BEFORE

THE PUBLIC UTILITIES COMMISSION OF OHIO

In the Matter of the Annual Energy	)	
Efficiency Portfolio Status Report of	)	Case No. 19-621-EL-EEC
Duke Energy Ohio, Inc.	)	

ANNUAL ENERGY EFFICIENCY STATUS REPORT

OF DUKE ENERGY OHIO, INC.

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COMPLIANCE STATUS REPORT

This portfolio status report represents Duke Energy Ohio, Inc.'s, (Duke Energy Ohio) ninth filing of a status report on the load impacts achieved through implementation of its energy efficiency and demand response programs pursuant to Rule 4901:1-39-05 (C), O.A.C. This report is composed of the following two sections: (1) Compliance Benchmarks which provide information on load impact achievements relative to the baseline and (2) Program Performance Assessment which summarizes program activities and evaluation, measurement, and verification information. Following this report are ten appendices that fulfill the remaining requirements set forth in the Commission's regulations.

Compliance Benchmarks

4901:1-39-05 (A) and (B) Initial Benchmark Report

Pursuant to Rule 4901:1-39-05 (A), O.A.C., Duke Energy Ohio must file the following information in a benchmark report:

(1) The energy and demand baselines for kilowatt-hour sales and kilowatt demand for the reporting year; including a description of the method of calculating the baseline, with supporting data.

(2) The applicable statutory benchmarks for energy savings and electric utility peak-demand reduction.

In compliance with 4901:1-39-05(B), in preparing the baseline, Duke Energy Ohio is required to adjust the sales and/or demand baseline for normal weather as well as for changes in numbers of customers, sales, and peak demand to the extent such changes are outside its control.

This benchmark update report provides information related to two topics. The first topic involves the baseline for 2018, including a discussion of adjustments made to normalize for weather and to adjust for changes in numbers of customers, sales, and peak demand, where those changes are outside the control of Duke Energy Ohio. The second topic involves an estimate of the statutory benchmarks for energy savings and electric utility peak-demand reduction.

In estimating the baseline for Duke Energy Ohio for the year 2018, the Company uses the three-year average of the actual level of total energy sold and peak demand, adjusted for differences from normal weather. Table 1 provides the historical level of total energy (kWh) and demand (kW) for the years 2006 to 2017, the amount of the weather adjustment, and the weather normalized level of total energy.

Table 1 - Duke Energy Ohio Baseline and Benchmark for 2018[1]

Year	Total Energy (MWh)	Weather Normalization Adjustment (MWh)	Weather Normal Level of Total Energy (MWh) less opt out	Baseline: Three Year Average (MWh)	Cumulative Benchmark Percentage	Cumulative Benchmark Requirement (MWh)	Incremental Benchmark Percentage	Incremental Benchmark Requirement (MWh)
2009	20,405,122	320,494	20,725,616	22,553,819	0.3%	67,661	0.3%	67,661
2010	22,545,823	(621,454)	21,924,369	21,907,173	0.8%	177,197	0.5%	109,536
2011	20,238,172	(207,407)	20,030,765	21,633,024	1.5%	328,628	0.7%	151,431
2012	22,560,245	(15,568)	22,544,678	20,893,583	2.3%	495,777	0.8%	167,149
2013	21,339,163	92,375	21,431,537	21,499,937	3.2%	689,277	0.9%	193,499
2014	19,874,459	173,384	20,047,842	21,335,660	4.2%	902,633	1.0%	213,357
2015	19,552,288	(14,513)	19,537,775	21,341,352	5.2%	1,116,047	1.0%	213,414
2016	20,187,099	(211,689)	19,975,410	20,339,051	6.2%	1,319,437	1.0%	203,391
2017	19,473,540	279,769	19,753,309	19,853,676	7.2%	1,517,974	1.0%	198,537
2018			**19,509,789**	**19,755,498**	8.2%	1,715,529	1.0%	197,555

[1] Calculated in accordance with Sec. 4928.66 A(2)(a)(i – iii)

Year	Peak Demand (MW)	Weather Normalization Adjustment (MW)	Weather Normal Level of Peak Demand (MW) less opt out	Baseline: Three Year Average (MW)	Cumulative Benchmark Percentage	Cumulative Benchmark Requirement (MW)	Incremental Benchmark Percentage	Incremental Benchmark Requirement (MW)
2009	4,002	476	4,478	4,460	1.00%	44.6	1.00%	44.6
2010	4,114	330	4,444	4,423	1.75%	77.8	0.75%	33.2
2011	4,398	(28)	4,370	4,461	2.50%	111.2	0.75%	33.5
2012	4,295	300	4,595	4,431	3.25%	144.5	0.75%	33.2
2013	4,378	76	4,454	4,470	4.00%	178.0	0.75%	33.5
2014	4,013	177	4,191	4,473	4.75%	211.5	0.75%	33.5
2015	4,001	204	4,205	4,413	5.50%	244.6	0.75%	33.1
2016	4,128	(6)	4,122	4,283	6.25%	276.8	0.75%	32.1
2017	3,916	371	4,287	4,172	7.00%	308.1	0.75%	31.3
2018			**4,023**	**4,205**	**7.75%**	**339.60**	**0.75%**	**31.5**

The Company employs the following process to normalize kWh and kW for differences in the weather: Using econometric equations for each customer class, from the load forecast process discussed in the Long-Term Forecast Report filing, the adjustment process for kWh is performed as follows:

Let: KWH(N) = f(W(N))g(E)

KWH(A) = f(W(A))g(E)

Where: KWH(N) = electric sales - normalized

W(N) = weather variables - normal

E = economic variables

KWH(A) = electric sales - actual

W(A) = weather variables – actual

Then: KWH(N) = KWH(A) * f(W(N))g(E)/f(W(A))g(E)

= KWH(A) * f(W(N))/f(W(A))

With this process, weather-normalized sales are computed by scaling actual monthly sales for each class by a factor from the econometric equation that accounts for the impact of deviations from monthly normal weather. Similarly, using an econometric equation for peak, the adjustment process for kW is performed as follows:

Let: $KW(N) = f(W(N))g(E)$

$KW(A) = f(W(A))g(E)$

Where: $KW(N)$ = electric peak demand - normalized

$W(N)$ = weather variables - normal

E = economic variable

$KW(A)$ = electric peak demand - actual

$W(A)$ = weather variables - actual

Then: $KW(N) = KW(A) * f(W(N))g(E)/f(W(A))g(E)$

$= KW(A) * f(W(N))/f(W(A))$

With this process, weather-normalized peak demand is computed by scaling actual peak demand by a factor from the econometric equation that accounts for the impact of deviations from normal weather.

Once total energy and peak demand have been adjusted for normal weather, the computation of the baseline for 2018 is the arithmetic mean of the historical values for the three years 2015 to 2017. The baseline values for energy and demand are provided above in Table 1.

4901:1-39-05(C)(1)(a)-(c) Portfolio Status Report and Compliance Demonstration

In accordance with 4901:1-39-05(C)(1)(a), with the establishment of the baseline energy and peak demand, the level of the statutory benchmark is computed by applying the appropriate incremental percentage of achievement, as established in Substitute Senate Bill 221 (S.B. 221) and modified in Senate Bill 310 (S.B. 310), to the baseline. The computation of the benchmark achievement level for 2018 is provided above on Table 1. The baseline for energy is 197,555 MWH and the baseline for peak loads is 31.5 MW.

Duke Energy Ohio respectfully submits that this information is responsive to all of the baseline and benchmark calculations as set forth in Rule 4901:1-39-05(A), O.A.C., and requests that the Commission approve these baseline and benchmark calculations as submitted.

Pursuant to 4901:1-39-05(C)(1)(b),O.A.C., which requires a comparison of the applicable benchmark of actual energy savings and peak-demand reductions achieved, as a result of the Company's 2018 efforts to promote customer participation in its energy efficiency and demand response programs, the Company has achieved incremental energy and demand impacts in 2018 as summarized below in Table 2.

Details of impacts for each program are provided in **Appendix A.**

Table 2: Incremental Energy Efficiency and Demand Response Program Impact Summary

		Participants / Measures	MWH	MW
Demand Response Programs				
Power Manager®				71.4
Power Manager® for Business				1.5
PowerShare®				49.3
Total Demand Response Programs				**122.2**
Energy Efficiency Programs				
Residential Programs		2,328,786	223,648	39.9
Non-Residential Programs		16,340,712	124,099	20.3
Total EE Programs		**18,669,498**	**347,747**	**60.3**
Additional Impacts Under SB310				
T&D Infrastructure - 2018			76,556	
Updated Prior Impacts for SB310 Counting Provisions - 2016	1		91,169	8.0
Updated Prior Impacts for SB310 Counting Provisions - 2017	1		91,169	8.0
Total Additional Impacts			**258,893**	**16**
Prior Bank per SB-310			1,959,357	506.6
Total Load Impacts			**2,565,997**	**705**

1 - For details, see Appendix M

Table 3 below provides a comparison of the impacts relative to the benchmarks previously mentioned. This indicates that the Company has complied with the S.B. 310 statutory benchmarks for the year 2018.

Table 3: Comparison of Achieved Impacts to the 2018 Benchmark			
	2018 Benchmark	Achievement	Variance Over / (Under)
MWH	197,555	2,565,997	2,368,442
MW	31.5	705.0	673.5

In addition, since the Company's cumulative efforts continue to exceed the cumulative benchmark requirement, there is still a residual amount of load impacts that carry forward to support achievement of the benchmarks for 2019 and beyond.

In compliance with 4901:1-39-05(C)(1)(c), an affidavit indicating that the reported performance complies with the statutory benchmarks is provided in **Appendix B**.

4901:1-39-05(C)(2), O.A.C. Program Performance Assessment

In June 2016, Duke Energy Ohio filed a new three-year portfolio[2] plan for 2017 – 2019. This portfolio application was amended and resubmitted with updates on October 14, 2016 to incorporate the results of the market potential study conducted by Nexant. On September 27, 2017 the amended stipulation was approved by The Commission with modifications. Because the Commission's Order was issued in September of 2017, the Commission recognized that the Company's spending for 2017 might exceed the cap imposed. Therefore, the Commission stated that it might permit the Company to exceed the cap but would not permit shared savings for

[2] Case No. 16-0576-EL-POR

2017. The Commission also stated that the Company should not exceed the Portfolio Plan budget for programs for calendar year 2017 absent obtaining a waiver from the Commission. On October 12, 2017 Duke Energy Ohio requested a waiver and the waiver was approved on November 21, 2017. Consistent with the amended stipulation that the Commission had approved, until the Company received approval of the 2017 – 2019 portfolio the programs, it continued to operate under the 2016 portfolio guidelines. The Company operated under the imposed cap for program year 2018.

Program Performance Assessment

Program descriptions and key activities for its current portfolio are provided below.

4901:1-39-05 (C)(2)(a)(i), O.A.C. Program Descriptions and Key Activities

Residential Programs

Smart $aver® Residential Program

The Smart $aver® Residential program offers a variety of programs and measures that allow customers to take action and reduce energy consumption. The program is available to residential customers served by Duke Energy Ohio.

Free LED Program

The Free LED Program is designed to increase the energy efficiency of residential customers by offering customers LEDs to install in high-use fixtures within their homes. The LEDs are offered through an on-demand ordering platform, enabling eligible customers to request LEDs and have them shipped directly to their homes. Eligibility is based on past campaign participation (i.e. coupons, Business Reply Cards (BRCs) and other Duke Energy Ohio programs distributing free bulbs). Bulbs are available in 3, 6, 8, 12 and 15 pack kits that contain

9-watt bulbs that are the equivalent a 60-watt incandescent. The maximum number of bulbs available for each customer is 15, but customers may choose to order less. In 2018, the program expanded eligibility to include customers who previously ordered free CFLs so long as at least 5 years has passed since the original ship date of their order.

Customers have the flexibility to order and track their shipment through three separate channels:

1) Telephone:

   Customers may call a toll-free number to access the Interactive Voice Response (IVR) system which provides prompts to facilitate the ordering process. Both English and Spanish-speaking customers may easily validate their account, determine their eligibility and place their LED order over the phone.

2) Duke Energy Web Site:

   Customers can go online to complete the ordering process. Eligibility rules and frequently asked questions are also available.

3) My Account:

   Customers who participate in the My Account program are encouraged to order their LEDs through this Duke Energy Ohio authenticated portal, if they are eligible.

The benefits of providing these three distinct channels include:

- Improved customer experience
- Advanced inventory management
- Simplified program coordination
- Enhanced reporting

- Increased program participation
- Reduced program costs

Customers continue to utilize the simple ordering process and the convenience of bulbs being shipped directly to their home. Over 137,000 orders were placed in 2018; resulting in over 1.5M bulbs distributed.

The overall strategy of the program is to reach residential customers who have not adopted LED bulbs. Duke Energy Ohio will continue to educate customers on the benefits of LEDs while addressing barriers for consumers who have not participated in the program. Additionally, the ease of program participation will also be highlighted to encourage use of the on-demand ordering platform.

Regarding marketing in 2018, the Free LED program relied heavily on intercepts (through our IVR and My Account ordering channels) to engage with customers. Overall, the IVR intercept accounted for 42% of the program's orders while the My Account intercept accounted for 40%.

The Duke Energy website contains pages explaining the program and portal through which the customer can check their eligibility and order free bulbs. Moving forward, Duke Energy Ohio will continue to explore marketing the LED program through various channels including email and direct mail. Response of each channel will be tracked and monitored. Cross-promotion with the online Savings Store will also be utilized to help offer lighting for specialty applications and promote LED technology to customers who are eligible for both lighting programs.

Online Savings Store

The Online Savings Store offers specialty bulbs such as recessed lights, candelabras, globe, three-way bulbs, capsules and dimmable bulbs. Purchase limits are at the account level (36 bulbs for the lifetime of the account). However, customers may purchase additional bulbs without incentives if they choose. The web based ecommerce store provides discounted specialty lights and ships directly to the home.

In 2018 the online savings store added smart thermostats (2 smart thermostats for the lifetime of the account), as a part of the 2018 Stipulation Agreement.

Utilizing the existing on-demand platform, customers may participate in the online Savings Store via:

1) Duke Energy Web Site

   Customers may go to the Savings Store landing page to learn more about the program, review frequently asked questions and CFL recycling information.

2) My Account

   Customers who participate in the My Account program are encouraged to visit the Savings Store to order discounted energy efficient products, if they are eligible.

3) Order by Phone

   Duke Energy offers phone ordering as an option for customers to order bulbs from the Online Savings Store. Customers may call the vendor directly for assistance in placing orders for discounted lighting.

4) Mail in Order

   On occasion, Duke Energy provides customers with a mail-in option for placing an order. Direct mail campaigns offer specially priced bulbs with the option to order these online, by phone or with a postage paid return mailer.

Customers who choose to shop at the Savings Store will see a wide variety of discounted LED bulbs for different fixtures around their home. Bulbs are available in single and multi-pack sizes (for special promotions) and various wattages. Educational Information is available to help customers select the right bulb types for various applications, as well as resources to understand the difference between lumens versus watts and how to compare them.

