 10 being very easy

Table 4-12 Mean Rating of Program Enrollment Aspects

Response	Average*	Standard Deviation	n
Sign up to participate in the program	9.2	1.5	1,096
Schedule the technician in install the Easy Cool Rewards device	9.1	1.6	1,092
Understand the program requirements	8.7	1.8	1,096
Interact with the EDC staff during enrollment	8.5	2.1	1,087
Understand what you can do to reduce your electricity use when energy reduction events are occurring	7.6	2.5	1,086
Understand when and how you will be notified of an energy reduction event	7.3	2.7	1,088
*Using scale of 1 to 10, with 1 being very difficult and 10 being very easy			

The Companies attempt to control any uneasiness customers may have about utilities remotely accessing their air conditioner by allowing individuals to opt-out of one energy reduction event per year. In addition, the Companies also provide information about the program to customers prior to enrollment in an attempt to educate potential participants about the program. Finally, the Companies provide customers with a toll-free number to call with questions about the program. These various aspects of communication are essential to providing customers with easy access to information; survey results show that 22.5 percent of program participants had questions prior to enrolling in the program and 10.8 percent of respondents called the Easy Cool Rewards toll free number with questions about enrollment. Importantly, of the 120 individuals that called the toll-free number, over 92 percent indicated their questions were sufficiently answered.

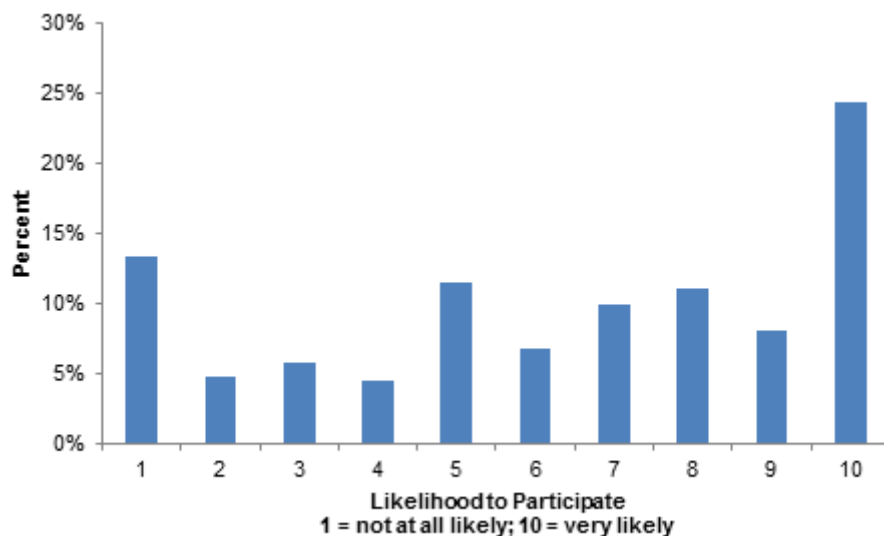
Participants found the information the Companies provided regarding savings events and how to save/reduce energy usage during the savings periods most helpful. Further, respondents noted that materials instructing customers on which telephone number to call with questions or concerns about the program were also helpful. Table 4-13 details how helpful participants found the information sources.

Table 4-13 Information Sources Participant Found Helpful (n=1,109)

	Responses	Percentage*
Savings periods/events	392	35.3%
How to save and/or reduce energy usage during savings periods	379	34.2%
What number to call if there are questions	161	14.5%
Rebate	142	12.8%
How savings are calculated	92	8.3%
How savings period/event notifications will be sent	87	7.8%
Other	77	6.9%
How to opt out of events	60	5.4%
How savings will be communicated	47	4.2%
What to do when a notification is received	45	4.1%
Penalties	21	1.9%
*Respondents can select more than one reason		

The incentive the Companies provided to encourage enrollment had the intended effect, as many participating respondents indicated they would be less likely to enroll in Easy Cool Rewards in the future without an incentive. Figure 4-2 summarizes respondents' likelihood to participate in Easy Cool Rewards in the future in absence of any incentive.

*Figure 4-2 Likelihood of Participating in Easy Cool Rewards without an Incentive
(n=1,011)*



4.7.4 Energy Reduction Events Experience

Survey results indicated participants found it difficult to understand when the Companies were calling an energy reduction event. During 2012, the Companies called six energy reduction events; however, no participants recalled experiencing six events during summer. Most participants (84.4 percent) could not recall the number of events the Companies called during summer, while 13.9 percent of participants believe no energy reduction events occurred, as detailed in Table 4-14. With most energy reduction events occurring during weekdays between noon and early evening hours, it could be many customers were not home and aware that events were occurring.