The Online Savings Store is managed by Energy Federations Incorporated (EFI). Customers can view special promotions and feature products as well as track order history. EFI handles inquiries regarding products, payments, shipping and warranties.

Over 10,990 orders were placed in 2018; resulting in over 89,035 bulbs and 3,282 smart thermostats being purchased. Eight percent of orders were placed through My Account and 92% of orders were placed through the Duke Energy Ohio web site. The top five categories purchased on the Savings Store include; LED Reflectors, LED Globes, LED Decorative, LED A-line, and smart thermostats.

Duke Energy Ohio marketed the online Savings Store program through various channels including Email, Direct Mail, Printed Collateral, and other Duke Energy Program collaboration efforts. Response of each channel is tracked and monitored. Special shipping promotions occurred throughout 2018 to increase customer's participation such as $5 flat rate shipping and free shipping.

Savings Store Program Potential Changes

For 2019, the Savings Store is considering several enhancements that are centered around improving the overall customer experience and communication path. Additionally, the program is evaluating adding more incentivized products.

Retail Lighting Program

The Retail Lighting Program is an upstream, buy-down retail-based lighting program that works through lighting manufacturers and retailers to offer discounts to Duke Energy customers selecting incentivized LEDs and energy-efficient fixtures at the shelf for purchase at the register. Retailers, such as, but not limited to, Home Depot, Lowe’s, Walmart and Habitat for Humanity Restores are evaluated at the store level for possible inclusion in this program.

This program encourages those customers not likely to shop at the on-line stores to adopt energy efficient lighting through incentives on a wide range of efficient lighting technologies including LED products, including Reflectors, Globes, Candelabra, 3 Way, Dimmable and A-Line type bulbs, as well as fixtures. Customer education is imperative to ensure customers are purchasing the correct bulb for the application to obtain high satisfaction with energy efficient lighting products, ensuring subsequent energy efficient purchases.

The incentive amount varies by product type and the customer pays the difference as well as any applicable taxes. Pack limits will be in place and enforced to the best of the retailers’ ability.

The Retail Lighting program is managed / implemented by CLEAResult Consulting Inc. This vendor is an industry leader and leverages their existing relationships and systems established with the participating retailers and manufacturers. Additionally, the vendor has a field team in place to promote and monitor this program at the participating retail locations. A toll-free call center and website are hosted by the vendor to provide program information to Duke Energy customers. The website includes a retailer locator where customers can enter their address and search for retailers in their area. Also available on the program website is an interactive savings calculator, which will explain the different types of lighting technologies to help guide customers to the appropriate bulb(s) for their application and provide an estimate of energy and monetary savings.

Eligible program participants include all Duke Energy Ohio residential customers.

The primary goals for this program are to help customers lower their energy bills and to remove inefficient equipment from the electric grid. This program educates customers about energy consumption attributed to lighting and how to reduce their consumption by using high efficiency alternatives.

Duke Energy Ohio marketed the Retail Lighting program through various channels including Point of Purchase materials at participating retailer locations, Email, Direct Mail, Printed Collateral, other Duke Energy Program collaboration, and other retail and community events. These marketing efforts are designed to create customer awareness of this program, to educate customers on energy saving opportunities and to emphasize the convenience of Program participation. Additionally, marketing efforts related to advertised in-store events are designed to motivate customer participation.

Multifamily Energy Efficiency Program

The Multifamily Energy Efficiency Program provides apartment complexes with free and installed lighting and water measures. Eligible units are Duke Energy Ohio served apartments on a residential rate. Traditionally, the properties targeted have four or more units. Franklin Energy is the program administrator. Franklin Energy oversees all aspects of the program which includes outreach, direct installations and customer care.

The program helps property managers upgrade lighting with energy efficient bulbs and save energy by offering energy efficient water measures such as bath and kitchen faucet aerators, water saving showerheads and insulating pipe wrap for installation on the hot water line that exits the water heater. Water measures are available to eligible customers with electric water heating. The Program filed in 2016 to adopt LED lighting technology and now offers as of 2018, LED A-lines, Globes, and Candelabras with no limits on the number of lighting measures installed in apartments. These measures assist with reducing maintenance costs while improving tenant satisfaction by lowering energy bills.

The program offers properties the option of DI (direct install) service by Franklin Energy crews. However, Property Managers also can have their own property maintenance crews complete the installations, upon request.

The LEDs and water measures are installed during scheduled direct install visits by Franklin Energy crews or routine maintenance visits by property personnel. In the case of direct installs, crews carry tablets to keep track of the measures installed in each apartment. In the case of installations that are self-installed, the property maintenance crew tracks the number of measures installed and reports them back to Franklin Energy. Franklin Energy then validates this information and uploads the results to Duke Energy.

After installations are completed, Quality Assurance (QA) inspections are conducted on 20% of properties that completed installations in each month. The QA inspections are conducted by an independent third party.

Franklin Energy uses outbound calling as the primary tactic to solicit initial interest in the program from property managers in Duke Energy Ohio. On-site visits by appointment are also used to attract properties to participate in the program.

In addition to proactively marketing the program using the above methods, a Multifamily Energy Efficiency public webpage was developed for property managers to learn more about the program. On the page, a program brochure and a frequently asked question sheet are available for download. Also on the page are an 800# and a link to email about the program. Property managers may use either of these methods to learn more about the program and schedule an appointment for an Energy Assessment.

During the Energy Assessment, a Franklin Energy Energy Assessor surveys each unit type on the property (e.g. 1 bedroom, 2 bedroom, etc.) to determine the types and quantities of measures that can be replaced by the program. After the assessment, the property manager is provided with a report that shows the potential energy and water that can be saved by participating in the program. Property Management companies enroll in the Program by signing a Service Agreement.

Once enrolled, Franklin Energy provides property managers with a variety of marketing tools to inform their tenants about the Program. This includes letters to each tenant informing them of the installation date and what will be installed in their apartment. In addition, tenants are provided an educational leave-behind brochure when the installation is complete. The brochure provides additional detail on the installed measures as well as a tear-off customer satisfaction survey to fill out and mail to Duke Energy to provide valuable program feedback. Customers also have the option of completing this Customer Satisfaction Survey online. To gauge property manager satisfaction with the program, property managers are provided with a separate survey to complete and provide feedback to Duke Energy.

In 2018, the Program installed 10,185 energy efficient measures installed in 5 properties. These measures comprised of:

- 5,244 LED A-lines
- 2,046 LED Candelabras
- 760 LED Globes
- 404 Bath Aerators
- 292 Kitchen Aerators
- 433 Showerheads
- 1,006 Ft of Pipe Wrap

Multifamily Energy Efficiency Program- Potential Changes

The Company continues to review new measures for inclusion in the program. Specifically, new LED measures such as track and recessed lighting are being considered for addition in 2019.

Save Energy and Water Kit Program (SEWKP)

The Save Energy and Water Kit Program was launched in April of 2014 and is designed to increase the energy efficiency of residential customers by offering customers High Efficiency, Low Flow Water Fixtures and Insulated Pipe Tape to install in high-use fixtures within their homes. The energy saving devices are offered through both Direct Mail and Direct Email campaigns, enabling eligible customers to request to have these devices shipped directly to their homes, free of charge. To be eligible, customers must live in a resident owned single-family home and own an electric water heater. Customers must not have participated in past campaigns including this program and any other programs offering low flow water measures that Duke Energy has offered to Ohio customers. Customers receive a kit with varying amounts of the following devices: low flow bath and kitchen aerators, low flow shower heads and insulated pipe tape. Kit size eligibility is based on the total square footage of the customer's home. The kit also includes directions and items to help with installation.

There were 3,816 kits were shipped to Ohio customers in 2018; resulting in over 15,600 aerators, over 5,900 shower heads and 19,000 feet of insulated pipe wrap being distributed.

The overall strategy of the program is to reach residential customers who have not adopted low flow water devices and hot water pipe insulation. Duke Energy Ohio will continue to educate customers on the benefits of using high efficiency, low flow water devices and saving the energy used to heat water, while addressing barriers for consumers who have not participated in the program.

Duke Energy Ohio will continue to market the program through Direct Mail and Direct Email and the response will continue to be tracked and monitored.

Save Energy and Water Kit Program Potential Changes

Targeted marketing campaigns and tactics will be utilized to improve awareness for hard to reach and late adopter[3] customers. In 2019, the Online Platform will be enhanced to allow customers to upgrade the showerhead in their kit. The goals of the upgrade option are to increase customer satisfaction and in-service rates for the showerheads.

Heat Pump Water Heater Program

The Heat Pump Water Heater Program is designed to encourage the adoption of energy efficient water heating in new or existing residences. Duke Energy Ohio served homeowners currently residing in or building a single-family residence, condominium, or duplex home, with electric water heating, are eligible for this program. Installation of a high efficiency heat pump water heater will result in a $350 incentive. Duke Energy program personnel establish

[3] Customers who are slow to start using or buying a new product, technology, or idea.

relationships with home builders, plumbing contractors, and national home improvement retailers who interface directly with residential customers. All incentives are paid directly to customers upon approval of a completed application.

During 2018, program personnel focused on developing the contractor network, along with consumer awareness and education. A training workshop for plumbing contractors and distributors was conducted during the 3rd quarter to recruit and educate contractors on the technology and energy-saving benefits. In addition, customer awareness campaigns included direct mail and targeted email leveraging Energy Star's promotional awareness month, bill inserts, product page on Duke Energy website, and in-store signage at home improvement retailers. While heat pump water heaters are a proven technology, adoption, and therefore market share, continues to represent only a fraction of overall water heater sales.

Heat pump water heaters are one of the most efficient technologies for domestic water heating, providing an energy and cost savings of up to 50 percent for the typical family over the life of the unit. Duke Energy Ohio will continue to educate customers on the benefits of heat pump water heaters, while addressing barriers for consumers who have not participated in the program.

<u>Variable-Speed Pool Pump Program</u>

The Variable-Speed Pool Pump Program is designed to encourage the adoption of energy efficient, variable-speed pool pumps for the main filtration of in-ground residential swimming pools. Duke Energy Ohio served homeowners currently residing in, or building, a single-family residence with an in-ground swimming pool are eligible for this program. Installation of a high efficiency, variable-speed pool pump will result in a $300 incentive. Duke Energy program personnel establish relationships with home builders and pool professionals who interface directly with residential customers. All incentives are paid directly to customers upon approval of a completed application.

During 2018, program personnel focused on developing the contractor network, along with consumer awareness and education. A training workshop for pool professionals was conducted to recruit and educate contractors on the program and energy-saving benefits. In addition, customer awareness campaigns included direct mail, targeted email, product page on Duke Energy website, and in-store signage at participating retailer locations. The Program processed 221 customer rebate applications for upgrading to a variable-speed pool pump during 2018. Duke Energy Ohio will continue to educate customers on the benefits of variable-speed pool pumps through awareness campaigns and in-store signage to promote program adoption.

Residential Heating, Ventilation and Air Conditioning (HVAC) Program

Duke Energy Ohio served homeowners currently residing in, or building, a single-family residence, condominium, duplex or mobile home are eligible for this program. The HVAC equipment measures were modified beginning January 2018 to include a tiered incentive structure, based on the efficiency rating of the new unit installed, along with an add-on optional smart thermostat measure that customers can choose to combine with equipment replacement to further improve the efficiency of the HVAC system. Installation of a high efficiency heat pump or air conditioner will result in a $300 or $400 incentive, based on the efficiency rating of the new system. The optional add-on smart thermostat will result in an additional $125 incentive. Blackhawk Engagement Solutions serves as the back-office support for the program while Duke Energy program personnel establish relationships with home builders and HVAC contractors who interface directly with residential customers. These trade allies adhere to program requirements and submit the incentive application on behalf of the customer. Once the application is processed, incentives are disbursed. For the additional complimentary measures offered through the HVAC program, eligible customers will receive $250 for the installation of attic insulation and completion of air sealing, $75 for the installation of duct insulation, and $100 for the completion of duct sealing. All incentives for these complimentary measures are paid directly to customers upon approval of a completed application.

Duke Energy Ohio has formed strong relationships with trade allies and continues to develop relationships with trades serving the new measures. These partnerships help application fulfillment and prompt payment of incentives as well as maintain top-of-mind awareness of the program and its benefits. The buy-in and participation of the trade ally network is vital to the success of the HVAC segment of the Program. During 2018 over 2,500 HVAC incentives, and 290 complimentary measures were processed for Duke Energy Ohio customers through a network of 120 active trade ally companies.

A new marketing referral component of the Program, Find It Duke, was launched in March 2018 as a new delivery channel that provides a free home contractor referral service to customers to enhance program awareness and participation. The service simplifies the customer's decision-making around energy efficiency purchases and takes the guesswork out of finding reliable, qualified contractors with competitive offers. This delivery channel supports the Company's role as an energy efficiency program administrator while building trusted partnerships with customers and HVAC and home performance contractors. Awareness and marketing for Find It Duke was promoted through a variety of channels including TV, spot radio, digital, targeted email, branded website on Duke Energy, and direct mail campaigns.

Residential Energy Assessments Program

The Residential Energy Assessments program currently consists of one assessment, the Home Energy House Call (HEHC). HEHC targets residential customers that own a single family home with at least four months of billing history. HEHC is a free in-home assessment designed to help customers reduce energy usage and save money. Duke Energy Ohio partners with several key vendors to administer the program in which an energy specialist completes a 60 to 90 minute walk through assessment of the home and analyzes energy usage to identify energy saving opportunities. The Building Performance Institute (BPI) certified energy specialist discusses behavioral and equipment modifications that can save energy and money with the customer. A customized report is provided to the customer that identifies actions the customer can take to increase their home efficiency. Example recommendations might include the following:

- Turning off vampire load equipment when not in use
- Turning off lights when not in the room
- Using energy efficient lighting in light fixtures
- Using a programmable thermostat to better manage heating and cooling usage
- Replacing older equipment/appliances
- Adding insulation and sealing the home

Customers receive an Energy Efficiency Starter Kit with a variety of measures that can be directly installed by the energy specialist. The kit includes measures such as energy efficient lighting, energy efficient showerhead, low flow faucet aerators, outlet/switch gaskets, weather stripping and energy saving tips booklet.

The Duke Energy Ohio Residential Energy Assessment Program conducted 2,956 assessments in 2018 and installed 12,271 additional LEDs. The program continues to explore enhancements to the program as well as test and consider new marketing channels to increase participation.

HEHC Program Potential Changes

- Explore offer to include a blower door test
- Determine if there will be an expansion of the Home Energy Score in partnership with the Greater Cincinnati Energy Alliance and Department of Energy.
- Explore updates to standard offerings to include additional bathroom aerators and pipe wrap.
- Explore options for upgradeable measures for a cost.
- Implement post audit follow up with reminders of recommendations/referrals.

Energy Efficiency Education Program for Schools

The Energy Efficiency Education Program for Schools Program is an energy conservation program available in Ohio. The Energy Efficiency Education Program is available to K-12 students enrolled in public and private schools and who reside in households with electricity served by Duke Energy Ohio.

The Program provides principals and teachers with an innovative curriculum that educates students about energy, electricity, ways energy is wasted and how to use our resources wisely. The centerpiece of the curriculum is a live interactive theatrical production delivered by two professional actors to students in kindergarten through eighth grade. Performances differ for elementary, middle and high school students. Teachers also receive educational materials focused on concepts such as energy, renewable fuels, and energy efficiency for classroom and student take home assignments. All workbooks, assignments and activities meet state curriculum requirements.

School principals are the main point of contact and will schedule the performance at their convenience for the entire school. Once the principal has confirmed the performance date and time, two weeks prior to the performance, all materials are delivered to the principal's attention for distribution. Materials include school posters, teacher guides, classroom and family activity books.

Students are encouraged to request an Energy Efficiency Starter Kit. The kit contains specific energy efficiency measures to reduce home energy consumption. It is available at no cost to all Duke Energy electric student households at participating schools.

Since 2011, The National Theatre for Children has partnered with Duke Energy Ohio to engage students in the Ohio service territory on energy and energy efficiency through live theatrical performances. For the 2017-2018 school year, two new productions were launched. Elementary schools will learn how to measure the energy we use and how we can reduce the energy we waste while watching Lorraine Quiche realize her dream of opening her own restaurant *Kilowatt Kitchen*. In this 25-minute educational play, Lorraine learns how to use energy wisely and saves the day for her Kilowatt Kitchen! *The E-Team* is a 40 minute, live show for grades six through nine. The program consists of two actors with two goals. The first goal is to highlight how we measure energy, the uses of energy, how energy is wasted and renewable resources. The second goal is to make the middle school students laugh so hard that they forget they are learning. The show is a series of improvised comedy sketches between characters in all sorts of hilarious situations. Before each scene, actors interact with the audience and get ideas that will be used during the sketch, such as their favorite band or a household pet. The ideas are incorporated into the show and may change the course of a scene.

From January through December 2018, there were 172 participating schools hosting 244 performances to reach over 50,400 students.

Duke Energy Ohio continues to enhance the program by:

- Leveraging the program webpage at duke-energy.com to showcase the program and bring awareness to employees and other stakeholders
- Partnering with Duke Energy Account and District Managers to leverage existing relationships in the community and develop positive communications
- Offering school, classroom and family contests for kit sign ups to create additional excitement in the schools and classrooms throughout the school year
- Utilizing social media to encourage awareness and participation
- Offering teacher satisfaction survey evaluations after the performances for both the elementary and middle school shows. Average survey data from 2018 indicated 94% of the teacher surveys had very high satisfaction ratings.

Now in its seventh year, the Program has effectively increased school participation. School outreach has focused on non-participating schools by making in person visits to the schools, which resulted in new schools participating. Enhanced communications before and after the performances throughout the year have encouraged participation. Additionally, after the performances, some classrooms in grades 3-5 receive follow up visits by actors in the classroom to reinforce the educational points from the curriculum and to encourage kit sign ups with the students and teachers.

The Program is reviewing how to enhance the offering by providing enhanced and prolonged engagement for all student households, including families that have already received the current Energy Efficiency Starter Kit. This will improve customer satisfaction and provide additional energy savings, particularly for those customers that would otherwise have been excluded from the kit offering but want to participate in energy saving measures.

<u>Low Income Services Program</u>

The Low Income Services Program provides assistance to low income customers by providing funding for energy efficiency measures. The upfront costs of high efficiency equipment are an especially difficult barrier for low income customers to overcome.

The Weatherization and Refrigerator Replacement program is available to all customers within Duke Energy Ohio's service territory, with a household income up to 200% of the federal poverty level and who have not participated in the program within the past 10 years.

The Electric Maintenance Service program is available for low-income elderly and disabled customers up to 175% of poverty level. This program offers low-cost solutions for energy efficiency. Customers may receive energy efficiency products and services such as energy efficient lighting, water saving showerheads and aerators, water heater wraps, HVAC cleaning, HVAC filters, and energy efficiency education.

The Pay for Performance Pilot program was piloted with People Working Cooperatively (PWC) in OH from 2013-2017. The program was evaluated in 2017, and filed for commercialization and approved in 2018. Duke Energy Ohio is currently working with People Working Cooperatively (PWC), Clermont County Community Services (CCCS) and Miami Valley Community Action Partnership (MVCAP) to provide incentives for installing energy efficiency measures in homes <200% of the poverty level. The participating agencies target low income customers who receive whole-house weatherization services, including installation of energy efficiency measures and education. Duke Energy Ohio will purchase and recognize the energy and demand savings achieved through the program that are currently funded by leveraged funds, funding from sources other than Duke that are not explicitly tied to efficiency.

These programs are promoted through, but not limited to, Community Action Agencies, Non-Governmental Organizations (NGO's), and direct mail to customers.

My Home Energy Report

My Home Energy Report (MyHER) is a periodic comparative usage report that compares a customer's energy use to similar residences in the same geographical area based upon the age, size and heating source of the home. Specific energy saving recommendations are included in the report to encourage energy saving behavior.

The reports are distributed up to 12 times per year (delivery may be interrupted during the off-peak energy usage months in the fall and spring). The report delivers energy savings by encouraging customers to alter their energy use. The monthly and annual energy usage of each home is compared to the average home (top 50%) in their area as well as the efficient home (top 25%). Suggested energy efficiency improvements given the usage profile for that home are also provided. In addition, measure-specific offers, rebates or audit follow-ups from other Company offered programs are offered to customers, based on the customer's energy profile.

Target customers reside in individually-metered, single-family or multifamily residences with active account and 12 months of usage history.

MyHER customers also have access to the Interactive portal which was made available in March 2015. The portal allows customers to see how they use energy, set and track energy saving goals, interact with calculators and ask an expert for advice. The portal also includes weekly email challenges. The portal was promoted on the paper report as well as email campaigns.

The Company developed a report for customers living in multifamily dwellings that was ready for implementation in December 2016. This program was part of the new portfolio filed by the Company. Due to the regulatory situation in Ohio, the multifamily program was not rolled out until June 2018. Eligible customers living in multifamily dwellings with the appropriate amount of usage history as well as a registered email address on file with the Company receive four printed reports and twelve electronic reports delivered throughout the year. Eligible customers without a registered email address on file with the Company receive six printed reports with a strong call to action to provide their email address to receive even more information on their home usage through the Interactive Portal.

The Company developed a dual fuel report for Ohio customers that receive both their electricity and gas from the Company. Fifty percent of eligible customers received their first dual fuel report in February 2018. The Company wants to ensure that providing this full energy perspective does not affect electric savings behaviors before rolling the report out to the full eligible population.

Low Income Neighborhood Program

The Low Income Neighborhood Program ("Program"), officially known as the Neighborhood Energy Saver (NES) Program assists low-income customers in reducing energy costs through energy education and installation of energy efficient measures to qualified customers. The primary goal of this Program is to empower low income customers to better manage their energy usage.

The Program targets neighborhoods with a significant low income customer base using a grassroots marketing approach to interact on an individual customer basis and gain trust. Participation is driven through a neighborhood kick-off event that includes community leaders supporting the benefits of the Program. The purpose of the kick-off event is to rally the neighborhood around energy efficiency and provide thorough and pertinent information on how the program will operate in their neighborhood. Customers will have the option to sign-up for an energy assessment at the time of the event.

In addition to the kick-off event, Honeywell/Duke Energy uses the following channels to inform potential customers about the Program:

- Direct mail
- Door hangers
- Press releases
- Community presentations and partnerships
- Inclusion in community publications such as newsletters, etc.

Customers participating in the Program receive an energy assessment to identify energy efficiency opportunities in their home and one-on-one education on energy efficiency techniques. Additionally, the customer receives a comprehensive package of up to sixteen energy efficient measures, installed by professionally trained technicians. Measures received are based on each home's individual walk-through assessment. For customers receiving furnace filters as part of their comprehensive kit, they will be provided a year's supply, including the initial installation.

The Program is available only to individually-metered residential customers in neighborhoods selected by Duke Energy Ohio, at its sole discretion, which are considered low-income based on third party data, which includes income level and household size. Areas targeted for participation in this Program will have approximately 50% of the households at an income equal to or less than 200% of the federal poverty level as established by the Department of Energy.

In 2018, a total of 1,029 homes were serviced through the program.

There are no program changes planned at this time.

Power Manager® Program

The Power Manager Program provides incentives to residential customers who allow the company to cycle their air conditioner's outdoor compressor on or off during peak energy periods between May and September. Participating customers of the Company who have a functioning outdoor A/C unit are eligible for the program.

Participants in the Power Manager program allow Duke Energy Ohio to control their air conditioners during peak summer demand periods. Customers receive a one-time enrollment incentive of $25 or $35 depending on the Power Manager option they choose. In addition, they receive credits each month of the Power Manager event season. Customers receive a total seasonal minimum credit amount of $12 or $18 depending on the option they enrolled in. The $12 minimum event season credit is paid out as $2.40 per month during event season (May – September) and the $18 minimum event season credit is paid out as $3.60 per month during event season (May – September).

The Power Manager program manager evaluates conditions to activate a Power Manager event including temperature, heat index, humidity and market conditions as communicated by the regional transmission organization, PJM. In 2018 Duke Energy Ohio activated the Power Manager program on eight separate occasions (3 times in June, 2 times in July, 1 time in August and 2 times in September) in addition to the required one-hour PJM test on September 6, 2018. The eight events totaled 15 hours of reduced demand and helped Duke Energy Ohio meet peak summertime demand needs and contribute to the stability of the electric grid.

The Power Manager program was promoted in 2018 through outbound calling and targeted email offers along with the company website. Marketing efforts yielded approximately 1,500 new participants in 2018. Approximately 1,200 participants requested to have their switch removed. All device installations and removals on customers' AC units were completed by a third- party vendor.

In addition, Duke Energy Ohio also uses the Move-out/Move-in communication and process for customer premises with a Power Manager control device. When a participating customer moves out of a residence, the control device is deactivated. The new tenant receives a letter that informs them of their opportunity to participate in the program and is given 30 days to contact Duke Energy Ohio if they do not wish to participate. If the new tenant does not contact Duke Energy Ohio after 30 days, the Power Manager control device is reactivated.

<u>Power Manager Program Changes</u>

Duke Energy Ohio received approval to increase participating customers' seasonal participation incentives. The new incentives are $18 or $12 depending on the option the customer is enrolled in. The new incentives were paid out beginning in the 2018 Power Manger program event season (May- September).

Non-Residential Programs

Smart $aver® Non-Residential Prescriptive Program

The Smart $aver® Non-residential Prescriptive Incentive Program provides incentives to commercial and industrial consumers to install energy efficient equipment in applications involving new construction, retrofit, and replacement of failed equipment. The program also uses incentives to encourage maintenance of existing equipment to reduce energy usage. Incentives are provided based on Duke Energy Ohio's cost effectiveness modeling to assure cost effectiveness over the life of the measure.

Commercial and industrial consumers can have significant energy consumption, but may lack knowledge and understanding of the benefits of high efficiency alternatives. Duke Energy Ohio's program provides financial incentives to customers to reduce the cost differential between standard and high efficiency equipment, offer a quicker return on investment, save money on customers' utility bills that can be reinvested in their business, and foster a cleaner environment. In addition, the Program encourages dealers and distributors (or market providers) to stock and provide these high efficiency alternatives to meet increasing demand for the products.

The program promotes prescriptive incentives for the following technologies – lighting, HVAC, pumps, variable frequency drives, food services, process equipment, and information technology equipment. Equipment and incentives are predefined based on current market assumptions and Duke Energy's engineering analysis. The eligible measures, incentives and requirements for both equipment and customer eligibility are listed in the applications posted on Duke Energy's website.

All non-residential customers served by Duke Energy and pay the EE rider in Ohio are eligible for the Smart $aver® program.

The program has developed multiple approaches to reaching the very broad and diverse audience of business customers. In 2018 this consisted of incentive payment applications, with paper and online options, and instant incentives offered through the Online Energy Savings Store. The 2018 results include:

- Customers continue to have high interest in energy efficiency and have significant funds to invest in efficiency along with the requested rebates which offset a portion of the cost.
- More applicants are using the online application, an easier way to apply
- Outreach continued to support Trade Allies working with the program
- Due to funding limitations, marketing activities were limited to program updates only
- High levels of customer service were provided by a dedicated team of representatives answering customer questions via phone and email
- Large account management continue to provide large businesses with personalized relationships to identify and support new EE projects

Many changes for the program occurred in early 2018. More information is provided in the section "2018 Program Changes."

The following chart summarizes 2018 participating customers by Program channel:

Program Option	Participating Customers*	% 2018 Repeat Customer
Paper and Online Application Form	1,020	59%
Online Energy Savings Store	88	49%

*May include multiple facilities/sites for one customer.

Paper and Online Applications

During 2018, 1,250 applications, consisting of 3,037 measures, were paid for Duke Energy Ohio prescriptive incentives. Sixty-seven percent of applications were submitted via the new online application portal. The average payment per paid application was $6,224.

Many Trade Allies participating in the application process reduce the customer's invoice by the amount of the Smart $aver® Prescriptive incentive and then receive reimbursement from Duke Energy. Customers often prefer this rather than paying the full equipment cost upfront and receiving an incentive check from Duke Energy. More information is provided on the next page, as to how the program engages with Trade Allies.

As of 1/1/2016, the program applications are no longer administered by a third party. Duke Energy has developed an internal database that allows the program to self-administer and analyze program data more efficiently for better performance.

Online Energy Savings Store

Duke Energy Ohio also offers the Business Savings Store on the Duke Energy website, with orders fulfilled by the third-party EFI. The site provides customers the opportunity to take advantage of a limited number of incentive measures by purchasing qualified products from an on-line store and receiving an instant incentive that reduces the purchase price of the product. The incentives offered in the store are consistent with current program incentive levels.

Trade Ally Management

Over the years, the program has worked closely with Trade Allies (TA) to promote the program to our business customers at the critical point in time when customers are considering standard or high efficiency equipment options. Currently, there are 774 energy-efficiency equipment vendors, contractors, engineers, architects and energy services providers who are based in Ohio and registered as a TA with the Smart $aver® Non-residential programs (prescriptive and custom). The Smart $aver® outreach team builds and maintains relationships with TAs associated with the technologies in and around Duke Energy's service territory. Existing relationships continue to be cultivated while recruitment of new TAs also remains a focus. Duke Energy's efforts to engage TAs include the following activities:

- Trade Ally Search tool located on the Smart $aver® website
- Inspections of a sample of all projects to ensure quality control
- Trade Ally co-marketing including information about the Smart $aver® program in the TA's marketing efforts
- Online application portal training and support
- Midstream channel support
- Trade Ally year-end awards
- Trade Ally newsletter and monthly emails
- Technology- and segment-specific marketing collateral
- Trade Ally discussion group (20 trade allies that give input on program)
- Trade Ally training
- Sponsorship of trade ally events
- Online collateral toolkit for access to marketing materials

The TA outreach team educates TAs on the program rules and the Smart $aver® program expectations for TA conduct. The Company continues to look for ways to engage the TAs in promotion of the Program as well as more effective targeting of TAs based on market opportunities.