Table 4-14 Number of Energy Reduction Events Recall the Companies Issuing this Past Summer

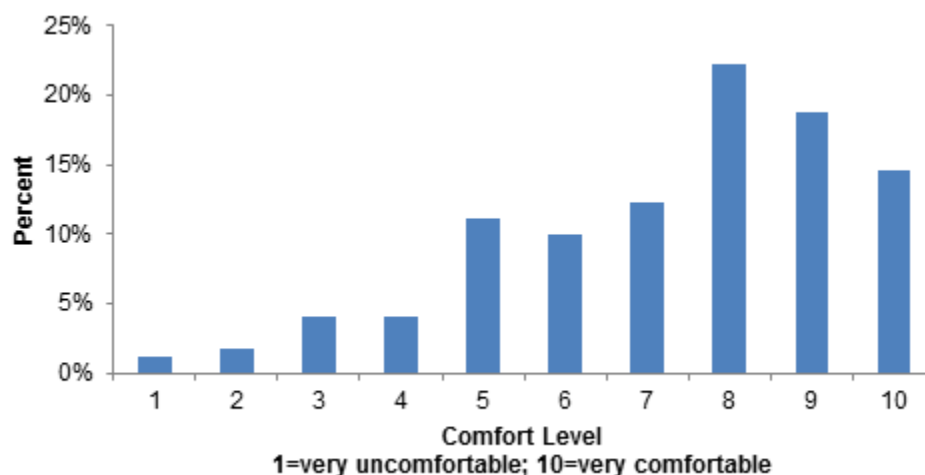
Number of Events	N	Percent.
Don't know	858	84.4%
Never	141	13.9%
1	2	0.2%
2	4	0.4%
3	2	0.2%
4	1	0.1%
5	1	0.1%
6	0	0.0%
7	1	0.1%
8	0	0.0%
9	0	0.0%
10	4	0.4%
15	1	0.1%
60	1	0.1%
Total	1,016	100.0%

Respondents indicating they recalled the Companies issuing an energy reduction event received an additional question asking what specific factor, in their experience, signaled that an event was occurring. The top responses from participants were the fact they did not hear the air conditioner run as often (29.4 percent) or saw the temperature had increased on the thermostat (23.7 percent). Table 10 provides statistics on the responses.

Table 4-15 Reason Knew the Companies were Running Event

Response	N	Percentage
I didn't hear the air conditioner run as often	52	29.4%
I looked at the thermostat and saw that the temperature had been increased	42	23.7%
The house got uncomfortably warm	33	18.6%
I received a notification via my thermostat	29	16.4%
Did not notice	16	9.0%
Slight rise in temperature	3	1.7%
Other	2	1.1%

Overall, a majority of program participants indicated their household maintained high levels of comfort during reduction events. Using a scale of 1 to 10, with 1 being very uncomfortable and 10 being very comfortable, over half of all participants rated their comfort level at 8 or higher. Figure 4-3 provides the full distribution of ratings.

Figure 4-3 Comfort Level in Home During Events (n=171)

Most energy reduction events occur during weekdays between noon and early evening hours, when many customers are not home. Some participants may choose to enroll with full knowledge they will never personally experience an energy reduction event due to their work schedule or other commitments. Table 4-16 provides a cross tabulation of the number people living in customers' homes during summer 2012 and the number of people present in the home (on average) during energy reduction events. Almost 20 percent of households indicated that no one was home during reductions, while 61.8

percent of respondents indicated that their entire household was never present during energy reduction events.

Table 4-16 Household Experiences with Energy Reduction Events

	Number people home during energy reduction events (on average)												
		0	1	2	3	4	5	6	7	8	9	10	Total
Number of people living in home during 2012	1	54	115	-	-	-	-	-	-	-	-	-	169
	2	83	155	220	-	-	-	-	-	-	-	-	458
	3	27	45	47	29	-	-	-	-	-	-	-	148
	4	21	22	64	56	28	-	-	-	-	-	-	191
	5	1	8	9	17	17	10	-	-	-	-	-	62
	6	4	1	2	3	11	8	4	-	-	-	-	33
	7	2	-	1	-	1	2	2	-	-	-	-	8
	8	-	-	-	-	-	-	-	-	1	-	-	1
	9	-	-	-	-	-	-	-	-	-	-	-	0
	10	-	-	-	-	-	-	-	-	-	-	1	1
	Total	192	346	343	105	57	20	6	0	1	0	1	1,071

4.7.5 Program Satisfaction

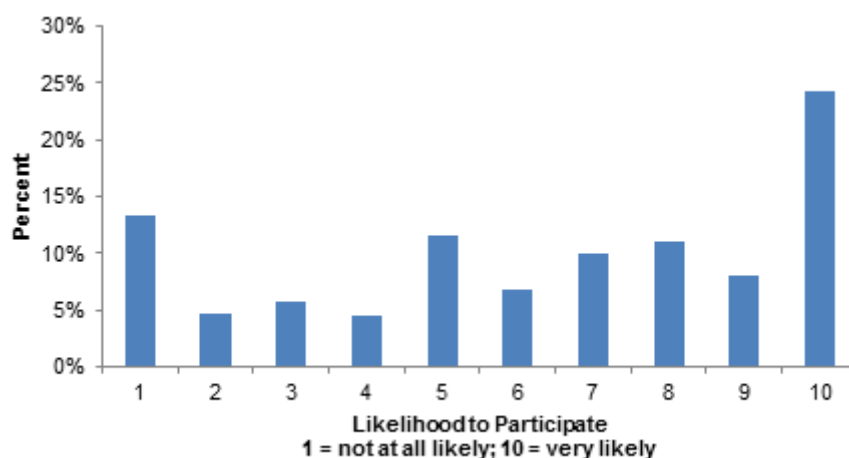
Program participants expressed very high levels of satisfaction with all aspects of the Companies' Easy Cool Rewards program. On a scale of 1 to 5, with 1 being very dissatisfied and 5 being very satisfied, respondents rated all aspects of program at 4.1 or greater, as shown in the table below.