Marketing

Non-residential customers are informed of programs via targeted marketing material and communications. Campaigns during 2018 were limited due to concerns about the high program costs during the year. Direct email campaigns were conducted to inform customers and trade allies of the program status.

The internal marketing channel is comprised of assigned Large Business Account Managers, small and medium Business Energy Advisors, and Local Government and Community Relations, who all identify potential opportunities as well as distribute program collateral and informational material to customers and Trade Allies. Duke Energy has two business energy advisors who perform outreach to unassigned small and medium business customers. The business energy advisors follow up on customer leads to assist with program questions and steer customers to the trade ally search tool. In addition, the business energy advisors are contacting customers with revenue between $60,000 and $250,000 to promote the Smart $aver® programs.

2018 Program Changes

In past years, the Smart $aver® program has operated without caps on program expenditures. This has allowed the program to fulfill all customers’ requests for incentives on eligible energy efficiency equipment. In some years, requests were lower than expected and program expenditures fell short of expectations. However, in the past two years, program expenditures have significantly exceeded expectations. This has prompted a shift towards capping the program expenditures, including incentive payments. In 2018, the program operations were designed to stay within defined limitations. The program changes implemented include the following:

- Measure additions and removals: To identify a program offer that would help stay within capped program costs, and have the best chance of achieving kWh goals, the program team analyzed the list of measures offered by the program. The analysis results identified those measures that are highly cost effective, provide the greatest potential for achieving kWh goals, and have lower costs. 165 existing measures will remain in the program based on this selection criterion; 19 of these measures have reduced incentive amounts due to updated data on equipment costs. 221 existing measures were removed from the program based on this criterion. Prior to the planned program changes, the program team worked with a consultant to identify new cost-effective measures. Of those identified, 36 new measures were selected for addition to the program, bringing the total number of measures offered to 201. All technology groups are represented in this list, except for information technology measures.
- Policy for measure updates: In the past, the program operated with a "grace period" policy for changes to incentive level and changes to equipment eligibility. The past grace period allowed customers to purchase equipment up to 90 days after the change and qualify for the previous, higher incentive. Demand for rebates has surged during past grace periods due to new projects being sold during the period to meet the old rebate and/or eligibility. The new policy for changes to incentives and/or equipment eligibility will implement an effective date for all changes. The lower incentive (or changed eligibility requirement) will apply to all equipment purchased on and after the effective date.

- Reservation system: To ensure that program expenditures will not exceed the cap, a reservation system was implemented in 2018. Customers and trade allies seeking a prescriptive reservation should submit a Pre-Application in advance of starting an energy efficiency project. The Pre-Application will determine equipment qualification and reserve program funds, if available. A waiting list was established when funds became fully subscribed. Applications received that were not previously reserved were reviewed and paid if unreserved funds are available.
- Application forms: In light of the 2018 program changes, new application forms were available in mid-January.
- Midstream channel ended: Considering the need to cap program expenditures, the growth provided by the midstream channel was determined to be unsustainable and the channel is being ended. Customers that purchase from distributors that participated in midstream can still work with the distributor to submit an application for incentives.

Smart $aver® Custom Program

Duke Energy Ohio's Smart $aver® Non-residential Custom Incentive Program offers financial assistance to qualifying commercial, industrial and institutional customers (that have not opted out) to enhance their ability to adopt and install cost-effective electrical energy efficiency projects.

The Smart $aver® Custom Incentive program is designed to meet the needs of Duke Energy Ohio non-residential customers with electrical energy saving projects involving more complicated or alternative technologies, or those measures not covered by standard Prescriptive Smart $aver® Incentives.

Unlike the Prescriptive Incentives, Custom Incentives require approval prior to the customer's decision to implement the project. Proposed energy efficiency measures may be eligible for Custom Incentives if they clearly reduce electrical consumption and/or demand. There are two approaches for applying for Custom Incentives, "Classic Custom" and "Custom to Go". Applications vary slightly. The difference between the two approaches focuses on the method by which energy savings are calculated.

Currently the following applications are located on the Duke Energy Ohio website under the Smart $aver® Incentives (Business and Large Business tabs).

- Custom Application – Administrative Information
- Energy Savings Calculations & Basis
    - Classic Custom approach (> 700,000 kWh <u>or</u> no Applicable Custom to Go calculator)
        - Variable Frequency Drives
        - Energy Management Systems
        - Compressed Air
        - Lighting
        - General
    - Custom to Go Calculators (< 700,000 kWh <u>and</u> Applicable Custom to Go Calculator)
        - HVAC (including Energy Management Systems)
        - Lighting (> 700,000 kWh is supported for lighting)
        - Compressed Air
        - Process VFDs

Early in 2019, the software-based Custom-to-Go calculation tools will transition to a web-based environment and marketed as the "Smart Saver Tools".

The program is promoted through, but not limited to the following;

- Trade ally outreach
- Duke Energy Ohio Business Relations Managers
- Duke Energy Ohio segment specific workshops
- Company website

Smart $aver® Custom Rebate Program Changes

Beginning in 2018, the Custom program implemented a reservation system to manage program incentives and consequently program spend. Customers are required to maintain an approved reservation for their offer to ensure incentive payment. The reservation system is coordinated with the Prescriptive program.

Non-Residential Energy Assessment

Due to program funding limits created by the Commission imposed portfolio cost cap, the Non-Residential Energy Assessments program was not offered in 2018.

Mercantile Self-Direct Rebates Program

The Duke Energy Ohio Mercantile Self-Direct program was enacted in accordance with Public Utilities Commission of Ohio (Commission) Rule 4901:1-39-05(G).A.C., and the Commission's Opinion and Order in Case No. 10-834-EL-POR. Customers who use 700,000 kWh or greater annually and national accounts are eligible for the program.

A mercantile self-direct customer may elect to commit energy savings or demand reductions from projects completed in the prior three calendar years that did not receive Smart $aver® incentives, to Duke Energy Ohio's benchmark achievements. In return, Duke Energy Ohio will assist the customer in filing an application with Commission for approval of a portion of the incentive the customer would have received had they participated in Duke Energy Ohio's standard Smart $aver® Non-Residential programs.

Any customers that paid a reduced rider amount as the result of a negotiated settlement and wish to receive a self-direct rebate will be invoiced for the differential from the date of project completion until the last effective date of the negotiated settlement.

The marketing channels for Mercantile Self-Direct project applications closely resemble those of the Smart $aver® Prescriptive and Smart $aver® Custom programs, based on applicability, as described in previous sections of this filing.

Rebates for self-direct projects eligible for a cash rebate reasonable arrangement will be a maximum of 50% of the dollar amount that would apply to the same project if evaluated in the Smart $aver® Prescriptive & Custom programs.

<u>Self-Direct Prescriptive Program</u>

The Self-Direct Prescriptive program provides rebates for mercantile customers who implement energy efficiency and/or demand reductions projects to install higher efficiency equipment. Major categories include lighting, motors, pumps, variable frequency drives (VFDs), food service, information technology, HVAC and process equipment. Eligible measures are reflective of the Smart $aver® Prescriptive Incentive portfolio. While many of the measures recorded under the Smart $aver® Prescriptive program will remain prescriptive in nature under the Self-Direct program, in accordance with Commission rules and orders on the mercantile program, certain measures may be evaluated under the Self-Direct Custom program to enable the use of as-found baseline. The Self-Direct Prescriptive program has limited funding and utilizes a reservation system to manage program expenditures.

<u>Self-Direct Custom Program</u>

The Self-Direct Custom program offers rebates for completed mercantile projects involving more complicated scopes, or unique technologies that resulted in improvements upon facility electrical energy efficiency. A proposed energy efficiency measure may be eligible for a Self-Direct Custom rebate if it clearly reduces electrical consumption and/or demand. Unlike the Smart $aver® Custom program, measurable and verifiable behavioral and operational measures are eligible in the Mercantile Self Direct program. The Self-Direct Custom program has limited funding and utilizes a reservation system to manage program expenditures.

<u>PowerShare® Program</u>

The PowerShare® program is Duke Energy Ohio's demand side management (or demand response) program geared toward commercial and industrial customers. The primary offering under PowerShare® is named CallOption and it provides customers a variety of offers that are based on their willingness to shed load during times of peak system usage. In this program, credits are received regardless of whether an event is called or not. Energy credits are also available for participation (shedding load) during curtailment events. The notice to curtail under these offers is 30 minutes (emergency) and there are penalties for non-compliance during an event.

The program is promoted through but not limited to the following;

- Duke Energy Ohio Account Executives
- Duke Energy Ohio Business Energy Advisors
- Email to customers
- Duke Energy Ohio website

Customer targets continue to be large manufacturers, water/wastewater facilities and school systems. The market is very competitive with other Curtailment Service Providers acquiring customers that had previously been PowerShare® participants.

PowerShare® Program Potential Changes

PJM rules required a shift to meet their "Capacity Performance" construct starting in the 2018-2019 planning year, which required a change in program parameters (such as removing the maximum number of interruption) and has had some impact on participation. For 2019-2020, there were no changes to the program structure. PJM rules will shift again in 2020-2021 to include a "Summer Period Seasonal DR" offering to provide additional coverage of the "shoulder periods" in October and May. Duke Energy Ohio program management staff is working with customers to explore ways to navigate these future changes

PJM Interconnection, Inc. Pilot Program

As agreed to by the signatory parties in the Stipulation and Recommendation for Case No. 13-0431-EL-POR, Duke Energy Ohio created a PJM Interconnection, Inc. (PJM) Pilot program capturing all the costs and benefits of PJM Reliability Pricing Model (RPM) participation. Duke Energy Ohio agreed to bid at least 80% of eligible[4], projected cost effective[5],

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[4] "Eligible" is defined for purposes of the Stipulation as existing and planned energy efficiency savings and demand response that comply with PJM Manuals 18 and 18b.

[5] "Cost effective" is defined for purposes of Duke Energy Ohio's PJM Pilot Program as the projected auction revenues are greater than the projected costs for existing and planned energy efficiency and demand response, where the phrase "projected auction revenues" is defined as the

approved Program Portfolio resources[6] into the PJM Base Residual Auctions (BRA) occurring during the term of the 2014 – 2016 Program Portfolio. This agreement continued within the stipulated agreement for Case No. 16-0576-EL-POR for program years 2017 – 2019. All cost effective, PJM approved MW resources were bid into the 2020/2021 BRA. This resulted in 41.9 Capacity Performance MWs of energy efficiency, 30 MWs of Capacity Performance DR and 14.2 MW of Summer-Only DR) that was paired with wind resources elsewhere in PJM) clearing in the 2020/2021 auction.

Clearing MW revenue is allocated back to programs after all administrative and EM&V costs are covered. Revenue offset is allocated back to program based on percentage of MWs clearing each auction and customer class.

Duke Energy Ohio continues to keep the Duke Energy Community Partnership (the Collaborative) updated regarding the auction process.

Small Business Energy Saver Program

The purpose of Duke Energy's Small Business Energy Saver program is to reduce energy usage through the direct installation of energy efficiency measures within qualifying small non-residential Duke Energy Ohio customer facilities. All aspects of the program are administered by a Company-authorized vendor. Program measures address major end-uses in lighting, refrigeration, and HVAC applications.

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estimated kW multiplied by the previous BRA clearing price for the Duke zone and "projected costs" are defined as the costs necessary to fully qualify and bid the resources into the PJM capacity auctions.

[6] "Program Portfolio resources" is defined as the energy efficiency and demand response resources, both existing and planned, that are expected to be created under Duke's 2014 – 2016 Program Portfolio application in Case No. 13-0431-EL-POR. Program Portfolio resources specifically exclude mercantile self-direct resources, unless a self-direct mercantile customer affirmatively and explicitly chooses to grant its energy efficiency capacity resources to Duke Energy Ohio, by separate agreement.

Program participants receive a free, no-obligation energy assessment of their facility followed by a recommendation of energy efficiency measures to be installed in their facility along with the projected energy savings, costs of all materials and installation, and up-front incentive amount from Duke Energy. Upon receiving the results of the energy assessment, if the customer decides to move forward with the proposed energy efficiency project, the customer makes the final determination of which measures will be installed. The energy efficiency measure installation is then scheduled at a convenient time for the customer and the measures are installed by electrical subcontractors of the Duke Energy-authorized vendor.

The program is designed as a pay-for-performance offering, meaning that the Duke Energy-authorized vendor administering the program is only compensated for energy savings produced through the installation of energy efficiency measures.

The Small Business Energy Saver Program is available to existing Duke Energy Ohio non-residential customer accounts with an actual average annual electric demand of 180 kilowatts (kW) or less. An individual business entity's participation is limited to no more than five premises on the Company's system during a calendar year.

SmartWatt Energy Inc. (SmartWatt), a company that specializes in administering utility energy efficiency programs nationwide, similar to Small Business Energy Saver, is the Duke Energy-authorized program administration vendor in Ohio. SmartWatt is also the program administrator for the Small Business Energy Saver program in Duke Energy's Kentucky and Indiana service territories.

In 2018, there were nearly 500 Small Business Energy Saver projects completed for eligible Duke Energy Ohio customers. The program underperformed versus goals in 2018, largely because the Company-authorized vendor scaled back program operations in Ohio in the fourth quarter of 2017, which negatively affected the program's staffing and project pipeline in early 2018, issues that the vendor ultimately were not able to recover from early enough in the year to meet targets.

Small Business Energy Saver Program Potential Changes

To broaden the Small Business Energy Saver Program offering to more small and medium business customers who would benefit from the direct install model and turn-key program process, the Company expanded program availability, effective in 2018, to now include all existing non-residential customer accounts with an average annual demand of 180 kW or less, which is an increase from the previous eligibility limit of 100 kW annual average demand per account.

As the program matures, the Company will continue to evaluate the opportunity to add incentivized measures suitable for the small and medium business market to the approved program which fit the direct install program model.

Power Manager® for Business Program

Power Manager® for Business (the "Program") is an energy efficiency and demand response program for non-residential customers that will allow the Company to reduce the operation of participants air conditioning (AC) units to help manage the power grid. The Program provides customers with options on how they would like to participate in the Program. For participation in the program, Company provides participants with an annual reward applied directly to their bill.

Program participants can choose between a Wi-Fi thermostat or load control switch that will be professionally installed for free by the Program for each air conditioning or heat pump unit that they have. In addition to equipment choice, the participants also can choose at what cycling level they would like to participate. There are three levels of cycling, 30%, 50% or 75%. The levels are the percentage reduction of the normal on/off cycle of the unit. During a conservation period, Company will send a signal to the thermostat or switch to reduce the on time of the unit by the percentage selected by the participant. For participating at the 30% level the customer will receive a $50 annual bill credit for each unit, $85 for 50% cycling or $135 for 75% cycling.

Participants choosing the thermostat will be given access to a portal that will allow them to control their units from anywhere they have internet access. They can set schedules, adjust the temperature set points and receive energy conservation tips and communications from the Company. In addition to the portal access, participants will also receive conservation period notifications. This will allow participants to adjust their schedules or notify their employees of the upcoming conservation period. Finally, the participants will be allowed to override two conservation periods per year. They can do this before the conservation period starts or during the conservation period.