Table 4-17 Mean Program Satisfaction Ratings

Aspect	Average*	Standard Deviation	n
Service professional who installed the Easy Cool Rewards device	4.6	0.9	1,098
Enrollment process	4.6	0.8	1,096
Receipt and installation of a new thermostat as compensation for your participation in the program	4.6	0.9	1,089
Overall experience during energy reduction events	4.3	1.1	1,082
Program information provided	4.2	1.1	1,093
Overall experience with the program	4.1	1.0	1,091
*on a 1 to 5 scale where 1 is very dissatisfied and 5 is very satisfied			

Another metric for estimating customer satisfaction is gauging the likelihood of participants participating in the program in subsequent years. Figure 4-4 Likelihood of Participating in Easy Cool Rewards Next Year (n=1,011) Figure 4-4 provides survey results supporting the assertion that, overall, participants are satisfied with the program and will likely continue to participate in future years.

Figure 4-4 Likelihood of Participating in Easy Cool Rewards Next Year (n=1,011)



4.8 Key Findings

Direct mailings are the most effective method of marketing the program to potential participants. Survey results confirm one respondent's intuition that *"the main driver for participation in this program is direct mail."* Another interviewee noted that, of the various advertising options, *"direct mail is the most cost effective; at the lowest cost you can hit the highest amount of customers."* Over 70 percent of respondents indicated they first learned of the Easy Cool Rewards program through either a utility bill insert (42.1 percent) or a utility direct mailing (28.2 percent). While overall, 62.1 percent of respondents recalled hearing about the program through a utility bill insert.

Customers prefer to receive information about this and other energy efficiency programs via direct mail or email. Over half of all respondents indicated they prefer receiving information about programs similar to Easy Cool Rewards via direct mail or email from the Companies. Conversely, very few respondents want to receive telephone calls about the Companies' energy efficiency programs.

The established methods of communication between the Companies' staff and Honeywell staff are working well. The Companies' staff noted that Honeywell's implementation team *"is on top of every situation that has come up and we are confident in the information they report...every data need or marketing need or customer issue I have had has been handled quickly and accurately and well."* A staff member at Honeywell had similar thoughts, stating, *"We had an excellent working relationship and we always want to be responsive to the Companies."* Staff members at both the Companies and Honeywell indicated that during particularly hot periods in the summer, morning phone calls between the two firms would take place on a daily basis to discuss the likelihood of an energy reduction event occurring. At a minimum, weekly phone calls between program managers at the two companies occurred throughout the life of the 2012 program.

Timelines for internal reporting are well established and routinely met. The Companies' staff report receiving a standard weekly status report and agenda from Honeywell throughout the 2012 program year. Each firm's program managers subsequently discussed the reports during weekly telephone calls. During months when the program is not active, program managers typically hold bi-weekly phone calls to discuss any issues with the program. Additionally, after completed energy reduction events, Honeywell provides the Companies with a report detailing the number of participants in the event, the number of customers that chose to opt out of the event and at what time they chose to opt out. All of these reports provide the Companies with necessary information to evaluate the results of their energy reduction events in a timely manner.

Participants would like to receive direct feedback from the Companies, preferably via direct mail or email, about their home's performance during an energy reduction event. Currently, customers can use the Home Energy Analyzer to analyze their home's performance after reduction events. Respondents indicated a preference for receiving feedback information from the Companies via email (48.7 percent) or direct mail (18.4 percent).

Current quality assurance and quality control practices are resulting in high levels of customer satisfaction with the installation process. One respondent noted, *"We want to make sure our customers are served well"* as part of that effort, the respondent indicated they did *"very close monitoring of QA as well as turn-downs and skips by installer."* Individual installers had a minimum of five percent of their installations inspected by managers as well as an additional one percent inspected by Honeywell managers. In addition to these quality controls, Honeywell sends surveys to customers to gauge their satisfaction with the installation process. Having sent approximately 3,400 surveys, the average rating from Honeywell surveys for the installation process is 9.1 out of 10, and a respondent noted that, *"In terms of field service, the highest satisfaction rates were on courtesy and professionalism, willingness to help, preparedness, length of time for install, quality and the condition in which the site was left."* Survey data provided by ADM supports Honeywell's findings, as a vast majority of survey respondents (81.3 percent) expressed they were "very satisfied" with the service professional that installed their programmable thermostat.

Program participants expressed very high levels of satisfaction with all aspects of the Companies' Easy Cool Rewards program. Participant satisfaction with the overall experience with the program was high (an average of 4.1 on a scale of 1 to 5, with 1 being very dissatisfied and 5 being very satisfied). Other program aspects such as the enrollment process, receipt and installation of the programmable thermostat as compensation for participation and the service professional who installed the Easy Cool Rewards device score equally high (mean score of 4.6),

Customers are extremely satisfied with the service they receive when calling the toll-free number. Over half of all respondents (52.1 percent) indicated they were aware that the Companies maintained a toll-free number for the Easy Cool Rewards program. More importantly, individuals reported very high levels of satisfaction when calling the

toll free number, with 92.5 percent indicating their questions about enrollment were sufficiently answered and 81.0 percent saying they received sufficient answers to their questions about energy reduction events.

Participants found it difficult to understand when the Companies were calling an energy reduction event. During 2012, the Companies called six energy reduction events; however, no participants recalled experiencing six events during summer. Most respondents (84.4 percent) could not recall the number of events the Companies called during summer, while 13.9 percent of participants believe no energy reduction events occurred.

The energy efficiency information provided on the Companies website is useful to customers. The usefulness of the energy efficiency information provided on FirstEnergy's website received a rating of 8.2 (on a 1 to 10 scale with 1 being not at all useful and 10 being very useful) from customers, indicating the high value of the information provided on the website. However, only 29.1 percent of program participants have been to the site to review the energy savings tips.

Non-participants had difficulty understanding how to operate their new programmable thermostat as well as understanding the program requirements. Non-participants rated the ease/difficulty of understanding how to operate their new programmable thermostat an average score of 6.9 (on scale of 1 to 10, with 1 being very difficult and 10 being very easy). Further, non-participants rated their experience understanding the program requirements an average of 7.3 (on the same 1 to 10 scale). The remaining aspects, including signing up to participate in the program, scheduling an appointment to have the Easy Cool Rewards device installed, and interacting with program staff, all received average scores of at least 8.0.

5. Conclusions and Recommendations

5.1 Conclusions from the Impact Evaluation

A total of 16,944 customers had their AC usage curtailed during the summer of 2012 through the Direct Load Control Program implemented in the service territories of the Companies. The number of participants from each service territory was as follows:

- CEI 5,630
- Ohio Edison 9,995
- Toledo Edison 1,319

The overall evaluation results for estimated gross energy savings and peak demand reductions for the program in the Companies' service territories are summarized in Table 5-1.

Table 5-1 Overall Evaluation Results for Gross kWh and kW Savings

Utility	Ex Ante Expected Pro-Rata Savings		Ex Post Pro Rata Savings		kW Realization Rate
	kWh	kW	kWh	kW	
Ohio Edison	61,981	7,299	58,225	4,755	65%
Illuminating Company	34,900	4,075	9,254	1,501	37%
Toledo Edison	8,135	958	13,257	655	68%
Total Program	105,016	12,332	80,736	6,912	56%

The gross kWh savings totals shown in Table 5-1 give a realization rate for kWh savings of about 77 percent, as determined by the ratio of verified gross kWh savings to expected gross kWh savings. The realization rate for kW reductions was about 56 percent.

5.2 Conclusions from the Process Evaluation

The Companies effectively marketed the Easy Cool Rewards program to consumers leading up to the program's start in summer 2012, taking advantage of a legacy thermostat program the company administered between 2006 and 2009. The program appears to be running well – residential customers expressed their satisfaction with the overall program and high numbers indicated they plan to participate in the program in 2013. From an operational standpoint, implementation and program staff have created effective lines of communication and report excellent working relationships between all parties.

5.3 Recommendations

Overall, the program appears to be progressing 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 and customers reporting high satisfaction with the program. However, several recommendations are provided for consideration.

Provide program participants with their individual performance statistics after energy reduction events via email. Currently, participants can access the Home Energy Analyzer to determine their energy reduction after an event; although almost half of program participants surveyed (48.7 percent) indicated email as their preferred method of receiving information about their performance during energy reduction events. Providing results via email could improve customer understanding of the program while also detailing participant savings.

Consider offering referral bonuses to existing participants to increase enrollment. Just over five percent of program participants indicated they first heard about the Easy Cool Rewards program through word of mouth. Offering existing customers a referral bonus – would encourage participants to promote the program to groups of people that have established trust in their judgment, such as friends and relatives. Leveraging the trust existing participants have built with friends and family while simultaneously incenting participants to promote the program could lead to increased levels of enrollment in future iterations of Easy Cool Rewards.

Provide newly enrolled customers with more training or additional information on how to operate the programmable thermostat. Operating the newly installed thermostat was the single aspect of the program non-participants found most difficult. Providing additional training or instructions, both online and through information brochures, may decrease the number of participants deciding to drop out of the program.

Appendix A: Required Savings Tables

Tables showing participation counts and savings for the Direct Load Control Program were provided various locations throughout this report. This appendix provides additional tables summarizing savings results.

- Table A-1 reports the annual Ex Post MWh savings by utility.
- Table A-2 reports the average annual Ex Post on-peak kW reductions by utility.
- Table A-3 reports the first-year pro-rata Ex Post MWh savings by utility.
- Table A-4 reports the lifetime Ex Post MWh savings by utility.