The Program will be offered to business customers with qualifying air conditioning systems, weekday energy usage during the months of May to September and adequate communication signal can be received by device. Customers must agree to have the control device installed on their AC system, provide broadband/Wi-Fi internet to receive the thermostat and to allow Duke Energy Ohio to control their AC system during Power Manager® for Business events.

The Power Manager® for Business program manager evaluates conditions to activate a Power Manager® event including temperature, heat index, humidity and market conditions as communicated by the regional transmission organization, PJM. In 2018 Duke Energy Ohio activated the Program on four separate occasions (twice in June and twice in September). In all the four events totaled eight hours of reduced demand and helped Duke Energy Ohio meet peak summertime demand needs and contribute to the stability of the electric grid.

The Program was promoted in 2018 through customer visits and targeted email offers along with the company website. Marketing efforts yielded approximately 508 new participants in 2018 with 675 devices. All device installations and removals on customers' AC units were completed by a third-party vendor.

4901:1-39-05(C)(2)(a)(i), O.A.C. Continued:

Number and Type of Participants and Comparison of Forecasted Savings to Achieved Savings

The number of participants or measures installed by customer type is summarized above in Table 2. Details on participation by measure are provided in Appendix A. Table 4 provides a comparison of achieved impacts for 2018 as well as the forecasted impacts for 2019.

Table 4: Comparison of Achievement to Forecasted Impacts and Trend Projection Through 2018

	Achieved Load Impacts		Forecasted Load Impacts					
	MWH 2018	MW 2018	MWH 2018	MWH 2019	MWH Total	MW 2018	MW 2019	MW Total
Other Programs								
Low Income Weatherization	330	0.1						
Residential Programs								
Energy Efficiency Education Program for Schools	3,549	1.0	3,210	3,210	6,419	0.9	0.9	1.7
Home Energy Comparison Report	102,340	26.1	98,463	93,638	192,101	25.2	23.9	49.1
Low Income Neighborhood Program	461	0.1	603	608	1,211	0.2	0.2	0.4
Low Income Weatherization - Pay for Performance	1,033	0.1	2,714	1,026	3,740	0.6	0.1	0.7
Residential Energy Assessments	3,277	0.4	2,972	3,392	6,364	0.4	0.3	0.7
Smart $aver® Residential	112,658	12.1	58,254	79,705	137,959	6.6	8.5	15.1
Power Manager®	0	71.4	0	0	0	64.3	72.9	137.2
Power Manager® for Apartments	0	0.0	0	0	0	0.0	0.0	0.0
Non Residential Programs								
Power Manager® for Business - EE	638	0.2	677	1,030	1,707	0.2	0.4	0.6
Small Business Energy Saver	16,365	3.0	23,368	15,992	39,360	4.4	3.1	7.5
Smart $aver® Non Residential Custom	29,057	3.6	29,076	25,966	55,041	3.3	3.0	6.3
Smart $aver® Non Residential Performance Incentive Program	0	0.0	0	536	536	0.0	0.1	0.1
Smart $aver® Non Residential Prescriptive	75,768	13.1	61,279	50,570	111,849	13.1	10.3	23.3
Power Manager® for Business - DR	0	1.5	0	0	0	2.9	4.1	7.1
PowerShare®	0	49.3	0	0	0	44.5	64.2	108.6
Mercantile Self-Direct	2,271	0.5	9,951	2,982	12,933	1.1	0.3	1.5
Total for All Programs	**347,747**	**183**	**290,565**	**278,654**	**569,219**	**168**	**192**	**360**

This table indicates that the achieved MWH impacts through 2018 are above the 2018 forecasted load impacts.

4901:1-39-05(C)(2)(a)(ii) O.A.C., Energy Savings Counted Toward Benchmark as a Result of Mercantile Customers

The energy savings counted towards the benchmark for 2018 as a result of energy efficiency improvements and implemented by mercantile customers and committed to the Company are 2,271 MWH.

4901:1-39-05(C)(2)(a)(iii) O.A.C., Peak Demand Reduction Counted Toward Benchmark as a Result of Mercantile Customers

The peak-demand reductions counted towards the benchmark for 2018 as a result of energy efficiency improvements and implemented by mercantile customers and committed to the Company are 0.5 MW.

4901:1-39-05(C)(2)(a)(iv) O.A.C., Peak-Demand Reductions Claimed Due to Transmission and Distribution Infrastructure Improvements

Consistent with S.B. 310, the Company's verified savings now reflect Duke Energy Ohio impacts from transmission and distribution infrastructure improvements. The associated net benefits will not be counted in the calculation of shared savings during the course of its 2017-2019 portfolio plan.

4901:1-39-05(C)(2)(b) O.A.C., Evaluation, Measurement, and Verification (EM&V)

In its Entry in Case Number 09-512-GE-UNC, July 31, 2013, the Commission stated an intention to treat the 2010 Draft Technical Reference Manual (TRM) and those comments agreed to by Vermont Energy Investment Corporation (VEIC) as a "safe harbor" rather than a mandate. As a result, Duke Energy Ohio has directed third-party evaluators to consider guidelines presented by the TRM in evaluations when appropriate going forward into the 2018 program evaluation year. It should be noted however, that the TRM provides no specific methodologies for behavior programs or direct load control.

Energy savings and peak-demand reduction values are documented in the individual program EM&V studies in the appendices. The following studies have been completed.

Power Manager Impact and Process Evaluation Report (July 2018)	**Appendix D**
PowerShare Impact and Process Evaluation Report (May 2018)	**Appendix E**
Small Business Energy Saver Evaluation Report (August 2018)	**Appendix F**
MyHER Evaluation (October 2018)	**Appendix G**
Energy Efficiency Education for Schools Program Evaluation (October 2018)	**Appendix H**
Smart $aver® Non-residential Custom Program (September 2018)	**Appendix I**
Residential Assessments Program Evaluation (October 2018)	**Appendix J**
Free LED and Online Savings Store Evaluation (September 2018)	**Appendix K**

Appendix C provides an up-to-date summary of EM&V methodologies and protocols. Any new programs or measures that will be offered in the future have not been included in Appendix C.

The cost effectiveness of the current programs is provided below in Table 5.

TABLE 5:

SB310 - 2018
Cost Effectiveness Test Results

Program Name		UCT	TRC[1]	RIM	PCT
Residential Programs					
Energy Efficiency Education Program for Schools		3.73	5.64	1.67	
Home Energy Comparison Report		2.07	2.42	1.18	
Low Income Neighborhood Program		0.70	1.89	0.58	
Residential Energy Assessments		1.90	2.44	1.00	
Smart $aver® Residential		5.65	8.25	1.58	19.66
Low Income Weatherization - Pay for Performance		1.59	5.91	0.87	
Power Manager®		13.38	35.63	13.38	
Total Residential		**4.86**	**6.71**	**1.73**	**22.61**
Non-Residential Programs					
Power Manager® for Business		1.19	1.28	1.03	
Small Business Energy Saver		2.97	1.83	1.69	2.94
Smart $aver® Non Residential Custom		4.87	0.74	1.98	1.08
Smart $aver® Non Residential Prescriptive		4.22	2.95	2.01	3.84
PowerShare®	**2**	5.22	N/A	5.22	
Total Non-Residential		**4.11**	**1.80**	**2.10**	**2.37**
Other Programs					
Mercantile Self-Direct		6.91	0.89	2.53	1.09
Total Other		**6.91**	**0.89**	**2.53**	**1.09**
Portfolio Total		**4.50**	**2.94**	**1.88**	**4.60**

1 - TRC scores include Avoided Gas Production

2 - Due to applied credits from the PJM auctions, the TRC calculation for PowerShare® is not applicable

4901:1-39-05(C)(2)(c) O.A.C., Continuation of Programs

Based on the success of the programs and positive response from customers and trade allies, Duke Energy Ohio proposes to continue with the existing portfolio of programs with modifications and additional measures as filed in Case No. 16-0576-EL-POR. The portfolio is subject to annual adjustments for changes in efficiency levels or market conditions.

The Company is continually researching other energy efficiency opportunities for both the residential and non-residential customer classes. Also, based on such factors as changing market conditions, customers' efficiency needs, etc., the Company modifies and otherwise manages existing programs as needed given contemporaneous experience. This allows it to meet its annual energy efficiency benchmarks as required.

The Company's portfolio plan, including its shared savings incentive mechanism, was approved incorporating the same banking principles that were established by the Commission's rules with respect to its energy efficiency benchmark compliance. As approved by the Commission, the Company does not double count the net benefit of energy savings achieved in a particular year for the purposes of calculating the incentive. Once energy savings are recognized in determining the Company's allowed shared savings percentage, the impacts are exhausted for the purpose of determining its annual incentive achievement level in the future. Duke Energy Ohio has entered into a stipulation related to its approved application of a new portfolio that does not allow it to earn an incentive in any year in which it does not meet its required benchmark savings and clarifies what net benefits should not be included in the calculation of shared savings in 2017 and beyond.[7]

[7] *In the Matter of the Application of Duke Energy Ohio, Inc., for Approval of its Energy Efficiency and Peak Demand Reduction Program Portfolio Plan*, Case No.16-576-EL-POR, Amended Stipulation and Recommendation, (January 27, 2017), at paragraphs 5 and 7.

4901:1-39-05(D) O.A.C., Independent Program Evaluator Report

Appendix C, provides an up-to-date summary of EM&V methodologies and protocols. Individual reports have been provided as appendices D through K.

4901:1-39-05 (E)(1) and (2)(a-b) O.A.C., Peak Demand Reductions

Duke Energy Ohio has satisfied its peak-demand reduction benchmarks through energy efficiency and peak-demand response programs implemented by the Company and programs implemented on mercantile customer sites where the mercantile program is committed to the electric utility.

4901:1-39-05(F) and (G)(1-5) O.A.C., Mercantile Customers

Duke Energy Ohio's Mercantile Self Direct program is the avenue through which mercantile customers commit energy and demand impacts from their energy efficiency projects to Duke Energy Ohio in exchange for cash rebates or commitment payments. The program uses the constructs for calculating and deeming energy and demand savings that are present in the Custom Incentive and Prescriptive Incentive programs, respectively.

Upon approval of the customer's application, Duke Energy Ohio tenders an offer letter agreement to the customer which outlines the cash rebate or commitment payment offered. After the customer signs the offer letter agreement, Duke Energy Ohio submits a mercantile application to the Commission on behalf of the customer. Upon Commission approval of the application or the passing of 60 days, Duke Energy Ohio remits payment to the customer for the agreed dollar amount.

The offer letter provided to applicants pursuant to each project submitted to Duke Energy Ohio requires the customer to affirm its intention to commit and integrate the energy efficiency projects listed in the offer into Duke Energy Ohio's peak demand reduction, demand response and/or energy efficiency programs. The offer letter agreement also requires the customer to agree to serve as joint applicant in any future filings necessary to secure approval of this arrangement as required by the Commission and to comply with any information and reporting requirements imposed by rule or as part of that approval. Noncompliance by the customer with the terms of the commitment is not applicable at this time.

The offer letter agreement template, used for each mercantile application provides for formal declaration. Additionally, the application documents located on Duke Energy Ohio's website request that the applicant allow Duke Energy Ohio to share information only with vendors associated with program administration. The release is limited to use of the information contained within the application and other relevant data solely for the purposes of reviewing the application, providing a rebate offer, submitting documentation to the Commission for approval and payment of the rebate. All program administration vendor contracts strictly prohibit the sharing of customer information for other purposes.

Upon customer request, Duke Energy Ohio will agree, as it is able to do so, to provide information to the Commission in the proper format such that confidential customer information is redacted from the public record.

With regard to the customers in Duke Energy's Ohio territory who have undertaken self-directed energy efficiency projects, these initiatives will not be evaluated by the Company's independent evaluation contactor. These efforts have been implemented in the past and were self-directed by our mercantile customers without involvement in Duke Energy Ohio's energy efficiency or demand reduction programs under Duke Energy Ohio's Shared Savings Cost Recovery mechanism. As a result they will not be included in the evaluations of Duke Energy Ohio programs.

4901:1-39-05(H), O.A.C. Prohibition Against Counting Measures Required by Law Toward Meeting the Statutory Benchmark

Duke Energy Ohio did not count, in meeting its statutory benchmark, the adoption of measures that were required to comply with energy performance standards set by law or regulation, including but not limited to, those embodied in the Energy Independence and Security Act of 2007, or an applicable building code.

4901:1-39-05 (I) and (J), O.A.C. Benchmarks Not Reasonably Achievable

The above referenced sections are not applicable to Duke Energy Ohio since it has met its statutory benchmarks.

Conclusion

With this status report, Duke Energy Ohio has demonstrated that it is in compliance with the statutory load impact requirements as measured and reported in its Benchmark Report. Duke Energy Ohio respectfully requests that the Commission find that the Company has met its compliance requirements for the 2018 compliance year.

Respectfully submitted,

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APPENDIX A - IMPACTS BY PROGRAM

SB 310 Appendix A

2018 Total Reported Achievement

Program	Customer	Product Code	Measure	Annual KWH Gross FR, @ Plant Total	Annual KW Gross FR, @ Plant Total	Participants
Grand Total				**347,746,516**	**182,505**	**18,669,498**

Other EE Programs and Impacts

Program	Customer	Product Code	Measure	Annual KWH Gross FR, @ Plant Total	Annual KW Gross FR, @ Plant Total	Participants
Low Income Weatherization	Res		Low Income Weatherization	330,068	89	313
Grand Total				**330,068**	**89**	**313**

Shared Savings and Mercantile Portfolios

Program	Customer	Product Code	Measure	Annual KWH Gross FR, @ Plant Total	Annual KW Gross FR, @ Plant Total	Participants
Energy Efficiency Education Program for Schools	Res	K12PRF	K-12 Education Program- Curriculum Post EMV	1,006,199.57	270.20	1,881.00
Energy Efficiency Education Program for Schools	Res	K12PRF	K-12 Education Program- Curriculum Pre EMV	2,542,512.78	684.03	4,753.00
		K12PRF Total		3,548,712	954	6,634
Energy Efficiency Education Program for Schools Total				3,548,712	954	**6,634**
Home Energy Comparison Report	Res	HECR	Home Energy Comparison Report - Commercialized Post EMV	93,360,943.10	23,850.80	340,197.00
Home Energy Comparison Report	Res	HECR	Home Energy Comparison Report - Commercialized Pre EMV1	88,225,789.43	22,559.07	321,749.00
Home Energy Comparison Report	Res	HECR	My Home Energy Report - Online Post EMV	3,678,760.96	939.81	13,405.00
Home Energy Comparison Report	Res	HECR	My Home Energy Report - Online Pre EMV1	3,583,473.45	916.28	11,684.00
		HECR Total		97,039,704	24,791	353,602
Home Energy Comparison Report	Res	MFHECR	Multifamily MyHER	5,211,135.65	1,332.47	43,794.00
Home Energy Comparison Report	Res	MFHECR	Multifamily MyHER Interactive	89,593.47	22.91	674.00
		MFHECR Total		5,300,729	1,355	44,468
Home Energy Comparison Report Total				102,340,433	26,146	398,070
Low Income Neighborhood Program	Res	HWLI	Low Income Neighborhood	461,045.76	142.70	1,024.00
		HWLI Total		461,046	143	1,024
Low Income Neighborhood Program Total				461,046	143	**1,024**
Low Income Weatherization - Pay for Performance	Res	WTZKWH	WTZKWH - CFL_EH	87,371.46	15.86	2,312.00
Low Income Weatherization - Pay for Performance	Res	WTZKWH	WTZKWH - CFL_NonEH	561,757.89	70.01	10,204.00
Low Income Weatherization - Pay for Performance	Res	WTZKWH	WTZKWH - Energy Efficient Shower Head_EH	346.76	0.08	2.00
Low Income Weatherization - Pay for Performance	Res	WTZKWH	WTZKWH - Energy Efficient Shower Head_NonEH	346.76	0.08	2.00
Low Income Weatherization - Pay for Performance	Res	WTZKWH	WTZKWH - Faucet Aerator_EH	80.37	0.02	4.00
Low Income Weatherization - Pay for Performance	Res	WTZKWH	WTZKWH - Refrigerator Replacement_EH	55,736.98	6.36	62.00
Low Income Weatherization - Pay for Performance	Res	WTZKWH	WTZKWH - Refrigerator Replacement_NonEH	320,238.83	36.56	234.00
Low Income Weatherization - Pay for Performance	Res	WTZKWH	WTZKWH - Water Heater Pipe Insulation_EH	1,010.53	0.23	4.00
Low Income Weatherization - Pay for Performance	Res	WTZKWH	WTZKWH - Water Heater Pipe Insulation_NonEH	2,021.07	0.45	8.00
Low Income Weatherization - Pay for Performance	Res	WTZKWH	WTZKWH - Water Heater Replacement Electric_EH	1,734.79	0.39	13.00
Low Income Weatherization - Pay for Performance	Res	WTZKWH	WTZKWH - Water Heater Replacement Electric_NonEH	1,734.79	0.39	13.00
Low Income Weatherization - Pay for Performance	Res	WTZKWH	WTZKWH - Water Heater Tank Wrap_EH	207.69	0.05	1.00
		WTZKWH Total		1,032,588	130	12,859
Low Income Weatherization - Pay for Performance Total				1,032,588	130	**12,859**
Mercantile Self-Direct	NonRes	NRCSSD	SD Custom	1,437,211.05	168.26	194.00
		NRCSSD Total		1,437,211	168	194
Mercantile Self-Direct	NonRes	NRPRSD	SD Exterior HID replacement above 175W to 250W HID retrofit	38,157.05		45.00
Mercantile Self-Direct	NonRes	NRPRSD	SD VFD HVAC Fan	14,099.05	0.98	13.00
Mercantile Self-Direct	NonRes	NRPRSD	SD Window Film	571,183.62	248.60	130,198.00
Mercantile Self-Direct	NonRes	NRPRSD	SelfDirect LED Highbay replacing 251-400W HID	209,984.70	42.41	188.00
		NRPRSD Total		833,424	292	130,444
Mercantile Self-Direct Total				2,270,635	460	**130,638**
Power Manager®	Res	PWRMGR	PowerManager - 0.5 Low		30.44	
Power Manager®	Res	PWRMGR	PowerManager - 1.0 Med		59,700.00	
Power Manager®	Res	PWRMGR	PowerManager - 1.5 High		11,693.38	
		PWRMGR Total			71,424	
Power Manager® Total					71,424	
Power Manager® for Business - DR	NonRes	SBEEDR-DR	SBDR Switch 30% DR - Midwest		21.71	
Power Manager® for Business - DR	NonRes	SBEEDR-DR	SBDR Therm 30% DR - Midwest		1,170.01	
Power Manager® for Business - DR	NonRes	SBEEDR-DR	SBDR Therm 50% DR - Midwest		145.83	
Power Manager® for Business - DR	NonRes	SBEEDR-DR	SBDR Therm 75% DR - Midwest		162.49	
		SBEEDR-DR Total			1,500	
Power Manager® for Business - DR Total					1,500	

Power Manager® for Business - EE	NonRes	SBEEDR	SBDR Thermostat EE	637,522.69	234.97	682.00
		SBEEDR Total		637,523	235	682
Power Manager® for Business - EE Total				637,523	235	**682**
PowerShare®	NonRes	PWRSHR	PowerShare - Annual		15,105.55	
PowerShare®	NonRes	PWRSHR	PowerShare - Extended Summer			
PowerShare®	NonRes	PWRSHR	PowerShare - Summer Only		34,211.81	
		PWRSHR Total			49,317	
PowerShare® Total					49,317	
Residential Energy Assessments	Res	HEHC	Home Energy House Call - Additional LED Post EMV	123,591.58	12.05	2,276.00
Residential Energy Assessments	Res	HEHC	Home Energy House Call - Additional LED Pre EMV	540,251.59	52.69	9,949.00
Residential Energy Assessments	Res	HEHC	Home Energy House Call - Kit w LEDs Post EMV	595,286.75	53.50	577.00
Residential Energy Assessments	Res	HEHC	Home Energy House Call - Kit w LEDs Pre EMV	2,018,043.08	254.44	2,371.00
		HEHC Total		3,277,173	373	15,173
Residential Energy Assessments Total				3,277,173	373	**15,173**
Small Business Energy Saver	NonRes	SSBDIR	SBES HVAC HP	112,696.14	24.05	105,127.00
Small Business Energy Saver	NonRes	SSBDIR	SBES Lighting 8760 Post EMV	1,096,061.50	92.64	983,141.00
Small Business Energy Saver	NonRes	SSBDIR	SBES Lighting 8760 Pre EMV	1,134,909.29	99.76	1,058,706.00
Small Business Energy Saver	NonRes	SSBDIR	SBES Lighting Daylighting Post EMV	5,590,937.28	1,115.86	5,075,192.00
Small Business Energy Saver	NonRes	SSBDIR	SBES Lighting Daylighting Pre EMV	6,137,286.48	1,273.90	5,793,988.00
Small Business Energy Saver	NonRes	SSBDIR	SBES Lighting DusktoDawn Post EMV	880,000.32	148.65	788,799.00
Small Business Energy Saver	NonRes	SSBDIR	SBES Lighting DusktoDawn Pre EMV	850,757.16	149.46	793,090.00
Small Business Energy Saver	NonRes	SSBDIR	SBES OccSensors Post EMV	31,608.81	6.31	28,693.00
Small Business Energy Saver	NonRes	SSBDIR	SBES OccSensors Pre EMV	6,862.89	1.42	6,479.00
Small Business Energy Saver	NonRes	SSBDIR	SBES Refrigeration Post EMV	144,690.58	12.23	129,784.00
Small Business Energy Saver	NonRes	SSBDIR	SBES Refrigeration Pre EMV	379,243.22	33.34	353,779.00
		SSBDIR Total		16,365,054	2,958	15,116,778
Small Business Energy Saver Total				16,365,054	2,958	**15,116,778**
Smart $aver® Non Residential Custom	NonRes	NRPRSC	Custom	29,056,902.40	3,612.68	4,070.00
		NRPRSC Total		29,056,902	3,613	4,070
Smart $aver® Non Residential Custom Total				29,056,902	3,613	**4,070**
Smart $aver® Non Residential Prescriptive	NonRes	NRFS	Anti-sweat Heater Controls	358,899.70	1.18	200.00
Smart $aver® Non Residential Prescriptive	NonRes	NRFS	Combination Oven_10 pan	62,772.22	11.60	9.00
Smart $aver® Non Residential Prescriptive	NonRes	NRFS	Convection Oven Full-Sized	7,926.78	1.46	1.00
Smart $aver® Non Residential Prescriptive	NonRes	NRFS	ECM Case Motors	26,459.17	3.02	74.00
Smart $aver® Non Residential Prescriptive	NonRes	NRFS	ECM Refrigerated or Freezer Display Case Motors - ECM replacing PSC	39,899.79	4.55	5.00
Smart $aver® Non Residential Prescriptive	NonRes	NRFS	ECM Refrigerated or Freezer Display Case Motors - ECM replacing SP	49,806.21	5.69	2.00
Smart $aver® Non Residential Prescriptive	NonRes	NRFS	ECM Walk-In Cooler and Freezer Motors - ECM replacing SP	62,900.94	7.60	3.00
Smart $aver® Non Residential Prescriptive	NonRes	NRFS	FHAC_Variable Speed_1996-2003 (eff 11.30.15)	72,554.96	10.05	76.00
Smart $aver® Non Residential Prescriptive	NonRes	NRFS	Floating Suction_1996-2003	16,106.36		76.00
Smart $aver® Non Residential Prescriptive	NonRes	NRFS	HT ES Sngl Tank - CNV DW w-Boost Htr (Elec) New -repl on BO	21,460.68	2.64	2.00
Smart $aver® Non Residential Prescriptive	NonRes	NRFS	HT ES Sngl Tank - CNV DW w-Boost Htr (Gas) New -repl on BO	40,586.06	5.00	5.00
Smart $aver® Non Residential Prescriptive	NonRes	NRFS	HT ES UC DW w-Boost Htr (Elec) New -repl on BO	3,617.18	0.45	1.00
Smart $aver® Non Residential Prescriptive	NonRes	NRFS	Pre Rinse Sprayers	1,496.48	0.12	1.00
Smart $aver® Non Residential Prescriptive	NonRes	NRFS	Steamer_6 pan	122,477.36	23.47	4.00
Smart $aver® Non Residential Prescriptive	NonRes	NRFS	Zero Energy Doors_Med-Temp Cooler	102,053.97	11.65	68.00
		NRFS Total		989,018	88	527
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	0.5 gpm Faucet Aerator (DI) - COMM, pvt use	5,282.71	0.78	22.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	1.0 gpm Faucet Aerator (DI) - COMM, pvt use	25,744.62	3.75	152.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	1.5 gpm Low Flow Showerhead (DI) - COMM, public use	850.08	0.03	1.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	Air Cooled Chiller_Any greater than 150 tons	271,958.81	359.19	3,608.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	Air Cooled Chiller_Any less than 150 tons	51,127.95	66.20	665.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	ARC 10 to 15 Ton Gas Heat	85,692.33	21.88	123.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	ARC greater than 15 Ton Gas Heat	156,788.05	39.51	182.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	ARC less than 10 Ton Gas Heat	9,065.90	2.35	15.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	CoolRoof New Replace on Burnout Medium Offic-sq ft	882.21	0.99	3,900.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	CoolRoof New Replace on Burnout Other-sq ft	49,098.76	6.65	143,063.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	DCV Retrofit Retail - per sq ft	3,041.31	13.59	16,177.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	Guest Room Energy Management, Electric Heating	89,709.76	18.72	125.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	High Efficiency Fans 24 to 35 inches - C&I	5,846.96	1.55	13.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	High Volume Low Speed Fan	82,964.16	21.97	6.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	HVAC DX AC 135-240kBtuh 11.7 EER (Tier 0_1)	31,038.52	24.41	360.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	HVAC DX AC 135-240kBtuh 12.2 EER (Tier 2)	17,878.25	14.06	139.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	HVAC DX AC 240-760kBtuh 10.5 EER (Tier 0_1)	55,501.95	43.65	674.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	HVAC DX AC 240-760kBtuh 10.5 EER (Tier 0_1) - EER only	5,799.28	3.17	70.00

Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	HVAC DX AC 240-760kBtuh 10.8 EER (Tier 2)	21,844.86	17.18	191.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	HVAC DX AC 65-135kBtuh 11.7 EER (Tier 0_1)	3,621.16	2.85	55.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	HVAC DX AC 65-135kBtuh 11.7 EER (Tier 0_1) - EER only	458.82	0.25	7.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	HVAC DX AC 65-135kBtuh 12.2 EER (Tier 2)	11,040.65	8.68	102.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	HVAC DX AC greater than 760kBtuh 10.4 EER (Tier 2)	9,924.16	7.80	90.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	HVAC DX AC less than 65kBtuh 14 SEER (Tier 0_1)	2,194.87	1.90	33.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	HVAC DX AC less than 65kBtuh 15 SEER (Tier 2)	5,462.78	4.73	44.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	HVAC DX mini split AC 15 SEER	248.31	0.21	2.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	HVAC DX mini split AC 20 SEER	4,301.94	3.38	12.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	HVAC DX mini split HP 20 SEER 9.6 HSPF	422.51	0.22	1.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	HVAC DX PTAC 12000 Btuh 10.7 EER	166.37	0.13	3.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	HVAC DX PTAC 15000 Btuh 9.8 EER	166.02	0.13	2.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	HVAC DX PTAC 7600 Btuh 12.2 EER	1,706.29	1.34	46.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	Setback Programmable Thermostat	1,403,183.92	(0.26)	557.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	Water Cooled Chiller_Centrifugal at least 150 tons and less than 300 tons	9,578.48	14.23	299.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	Water Cooled Chiller_Centrifugal at least 300 tons and less than 600 tons	16,017.53	23.40	500.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	Water Cooled Chiller_Centrifugal at least 600 tons	41,645.58	60.84	1,300.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	Water Heater Pipe Insulation	3,962.03	0.37	48.00
Smart $aver® Non Residential Prescriptive	NonRes	NRHVAC	Window Film	36,500.16	15.89	8,320.00
		NRHVAC Total		2,520,718	806	180,907
Smart $aver® Non Residential Prescriptive	NonRes	NRIT	Controlled Plug Strip	7,932.64		74.00
		NRIT Total		7,933	-	74
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	CFL Reflector Flood	360,617.61	73.30	1,480.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	CFL Screw high wattage	154,084.37	31.31	312.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	CFL Screw in, Specialty	42,812.54	8.72	180.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	Daylighting Control with Occupancy Sensors	18,600.40	17.29	16,024.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	Exterior HID replacement above 175W to 250W HID retrofit	340,869.63		402.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	Exterior HID replacement above 175W to 250W HID retrofit Lamp	819.80		1.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	Exterior HID replacement above 250W to 400W HID retrofit	9,360,938.64		6,128.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	Exterior HID replacement above 250W to 400W HID retrofit Lamp	73,197.91		53.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	Exterior HID replacement above 400W HID retrofit	1,638,540.53		697.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	Exterior HID replacement to 175W HID retrofit	319,573.72		507.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	Garage HID replacement above 175W to 250W HID retrofit	57,623.86	6.85	34.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	Garage HID replacement to 175W HID retrofit	762,960.88	91.04	777.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	High Bay 4L T-5 High Output	5,165.09	0.95	5.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	High Bay T8 4ft Fluorescent 6 Lamp (F32 Watt T8)	113,693.78	21.01	109.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	High Performance Low Watt T8 4ft 1 lamp, replacing standard T8	1,314.98	0.22	20.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	High Performance Low Watt T8 4ft 2 lamp, replacing standard T8	27,238.97	4.61	290.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	High Performance Low Watt T8 4ft 3 lamp, replacing standard T8	49,499.79	8.38	310.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	High Performance Low Watt T8 4ft 4 lamp, replacing standard T8	10,144.17	1.72	60.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	High Performance T8 4ft 4 lamp, replacing standard T8	69,281.74	11.71	522.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED 2ft Tube 1-LED, replacing or in lieu of T8 fluorescent	228,470.34	47.78	5,043.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED 4ft Case Lights, T8 to LED	649.14	0.11	7.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED 4ft Tube 1-LED, replacing or in lieu of T5HO fluorescent	1,292,639.59	270.33	9,927.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED 4ft Tube 1-LED, replacing or in lieu of T8 fluorescent	18,485,684.86	3,865.94	301,232.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED 5ft Case Lights, T8 to LED	20,030.50	3.49	171.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED 5ft Case Lights, T8 to LED - With Controls	609.11	0.09	4.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED A Lamps	1,776,858.04	371.60	11,111.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED Canopy replacing 176-250W HID	88,979.80		63.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED Canopy replacing 251-400W HID	247,151.06		143.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED Canopy replacing up to 175W HID	88,165.47		80.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED Canopy replacing up to 175W HID Lamp	2,138.21	0.45	6.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED Decorative, Globe, 3-Way Lamps	197,370.89	41.28	1,141.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED Display Case (rplcng or ILO INCD or FL display case Ltng)	4,762.12	1.04	60.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED Downlight	632,226.76	143.69	2,234.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED Exit Signs Electronic Fixtures (Retrofit Only)	112,283.88	15.22	458.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED FLD rplcng or ILO greater than 500W HAL, INCD, or HID	1,982,559.97		494.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED FLD rplcng or ILO GRT 100W HAL, INCD, or HID	254,562.36		457.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED FLD rplcng or ILO up to 100W HAL, INCD, or HID	2,786.71		17.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED Highbay Fixture replacing 2-lamp 8ft T12 fixture	142,334.95	29.77	317.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED Highbay Fixture replacing 4-lamp 4ft T5HO fixture	253,994.86	53.12	539.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED Highbay Fixture replacing 6-lamp 4ft T8 fixture	288,971.51	60.43	972.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED Highbay replacing 251-400W HID	6,407,884.14	1,294.23	5,737.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED Highbay replacing 251-400W HID Lamp	430,444.07	90.09	363.00

Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED Highbay replacing greater than 400W HID	2,727,185.97	550.82	1,329.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED Highbay replacing greater than 400W HID Lamp	921,168.65	192.80	306.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED Indoor Sport Lighting	111,124.79	24.91	42.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED Lowbay replacing 176W-250W HID	337,769.69	68.22	424.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED Lowbay replacing 176W-250W HID Lamp	38,462.77	8.04	55.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED Lowbay replacing up to 175W HID	235,651.82	47.60	469.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED Panel 1x4 replacing or in lieu of T8 FL	312,880.64	67.04	3,640.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED Panel 2x2 replacing or in lieu of T8 FL	249,876.35	53.54	4,621.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED Panel 2x4 replacing or in lieu of T8 FL	15,127,463.05	3,241.24	37,119.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED PAR, BR, MR Lamps	1,836,273.35	384.02	11,316.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	LED Track Ltng (rplcng or ILO INCD, HAL, CFL, or HID track Ltng)	93,622.35	20.39	442.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	Low Watt T8 lamps 2-4ft, replacing standard 32 Watt T8	374,280.64	62.18	9,776.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	Occupancy Sensors per Watt	335,162.99	55.75	309,958.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	Occupancy Sensors under 500 Watts	1,043,741.87	469.41	3,560.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	Photocells	11,507.09		18,652.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	Photocells with Time Clocks	4,211.37		1,930.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	Remote-Mounted Daylight Sensor	6,126.35	1.55	15.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	Switch or Fixture Mounted Daylight Sensor per Watt	259.52	0.26	240.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	Switch or Fixture-Mounted Daylight Sensor	7,562.80	1.90	83.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	Switching Controls for Multi-Level Lighting	105,204.62	89.83	97,293.00
Smart $aver® Non Residential Prescriptive	NonRes	NRLTG	Time Clocks External Lighting	56,137.72		35,868.00
		NRLTG Total		70,284,211	11,905	905,625
Smart $aver® Non Residential Prescriptive	NonRes	NRP&M	1.5 Horse Power High Efficiency Pumps	950.48		4.00
Smart $aver® Non Residential Prescriptive	NonRes	NRP&M	10 Horse Power High Efficiency Pumps	6,477.35	1.37	3.00
Smart $aver® Non Residential Prescriptive	NonRes	NRP&M	15 Horse Power High Efficiency Pumps	3,536.00	0.69	1.00
Smart $aver® Non Residential Prescriptive	NonRes	NRP&M	2 Horse Power High Efficiency Pumps	1,295.47	0.27	3.00
Smart $aver® Non Residential Prescriptive	NonRes	NRP&M	20 Horse Power High Efficiency Pumps	28,286.25	5.49	6.00
Smart $aver® Non Residential Prescriptive	NonRes	NRP&M	3 Horse Power High Efficiency Pumps	1,295.47	0.27	2.00
Smart $aver® Non Residential Prescriptive	NonRes	NRP&M	5 Horse Power High Efficiency Pumps	2,053.51	0.46	2.00
Smart $aver® Non Residential Prescriptive	NonRes	NRP&M	7.5 Horse Power High Efficiency Pumps	6,178.12		6.00
Smart $aver® Non Residential Prescriptive	NonRes	NRP&M	VFD HVAC Fan	417,548.82	28.89	385.00
Smart $aver® Non Residential Prescriptive	NonRes	NRP&M	VFD HVAC Pump	701,473.92	93.20	420.00
Smart $aver® Non Residential Prescriptive	NonRes	NRP&M	VFD on Chilled Water Pump	35,372.00	10.61	64.00
Smart $aver® Non Residential Prescriptive	NonRes	NRP&M	VFD on Hot Water Pump	33,323.93		30.00
Smart $aver® Non Residential Prescriptive	NonRes	NRP&M	VFD Process Pump 1-50 HP	524,676.70	63.99	105.00
		NRP&M Total		1,762,468	205	1,031
Smart $aver® Non Residential Prescriptive	NonRes	NRPROC	VSD Air COMP replacing load no load COMP	204,083.13	49.29	380.00
		NRPROC Total		204,083	49	380
Smart $aver® Non Residential Prescriptive Total				75,768,431	13,054	**1,088,544**
Smart $aver® Residential	Res	HPWH	Heat Pump Water Heater	56,207.38	4.30	20.00
		HPWH Total		56,207	4	20
Smart $aver® Residential	Res	MFEEAR	Faucet Aerators MF Direct 1.0 GPM - bath	25,378.97	3.34	403.00
Smart $aver® Residential	Res	MFEEAR	Faucet Aerators MF Direct 1.0 GPM - kitchen	36,438.53	4.79	291.00
		MFEEAR Total		61,817	8	694
Smart $aver® Residential	Res	MFEEPW	Pipe Wrap MF Direct	55,517	6	1,006
		MFEEPW Total		55,517	6	1,006
Smart $aver® Residential	Res	MFEESH	LF Showerhead MF Direct 1.5 GPM	157,015	13	432
		MFEESH Total		157,015	13	432
Smart $aver® Residential	Res	MPSMTS	Marketplace Smart Thermostats	1,735,345		3,282
		MPSMTS Total		1,735,345	-	3,282
Smart $aver® Residential	Res	PEEPVS	Pool Pump	374,321	140	221
		PEEPVS Total		374,321	140	221
Smart $aver® Residential	Res	RCFLSP	RCFLSP - Specialty Bulbs 3 Way LED Post EMV	9,934	1	210
Smart $aver® Residential	Res	RCFLSP	RCFLSP - Specialty Bulbs 3 Way LED Pre EMV	66,622	6	1,409
Smart $aver® Residential	Res	RCFLSP	RCFLSP - Specialty Bulbs Candelabra LED Post EMV	173,828	25	6,016
Smart $aver® Residential	Res	RCFLSP	RCFLSP - Specialty Bulbs Candelabra LED Pre EMV	243,136	23	12,480
Smart $aver® Residential	Res	RCFLSP	RCFLSP - Specialty Bulbs Globe LED Post EMV	169,370	25	5,626
Smart $aver® Residential	Res	RCFLSP	RCFLSP - Specialty Bulbs Globe LED Pre EMV	303,961	28	16,045
Smart $aver® Residential	Res	RCFLSP	RCFLSP - Specialty Bulbs Recessed Outdoor LED Post EMV	5,219	0	41
Smart $aver® Residential	Res	RCFLSP	RCFLSP - Specialty Bulbs Recessed Outdoor LED Pre EMV	338,279	6	2,632
Smart $aver® Residential	Res	RCFLSP	Specialty Bulbs A Line LED Post EMV	118,274	12	2,180
Smart $aver® Residential	Res	RCFLSP	Specialty Bulbs A Line LED Pre EMV	385,708	38	7,103
Smart $aver® Residential	Res	RCFLSP	Specialty Bulbs Recessed LED Post EMV	547,317	74	11,345
Smart $aver® Residential	Res	RCFLSP	Specialty Bulbs Recessed LED Pre EMV	1,113,238	100	23,086

		RCFLSP Total		3,474,886	336	88,173
Smart $aver® Residential	Res	RLED	RLED - Free LED Phase 1 Post EMV	24,212,763	2,362	445,890
Smart $aver® Residential	Res	RLED	RLED - Free LED Phase 1 Pre EMV	29,296,363	2,857	539,507
Smart $aver® Residential	Res	RLED	RLED - Free LED Phase 2	31,864,146	3,108	586,794
		RLED Total		85,373,273	8,327	1,572,191
Smart $aver® Residential	Res	RLEDPM	RLEDPM-ALINE	284,489	28	5,239
Smart $aver® Residential	Res	RLEDPM	RLEDPM-CANDELABRA	56,860	5	2,043
Smart $aver® Residential	Res	RLEDPM	RLEDPM-GLOBE	20,568	2	760
		RLEDPM Total		361,917	35	8,042
Smart $aver® Residential	Res	RTLLED	LED - Retail A Line LED - 2016	2,216,232	216	40,813
Smart $aver® Residential	Res	RTLLED	LED - Retail Fixture LED	567,638	52	14,374
Smart $aver® Residential	Res	RTLLED	LED - Retail Reflector Outdoor LED	1,833,245	167	14,409
Smart $aver® Residential	Res	RTLLED	LED - Retail Reflector Recessed LED	2,146,505	195	45,986
Smart $aver® Residential	Res	RTLLED	LED - Retail Reflector Track LED	20,480	2	836
Smart $aver® Residential	Res	RTLLED	LED - Retail Specialty 3 Way	81,422	7	1,722
Smart $aver® Residential	Res	RTLLED	LED - Retail Specialty Decorative LED	669,441	61	34,465
Smart $aver® Residential	Res	RTLLED	LED - Retail Specialty Globe LED	426,644	39	22,521
		RTLLED Total		7,961,607	738	175,126
Smart $aver® Residential	Res	SFEEAR	Faucet Aerators SF DIY 1.0 GPM - bath	1,406,803	111	11,836
Smart $aver® Residential	Res	SFEEAR	Faucet Aerators SF DIY 1.0 GPM - kitchen	1,846,463	147	3,816
		SFEEAR Total		3,253,266	258	15,652
Smart $aver® Residential	Res	SFEEPW	Pipe Wrap SF DIY	940,873	76	19,080
		SFEEPW Total		940,873	76	19,080
Smart $aver® Residential	Res	SFEESH	LF Showerhead SF DIY 1.5 GPM	2,799,843	223	5,963
		SFEESH Total		2,799,843	223	5,963
Smart $aver® Residential	Res	SSAC	Smart Saver - Central Air Conditioner	50,412	31	60
		SSAC Total		50,412	31	60
Smart $aver® Residential	Res	SSAC2N	Smart Saver - Central Air Conditioner Tier 2 - Non-Referred	1,584,705	920	1,473
		SSAC2N Total		1,584,705	920	1,473
Smart $aver® Residential	Res	SSAC2R	Smart Saver - Central Air Conditioner Tier 2 - Referred	12,914	7	13
		SSAC2R Total		12,914	7	13
Smart $aver® Residential	Res	SSAC3N	Smart Saver - Central Air Conditioner Tier 3 - Non-Referred	569,428	329	420
		SSAC3N Total		569,428	329	420
Smart $aver® Residential	Res	SSAC3R	Smart Saver - Central Air Conditioner Tier 3 - Referred	11,267	7	9
		SSAC3R Total		11,267	7	9
Smart $aver® Residential	Res	SSAISN	Smart Saver - Attic Insul & Air Sealing - Non-Referred	235,430	73	189
		SSAISN Total		235,430	73	189
Smart $aver® Residential	Res	SSAISR	Smart Saver - Attic Insul & Air Sealing - Referred	85,951	26	69
		SSAISR Total		85,951	26	69
Smart $aver® Residential	Res	SSDINN	Smart Saver - Duct Insulation - Non-Referred	1,878	1	2
		SSDINN Total		1,878	1	2
Smart $aver® Residential	Res	SSDSEN	Smart Saver - Duct Sealing - Non-Referred	11,764	9	17
		SSDSEN Total		11,764	9	17
Smart $aver® Residential	Res	SSDSER	Smart Saver - Duct Sealing - Referred	8,445	7	13
		SSDSER Total		8,445	7	13
Smart $aver® Residential	Res	SSHP	Smart Saver - Heat Pump	27,447	10	23
		SSHP Total		27,447	10	23
Smart $aver® Residential	Res	SSHP2N	Smart Saver - Heat Pump Tier 2 - Non-Referred	1,360,828	220	409
		SSHP2N Total		1,360,828	220	409
Smart $aver® Residential	Res	SSHP2R	Smart Saver - Heat Pump Tier 2 - Referred	6,145	1	2
		SSHP2R Total		6,145	1	2
Smart $aver® Residential	Res	SSHP3N	Smart Saver - Heat Pump Tier 3 - Non-Referred	1,075,395	299	242
		SSHP3N Total		1,075,395	299	242
Smart $aver® Residential	Res	SSHP3R	Smart Saver - Heat Pump Tier 3 - Referred	12,310	3	3
		SSHP3R Total		12,310	3	3
Smart $aver® Residential	Res	SSSTN	Smart Thermostat - Non-Referred	984,525		1,862
		SSSTN Total		984,525	-	1,862
Smart $aver® Residential	Res	SSSTR	Smart Thermostat - Referred	13,219		25
		SSSTR Total		13,219	-	25
Smart $aver® Residential Total				112,657,951	12,109	**1,894,713**
Grand Total				**347,416,447.88**	**182,415.81**	**18,669,185.00**

1 My Home Energy Report impacts are annualized. Pre EMV annualized impacts (as of October 2018) are presented for reference only and not included in claimed impact achievements or totals.

APPENDIX B -
Affidavit of Trisha A. Haemmerle

AFFIDAVIT
OF
TRISHA A. HAEMMERLE

COMES NOW Trisha A. Haemmerle being duly sworn, deposes and says:

1. My name is Trisha A. Haemmerle. I am employed by Duke Energy Business Services, Inc. as Senior Strategy and Collaboration Manager.