Table A-1. Annual Ex Post Energy Savings (MWh)

<i>CEI</i>	<i>OE</i>	<i>TE</i>	<i>All Companies</i>
13.26	58.23	9.25	80.74

Table A-2. Annual Ex Post On-Peak Demand Reductions (MW)

<i>CEI</i>	<i>OE</i>	<i>TE</i>	<i>All Companies</i>
1.50	4.76	0.66	6.91

Table A-3. First-Year Pro-Rata (2012) Ex Post Energy Savings (MWh)

<i>CEI</i>	<i>OE</i>	<i>TE</i>	<i>All Companies</i>
13.26	58.23	9.25	80.74

Table A-4. Lifetime Ex Post Energy Savings (MWh)

<i>CEI</i>	<i>OE</i>	<i>TE</i>	<i>All Companies</i>
13.26	58.23	9.25	80.74

Appendix B: Survey Instrument

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

CaseID Unique identification number

Operating Company

- 1 OE (Ohio Edison)
- 2 CEI (Cleveland Electric Illuminating)
- 3 TE (Toledo Edison)

Type

- 1 Participant
- 2 Drop out
- 3 Participant – did not complete survey last year
- 4 New Participant (enrolled for 2011, not 2010)

Address

Phone

Signup date

Notification method

NOTE: All questions will have a “don’t know” and “refused” response option. These are not read to the respondent.

Participant Introduction

Intro Hello, my name is [interviewer name], and I am calling on behalf of [**OPERATING COMPANY**]. May I speak with [name]?

- 1 Yes [CONTINUE]
- 2 No [SCHEDULE CALLBACK AND/OR ATTEMPT TO CONVERT]

Intro2 I'm with Tetra Tech, an independent research firm. We have been hired to assist **[OPERATING COMPANY]** 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 should have received a postcard a couple of days ago explaining the purpose of this call. 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 **[OPERATING COMPANY]**. 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.

Intro3 The Easy Cool Rewards (Thermostat) program helps **[OPERATING COMPANY]** to save energy during peak demand periods. As a part of this program, your central air conditioning system is remotely controlled by **[OPERATING COMPANY]** by increasing the temperature setting to reduce energy usage when **[OPERATING COMPANY]** predicts that electricity demand will be high.

Do you recall enrolling for this program?

- 1 Yes [SKIP to Intro6]
- 2 No

Intro4 Is there someone else in the household who may be more familiar with the program?

- 1 Yes [Ask to speak to them and SKIP to Intro1]
- 2 No [Thank and terminate]

Intro5 May I speak to that person?

- 1 Yes [SKIP TO Intro2]
- 2 No [Thank and terminate]

Intro 6 **[Why are you conducting this study]:** Studies like this help **[OPERATING COMPANY]** better understand households' satisfaction with and need for energy savings programs.]

[Timing]: This survey should take approximately 15 minutes of your time. Is this a good time for us to speak with you? IF NOT, SET UP CALLBACK APPOINTMENT OR OFFER TO LET THEM CALL US BACK AT 1-800-454-5070].

[Sales concern response if asked if selling something]: I am not selling anything. We would simply like to learn about your experience with the Easy Cool Rewards (Thermostat) program. This information will help **[OPERATING COMPANY]** best design and deliver energy efficiency programs to assist residential customers. Your responses will be kept confidential by our firm.

[Utility contact]: If you would like to talk with someone about this study, feel free to call **[OPERATING COMPANY]** at **[PROGRAM CONTACT AND PHONE NUMBER]**.

Intro8 Are you an employee of **[OPERATING COMPANY]** or FirstEnergy?

- 1 Yes THANK YOU AND TERMINATE
- 2 No
- D Don't know
- R Refused

I would like to first ask you some questions about how you heard about the Easy Cool Rewards (Thermostat) program and why you decided to participate.

S1 How did you FIRST learn about the Easy Cool Rewards (Thermostat) program offered by **[OPERATING COMPANY]**?
[DO NOT READ; RECORD ONLY ONE RESPONSE]

- 1 Utility bill insert
- 2 Utility direct mailing
- 3 Telephone call from **[OPERATING COMPANY]** telemarketer
- 4 Utility website
- 5 Radio Advertising
- 6 Newspaper
- 7 Door hanger
- 8 Word of mouth: Friend/Relative/Neighbor/Co-worker
- 9 Other event [home and garden show, earth day]
- 10 Other [SPECIFY: PROBE for utility or other source]
- 11 Easy Cool Rewards email
- D Don't know [SKIP TO S3]
- R Refused [SKIP TO S3]

S2 How else did you hear about the program?
[DO NOT READ; RECORD ALL THAT ARE MENTIONED]

- 1 Utility bill insert
- 2 Utility direct mailing
- 3 Telephone call from **[OPERATING COMPANY]** telemarketer
- 4 Utility website
- 5 Radio Advertising
- 6 Newspaper
- 7 Door hanger
- 8 Word of mouth: Friend/Relative/Neighbor/Co-worker
- 9 Other event [home and garden show, earth day]
- 10 Other [SPECIFY: PROBE for utility or other source]
- D Don't know
- R Refused

S3 How would you prefer to receive information from **[OPERATING COMPANY]** 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 **[OPERATING COMPANY]**
- 3 Program website
- 4 Email from **[OPERATING COMPANY]**
- 5 Other [SPECIFY: PROBE for utility or other source]

D Don't know
R Refused

S4 For what reason or reasons did you decide to participate in the Easy Cool Rewards (Thermostat) program?

[IF R SAYS, SOUNDED LIKE A GOOD PROGRAM, PROBE FOR MORE SPECIFIC ANSWER] [DO NOT READ; RECORD 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 **[OPERATING COMPANY]**
- 5 Reduce need for building new power plants
- 6 Help **[OPERATING COMPANY]** 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
- 9 Other [SPECIFY]
- D Don't know
- R Refused

S5 [IF MORE THAN ONE RESPONSE GIVEN FOR S4] Of all the things that interested you about the program [READ BACK LIST], what was the most compelling reason you decided to enroll in the program?

[RECORD VERBATIM]

D Don't know
R Refused

S6 Did you have concerns about participating in the Easy Cool Rewards (Thermostat) program?

- 1 Yes
- 2 No [SKIP TO P1 for TYPE = 1; SKIP TO D01 for TYPE = 2]
- D Don't know [SKIP TO P1 for TYPE = 1; SKIP TO D01 for TYPE = 2]
- R Refused [SKIP TO P1 for TYPE = 1; SKIP TO D01 for TYPE = 2]

S7 What concerns did you have? [DO NOT READ; RECORD 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
- 4 Other [SPECIFY]
- D Don't know
- R Refused

Drop Outs Only (Type = 2)

DO1 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...

[FOR DO1A-G]

— [RECORD 1-10]

[6] NOT APPLICABLE

D Don't know

R 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

DO2 [Ask of each DO1A-E = 1, 2, 3 or 4] What could the program have done differently to make it easier for you to [INSERT A-E WORDING]?

[RECORD VERBATIM]

D Don't know

R Refused

DO3 I understand that your household decided not to participate and dropped out of the program. Can you tell me why that is? [DO NOT READ; INDICATE ALL THAT APPLY. PROBE: Any other reason?]

1 The temperature increase was/would be uncomfortable 1

2 Didn't want **[OPERATING COMPANY]** 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 Other [SPECIFY]

D Don't know

R Refused

DO4 What could the program have done differently to encourage you to remain in the program? [DO NOT READ; INDICATE ALL THAT APPLY. PROBE: Any other reason?]

1 Nothing they could have done

2 Better explained the program

3 Increase the amount of the incentive/payment for participating [SPECIFY AMOUNT]

4 Shorter event lengths

- 5 Fewer event days
- 6 Reduced the amount by which the temperature was increased
- 7 Other [SPECIFY]
- D Don't know
- R Refused

DO5 [IF MORE THAN ONE RESPONSE GIVEN FOR DO2] Of all the reasons you mentioned for deciding not to participate in the program, which reason was the most important?

[RECORD VERBATIM]

- D Don't know
- R Refused

DO6 Now I would like to understand how your experience with Easy Cool Rewards (Thermostat) program has affected your satisfaction with **[OPERATING COMPANY]** 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

DO7 Will you please tell me why you responded [RESPONSE FROM DO6]?

[RECORD VERBATIM]

- D Don't know
- R Refused

THANK DROP-OUT RESPONDENT AND TERMINATE

Participant Enrollment (Type = 1)

P1 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]

[FOR P1A-P1G]

— [RECORD 1-10]

[6] NOT APPLICABLE

- A Understand the program requirements
- B Sign up to participate in the program
- C Schedule the technician to install the Easy Cool Rewards device
- 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 **[OPERATING COMPANY]** staff during enrollment

P2 [ASK OF EACH P1A-F = 1 or 2] What can the program do differently to make it easier for you to [INSERT A-F WORDING]?

[RECORD VERBATIM]

P3 Have you called the Easy Cool Rewards (Thermostat) toll free number with any questions about enrollment?

3 Yes

4 No [SKIP TO P5]

D Don't know [SKIP TO P5]

R Refused [SKIP TO P5]

P4 Were your questions sufficiently answered?

1 Yes [SKIP to P6]

2 No [FOLLOW UP: What was not answered? RECORD VERBATIM and SKIP to P6]

D Don't know [SKIP TO P6]

R Refused [SKIP TO P6]

P5 Were you aware that there is a toll free number you can call with questions about the program?

1 Yes

2 No

D Don't know

R Refused

P6 Did you have any initial questions about participating in the program?

1 Yes

2 No [SKIP TO P8]

D Don't know [SKIP TO P8]

R Refused [SKIP TO P8]

P7 What questions or concerns did you have? [DO NOT READ; INDICATE ALL THAT APPLY. PROBE: Any other reason?]

1 Don'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 Didn't like the number of days a year when energy reduction events would occur

5 Problems with installation of Easy Cool Rewards device [SPECIFY]

6 Other [SPECIFY]

D Don't know

R Refused

P8 Can you tell me in your own words your understanding of what occurs during an energy reduction event?

[RECORD VERBATIM]

- P9 If respondent has no idea or vague idea of what an energy reduction event is] An “energy reduction event” is a period of time when **[OPERATING COMPANY]** predicts that total electricity demand will be very high. [if respondent has a good idea of what a “reduction event” is] Yes, that is correct.
- P10 What information did you find helpful? [DO NOT READ; INDICATE ALL THAT APPLY] [AFTER EACH RESPONSE, ASK “IS THERE ANYTHING ELSE?” UNTIL R SAYS “NO”]
- 1 Information about savings periods/events
 - 2 Information about rebate
 - 3 Information about how to save and/or reduce energy usage during savings p[eriods
 - 4 Information about how savings period/event notifications will be sent
 - 5 Information about what to do when a 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
 - 11 Other (SPECIFY_____)
 - D Don't know
 - R Refused

Energy Reduction Event Experience

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

- E1 How many energy reduction events do you think **[OPERATING COMPANY]** issued this past summer? [energy reduction events can be called June through September from 12:00 PM – 4:00 PM, Monday through Friday [excluding holidays].

___ Number of days

- 0 Never [SKIP to E8]
- D Don't know
- R Refused

- E2 Were you at home during any of the energy reduction events?

- 1 Yes
- 2 No [SKIP to E8]
- D Don't know [SKIP to E8]
- R Refused [SKIP to E8]

- E3 How could you tell that **[OPERATING COMPANY]** AC was cycling during an event?

- 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 **[OPERATING COMPANY]** to see if they had adjusted the temperature
- 5 I received a notification via my thermostat
- 6 Other [SPECIFY]
- D Don't know [SKIP to E10]
- R Refused [SKIP to E10]

E4 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?

- [RECORD 1-10]
- D Don't Know
- R Refused

E5 Were you aware that energy reduction events had occurred when you were not at home?

- 1 Yes
- 2 No [SKIP TO E10]
- D Don't know [SKIP TO E10]
- R Refused [SKIP TO E10]

E6 How did you know that energy reduction events had occurred when you were not at home during the event?

- 1 The house was uncomfortably warm when I returned home
- 2 The air conditioning ran more than usual
- 3 I called **[OPERATING COMPANY]** to see if they had adjusted the temperature
- 4 I received a notification via my thermostat
- 5 Other [SPECIFY]
- D Don't know
- R Refused

E7 [SKIP TO E14 IF E3 = 4] Have you called the Easy Cool Rewards (Thermostat) toll free number with any questions about energy reduction events?

- 1 Yes
- 2 No [SKIP TO E15]
- D Don't know [SKIP TO E15]
- R Refused [SKIP TO E15]

E8 Were your questions sufficiently answered?

- 1 Yes [SKIP to E15]
- 2 No [FOLLOW UP: What was not answered? RECORD VERBATIM] [SKIP to E15]
- D Don't know [SKIP to E15]
- R Refused [SKIP to E15]

E9 You mentioned in a previous question that you had called **[OPERATING COMPANY]** to ask if an energy reduction event had occurred. Were your questions sufficiently answered?

- 1 Yes
 2 No [FOLLOW UP: What was not answered? RECORD VERBATIM]
 D Don't know
 R Refused

E10 On a scale of 1 to 5, where:

- Very dissatisfied 01
 Somewhat dissatisfied 02
 Neither satisfied nor dissatisfied 03
 Somewhat satisfied 04
 Very satisfied 05

how unsatisfied or satisfied are you with...?

[FOR E14A-E14F]

— [RECORD 1-5]

D Don't know [SKIP TO NEXT E10 SUBSECTION, OR IF AT END SKIP TO E17]

R Refused [SKIP TO NEXT E10 SUBSECTION, OR IF AT END SKIP TO E17]

A The enrollment process?

B The program information 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?

E11 [ASK OF EACH E14A-E = 1, 2, 3, or 4] What can the program do differently to make you more satisfied with [INSERT A-f WORDING]?

[RECORD VERBATIM]

E12 On a scale of 1 to 10, where 1 is not at all likely and 10 is very likely, how likely or unlikely are you to participate in a Easy Cool Rewards (Thermostat) program in the future?

— [RECORD 1-10]

D Don't know

R Refused

E13 [ASK OF EACH E1A-B = 1, 2, 4, or 4] What can the program do differently to make you more likely to participate in the future?

[RECORD VERBATIM]

D Don't know

R Refused

E14 On a scale of 1 to 10, where 1 is not at all likely and 10 is very likely, how likely or unlikely are you to participate in a Easy Cool Rewards program (Thermostat) in the future if **[OPERATING COMPANY]** did not offer an incentive (i.e. a free thermostat) to participate?

- [RECORD 1-10]
D Don't know
R Refused

E15 What effect, if any, has the program had on how you will use energy in the future?

[RECORD VERBATIM]

- D Don't know [PROBE, "Is there anything you will continue to do to reduce your energy usage as a result of participating in the Easy Cool Rewards program?"]
R Refused

E16 Now I would like to understand how your experience with Easy Cool Rewards (Thermostat) program has affected your satisfaction with **[OPERATING COMPANY]** as your utility. Did it...? [READ LIST]

- 1 Greatly improve your satisfaction with [OPERATING COMPANY]
- 2 Somewhat improve your satisfaction with [OPERATING COMPANY]
- 3 Make no difference in your satisfaction with [OPERATING COMPANY]
- 4 Somewhat decrease your satisfaction with [OPERATING COMPANY]
- 5 Greatly decrease your satisfaction with [OPERATING COMPANY]

E17 Will you please tell me why you responded [RESPONSE FROM E21]?

[RECORD VERBATIM]

- D Don't know
R Refused

FirstEnergy Questions

FEINTRO 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 **[OPERATING COMPANY]**.

[PRESS ONE TO CONTINUE]

FE1 Do you have internet access?

- 1 Yes
2 No [SKIP to HINTRO]
D Don't know [SKIP to HINTRO]

R Refused [SKIP to HINTRO]

FE2 Have you ever visited **[OPERATING COMPANY]** or FirstEnergy website?

1 Yes
2 No [SKIP TO HINTRO]
D Don't know [SKIP TO HINTRO]
R Refused [SKIP TO HINTRO]

FE3 Have you ever used the **[OPERATING COMPANY]** or FirstEnergy Home Energy Analyzer to assess your home energy usage?

1 Yes
2 No
D Don't know
R Refused

FE4 Are there other methods that **[OPERATING COMPANY]** should consider using to provide feedback information about your performance during energy reduction events? [DO NOT READ; RECORD ALL THAT APPLY]

1 Text Message
2 Email
3 Cell Phone Call
4 Home Phone Call
5 Mail
6 In Home Display
7 Other [Specify]
D Don't know
R Refused

FE5 (FE2=1) Have you been to the **[OPERATING COMPANY]** website to review the energy savings tips they provide online?

1 Yes
2 No [SKIP TO HINTRO]
3 Don't know [SKIP TO HINTRO]
4 Refused [SKIP TO HINTRO]

FE6 Please rate the usefulness of the energy efficiency information provided on website using a scale of 1 to 10, where 1 is "not at all useful" and 10 is "very useful".

— [RECORD 1-10]
D Don't know [SKIP TO WINTRO]
R Refused [SKIP TO WINTRO]

FE7 What types of additional information would you like on the website?

[OPEN END]

Home Characteristics

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

[PRESS ONE TO CONTINUE]

H1 [IF H1=1] How many plasma TV's do you have?

___ [RECORD NUMBER]
88 Don't know
99 Refused

H2 [IF H1=2] How many LCD/LED TV's do you have?

___ [RECORD NUMBER]
88 Don't know
99 Refused

H3 [IF H1=3] How many conventional (tube-based) TV's do you have?

___ [RECORD NUMBER]
88 Don't know
99 Refused

H4 [IF H1=4] How many projection TV's do you have?

___ [RECORD NUMBER]
88 Don't know
99 Refused

H5 [IF H1=5] How many other TV's do you have?

___ [RECORD NUMBER]
88 Don't know
99 Refused

H6 What type of stove do you have?

1 Natural Gas
2 Electric
3 Propane
4 Other
D Don't know
R Refused

H7 What type of water heater do you have?

1 Natural Gas

- 2 Electric
- 3 Propane
- 4 Other
- D Don't know
- R Refused

H8 What type of clothes dryer do you have?

- 1 Natural Gas
- 2 Electric
- 3 Propane
- 4 Other
- D Don't know
- R Refused

H9 Which of the following best describes your home/residence?

- 01. Single-family home, detached construction **[NOT A DUPLEX, TOWNHOME, OR APARTMENT; ATTACHED GARAGE IS OK]**
- 02. Single family home, factory manufactured/modular
- 03. Single family, mobile home
- 04. Row House
- 05. Two or Three family attached residence—traditional structure
- 06. Apartment (4 + families)---traditional structure
- 07. Condominium---traditional structure
- 08. Other: **[Specify]** _____
- 98. Don't know
- 99. Refused

H10 Do you own or rent this residence?

- 1. Own
- 2. Rent
- 98. Don't know
- 99. Refused

H11 Approximately when was your home constructed? **[DO NOT READ]**

- 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

H12 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

H13 [IF Q41=98,99] 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

H14 How many square feet of conditioned living space is below- ground (IF NECESSARY, THIS INCLUDES WALK-OUT BASEMENTS)?

- 1. Numerical open end [Range 0-99,999]_____
- 98. Don't know
- 99. Refused

H15 [IF 43=98,99] 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

H16 What kind of air conditioning does your home have? [SELECT ALL THAT APPLY]

- 1 Central Air Conditioning
- 2 Heat Pump
- 3 Window A/C [probe for number of window A/C units and record]
- 4 None
- D Don't know
- R Refused

H17 How many window A/C units does your home have?

____ [RECORD NUMBER]
88 Don't know
99 Refused

Household Characteristics

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

[PRESS ONE TO CONTINUE]

D1 How many years have you lived at your current address? [DO NOT READ]

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
D Don't know
R Refused

D2 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
D Don't know
R Refused

D3 How many people were living in your home during the summer of 2012?

____ Number of people
D Don't know
R Refused

D4 [Skip if D3=0] On average, how many of these people were home during week during the hours of [Savings period] during the summer?

____ Number of people
D Don't know
R Refused

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

Do you have any comments?

- 1 Yes [RECORD VERBATIM]
- 2 No

DEM9 [INTERVIEWER: DO NOT READ.]

Respondent gender:

- 1 Female
- 2 Male