2. This Affidavit will be filed with the Ohio Public Utilities Commission in support of Duke Energy Ohio's Annual Energy Efficiency Portfolio Status Report (the Report) which is required by Ohio Administrative Code §4901:1-39-05(C).

3. As Senior Strategy and Collaboration Manager, I have responsibility for overseeing the demand side management regulatory requirements for Ohio. As part of my professional responsibilities I assisted with the underlying analysis and preparation of Duke Energy Ohio's Report.

4. The information contained within the Report is true and accurate to the best of my knowledge.

5. The performance detailed in the Report demonstrates that Duke Energy Ohio has complied with the statutory benchmarks contained in Ohio Revised Code 4928.66.

FURTHER AFFIANT SAITH NOT.

Trisha A. Haemmerle

State of Ohio)
) SS:
County of Hamilton)

Subscribed to and sworn to before me this 22nd day of March 2019.

NOTARY PUBLIC STATE OF OHIO

E. MINNA ROLFES-ADKINS
Notary Public, State of Ohio
My Commission Expires
July 8, 2022

Notary Public

APPENDIX C -
2019 EMV PLANS & SCHEDULE

Schedule of Planned[1] Evaluation Activities and Reports

Residential Customer Programs	Program/ Measure	Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020
Energy Education Program for Schools	K12 Curriculum								
Low Income Neighborhood			M&V	M&V	M&V	2020 Report			
Low Income Weatherization	Pay for Performance				M&V	M&V	M&V	2020 Report	
My Home Energy Report	MyHER								
Res Energy Assessments	HEHC								
Residential Smart Saver®	HVAC								
	Lighting (Online Store)						M&V	M&V	2020 Report
	Lighting (Retail)			M&V	2019 Report				
	Multi-Family		M&V	M&V	2019 Report				
	Save Energy & Water				M&V	Report			
Power Manager		M&V	2018 Report	M&V	M&V	M&V	2019 Report	M&V	M&V

Non-Residential Customer Programs	Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020
Power Manager for Business								
Small Business Energy Saver								
Smart $aver® Custom								
Smart $aver® Prescriptive								
PowerShare®	M&V	2018-19 Report	M&V	M&V	M&V	2019-20 Report	M&V	M&V

LEGEND	
M&V	Plan Development and Data collection (surveys, interviews, onsite visits, billing data) and analysis
Report	Evaluation Report

[1] Note: evaluation report dates are subject to change. Those programs without reports scheduled in 2019 and 2020 have EM&V activities planned during those time periods.

Description of Planned Evaluation Activities by Program

Duke Energy Ohio has contracted with several independent, third-party evaluation consultants for each program in the portfolio to provide the appropriate Evaluation, Measurement & Verification support for planned evaluations. The work performed by the evaluation consultant varies by program and includes the development of a complete evaluation plan and the implementation of that plan to collect data and conduct impact evaluation analysis to estimate energy and demand savings resulting from the program. If included in the plan, the evaluation consultant conducts data collection and analysis for process evaluation to provide unbiased information on past program performance, current implementation strategies and opportunities for future improvements. The following section provides general descriptions of the current plans, which are subject to change in the complete evaluation plans.

Residential Programs

Energy Education Program for Schools

Evaluation, measurement and verification actions will provide an independent, third-party report of energy savings attributable to the program including an impact analysis and process evaluation.

The process evaluation is planned to include program manager, implementer and teacher surveys/interviews to assess program operations, and student family surveys to assess program awareness, satisfaction, and compliance with installations and recommendations. For the theater component, the process evaluation is planned to consist of interviews with school administrators and a review of the theatrical presentation and program operations. A statistically representative sample of participants will be selected for the analysis.

The impact analysis is planned to consist of engineering estimate to determine program impacts. Engineering inputs will consist of data collected through the participant survey. This analysis will provide measure level savings to offer insight into individual measure contributions to overall program impacts. Free-ridership and spillover are expected to be part of the net-to-gross analysis.

Low Income Neighborhood

Evaluation, measurement and verification actions will provide an independent, third-party report of energy savings attributable to the program including an impact analysis and process evaluation.

The impact analysis is planned to consist of a billing analysis to determine program impacts using a comparison of treated homes versus a comparison group of not-yet-treated homes. An engineering analysis is also planned to be conducted using data collected through the participant survey. This analysis will provide measure level savings to offer insight into individual measure contributions to overall program impacts. The billing analysis approach will incorporate the effects of both free ridership and spillover, thus providing program net savings. Since the billing analysis incorporates the effects of free ridership and spillover, a separate net-to-gross analysis is not included in the evaluation.

The process evaluation is planned to include a participant survey to collect information on energy efficiency actions taken because of the program, prior intentions, and changes in other major end uses, changes in household occupancy, persistence and program satisfaction. A statistically representative sample of participants will be selected for analysis. In addition, the process evaluation is planned to include program manager and implementer interviews to assess program operations, and program and measure satisfaction.

Low Income Weatherization (Pay for Performance)

The pilot evaluation, measurement and verification report provided an independent, third-party report of energy savings attributable to the program including an impact evaluation.

The impact analysis consisted of a review of program tracking data, measure installation verification reports from the independent inspector, and work-papers supporting the deemed energy savings values assigned to each measure. The program was filed in early 2018. A tentative evaluation is planned for completion in the third quarter of 2020, however this schedule assumes there is sufficient program participation with which to conduct an evaluation.

My Home Energy Report (MyHER)

Evaluation, measurement and verification actions will provide an independent, third-party report of energy savings attributable to the program including an impact analysis and process evaluation.

The MyHER program involves a control group of customers that is randomly assigned to be used in the impact analysis. The impact evaluation is planned to consist of a billing analysis, specifically a difference in differences regression model to estimate impacts of the treatment group versus the control group. Differences in impacts between the two groups are attributed to the MyHER program. Incremental uptake of energy efficiency measures will be used to adjust savings to be net of other Duke Energy energy efficiency programs.

The process evaluation is planned to include program manager and implementer interviews to assess program effectiveness. A participant survey will be used to collect information on energy efficiency actions taken because of the program, prior intentions, and changes in other major end uses, changes in household occupancy, persistence and program satisfaction. A statistically representative sample of participants will be selected for analysis.

Residential Energy Assessments

Evaluation, measurement and verification actions will provide an independent, third-party report of energy savings attributable to the program including an impact analysis and process evaluation.

The impact analysis is planned to consist of a billing analysis to determine program impacts using a comparison of participants who participated during the evaluation period versus a comparison group of participants who participated during a post-evaluation period. An engineering analysis is also planned to be conducted using data collected through the participant survey. This analysis will provide measure level savings to offer insight into individual measure contributions to overall program impacts. The billing analysis approach will incorporate the effects of both free ridership and spillover, thus providing program net savings. Since the billing analysis incorporates the effects of free ridership and spillover, a separate net-to-gross analysis is not included in the evaluation.

The process evaluation is planned to employ program staff interviews and participant surveys. Participant survey questions include perceived barriers to program participation, marketing and outreach tactics, and program satisfaction.

Residential Smart $aver®: HVAC

Evaluation, measurement and verification actions will provide an independent, third-party report of energy savings attributable to the program including an impact analysis and process evaluation.

The impact evaluation utilizes a multi-faceted technique for estimating savings:

- **Engineering Calculations:** The evaluation team may utilize engineering algorithms with field measurement and verification parameters to estimate energy consumption and savings.
- **On-Site Metering & Verification:** The evaluation team may include an in-situ metering study to estimate operational hours of air source heat pumps and central air conditioners, on-site verification of attic insulation and air sealing projects, and verification surveys with program participants paired with engineering desk analyses to estimate gross savings for all measures in the program.
- **Deemed Savings:** In some limited cases, the evaluation team may utilize deemed per-unit savings estimates from Ohio technical reference manual, as needed.

The process evaluation includes interviews with program staff, program implementer, and most-active trade allies. Surveys will be conducted among less-active trade allies and with participants to estimate free-ridership and uncover potential issues that might impact customer satisfaction or program effectiveness. A statistically representative sample of participants will be selected for the analysis.

Residential Smart $aver®: Online Savings Store

Evaluation, measurement and verification actions will provide an independent, third-party report of energy savings attributable to the program including an impact analysis and process evaluation.

The impact analysis is planned to use an engineering analysis to determine program savings, utilizing the savings algorithms and parameters provided by the Ohio or other relevant TRMs, with updated values of some parameters using data collected through a participant survey and an engineering analysis. A statistically representative sample of participants will be selected for the analysis.

The process evaluation is planned to include program staff interviews and participants to estimate net-to-gross and uncover potential issues that might impact customer satisfaction or program effectiveness. A statistically representative sample of participants will be selected for the analysis.

A completed evaluation is tentatively planned for the fourth quarter of 2020 since additional non-lighting measures have been added to the program. Final evaluation report timing is however dependent upon whether there will be sufficient participation for the non-lighting measures.

Residential Smart $aver®: Retail Lighting

Evaluation, measurement and verification actions will provide an independent, third-party report of energy savings attributable to the program including an impact analysis and process evaluation.

The impact analysis is planned to use an engineering analysis to determine program savings, utilizing the savings algorithms and parameters provided by the Ohio or other relevant TRMs.

The process evaluation is planned to include program staff interviews. In addition, interviews with retailers/manufacturers and sales data modeling will estimate net-to-gross and the state of the lighting market.

A completed evaluation is tentatively planned for the fourth quarter of 2019.

Residential Smart $aver®: Multi-Family

Evaluation, measurement and verification actions will provide an independent, third-party report of energy savings attributable to the program including an impact analysis and process evaluation.

The impact analysis is planned to consist of an engineering analysis, utilizing data collected during on-site field verification of program measures. The analysis will stratify the field verification sample by measure type, and include a sufficient number of properties and housing units within each property to gather representative information for the program.

The process evaluation is planned to include program manager, implementer interviews to assess program operations, and property manager and tenant surveys to estimate net-to-gross, assess program awareness and satisfaction. A statistically representative sample of participants will be selected for analysis.

The final evaluation report is scheduled for completion in the fourth quarter of 2019.

Residential Smart $aver: Save Energy & Water

Evaluation, measurement and verification actions will provide an independent, third-party report of energy savings attributable to the program including an impact analysis and process evaluation.

The impact analysis is planned to use an engineering analysis to determine program savings, utilizing the savings algorithms and parameters provided by the Ohio or other relevant TRMs, with updated values of some parameters using data collected through a participant survey and an engineering analysis. A statistically representative sample of participants will be selected for the analysis.

The process evaluation is planned to include program staff interviews and participants to estimate net-to-gross and uncover potential issues that might impact customer satisfaction or program effectiveness. A statistically representative sample of participants will be selected for the analysis.

The final evaluation report is scheduled for completion in the first quarter of 2020.

Power Manager (Demand Response)

Evaluation, measurement and verification actions will provide an independent, third-party report of demand savings attributable to the program.

The impact evaluation will be conducted using smart meter data and a randomized control trial design. The combination of smart meter data and a randomized control trial yields extremely precise estimates of demand reductions at substantial savings in comparison to end use data collection. It also enables side by side testing of operational strategies and side by side testing of the effect of event dispatch timing on demand reductions.

A process evaluation will be conducted in 2020, which included post-event surveys. There will not be a process component in the 2019 evaluation.

Non-Residential Programs

Power Manager for Business

Evaluation, measurement and verification actions will provide an independent, third-party report of demand and energy savings attributable to the program, including an impact analysis and process evaluation.

The timing of this evaluation will be determined by participation in the program. The impact analysis will include a billing analysis to determine the energy savings and will occur when enough participants have 12 months pre- and post- usage data available. The Demand impacts will be determined through planned operational or test events. AMI data will be used for this part of the analysis.

The process evaluation will include program staff interviews, implementation contractor interviews, and participant surveys.

Small Business Energy Saver

Evaluation, measurement and verification actions will provide an independent, third-party report of energy savings attributable to the program including an impact analysis and process evaluation.

The impact analysis is planned to consist of a detailed engineering analysis to estimate impacts. Depending on the distribution of installed measure types, the projects may be stratified into groups and then a sample selected for on-site verification of equipment installation and inputs to the engineering savings estimates.

The process evaluation is planned to include program staff interviews, implementation contractor interviews, and participant surveys to assess correlations between reductions in consumption and certain behavior changes and equipment purchases. The participant survey will be used collect data to estimate net-to-gross for the program.

Smart $aver® Non-Residential Custom

Evaluation, measurement and verification actions will provide an independent, third-party report of energy savings attributable to the program including an impact analysis and process evaluation.

The impact analysis for the Smart $aver Custom program is planned to use a statistically representative sample of participating projects. A blend of selective monitoring and site visits will be performed at each of the selected sample set projects, with engineering-based estimation.

The Process evaluation is planned to include participant surveys to collect information needed to estimate net impacts and participants will be asked about equipment that was replaced, energy efficiency actions taken, prior intentions regarding these measures, changes in other major end uses that impact energy consumption, hours of facility operation, persistence and program satisfaction. A statistically representative sample of participants will be selected for the analysis.

Smart $aver® Non-Residential Prescriptive

Evaluation, measurement and verification actions will provide an independent, third-party report of energy savings attributable to the program including an impact analysis and process evaluation.

The impact analysis for the Smart $aver Prescriptive program is planned to use a statistically representative sample of participants. A sample of facilities will receive a combination of selective monitoring and site visits to develop an engineering-based estimation

The process evaluation is planned to include participant surveys and Trade Ally interviews to collect information needed to estimate net impacts, as well as to ask about awareness and satisfaction with key program components and overall program satisfaction. Trade allies will also be asked about effects of program participation on their practices to help assess spillover.

PowerShare® (Demand Response)

The impact analysis is planned to measure and evaluate the short-term changes in customer load due to the notification to customers of a PowerShare event. The evaluation research includes the collection and processing of interval consumption data and analysis of actual event day load response by program participants.

The report delivered in 2019 will include the results of the Process evaluation and surveys conducted in 2018.

APPENDIX D -
POWER MANAGER EVALUATION

REPORT

Nexant
Reimagine tomorrow.

Duke Ohio 2017 Power Manager Evaluation

July 2, 2018

Eric Bell, Ph.D.
Ankit Jain, M.P.P.
Greg Sidorov, M.S.

Figures

Tables

1 Executive Summary

This report presents the results of the 2017 Power Manager impact evaluation for the Duke Energy Ohio territory. Power Manager is a voluntary demand response program that provides incentives to residential customers who allow Duke Energy to reduce the use of their central air conditioner's outdoor compressor and fan on summer days with high energy usage. During normal events, the signal to load control devices to reduce air conditioner use is phased in over the first half hour and the reduction is sustained through the remainder of the event and phased out over the half hour immediately after the event. During emergency operations, all devices are instructed to instantaneously shed loads and deliver larger demand reductions (66% and 75% cycling for moderate and high control option customers, respectively).

1.1 Impact Evaluation Key Findings

The impact evaluation is based on a randomized control trial. Each customer who had an addressable load control device at the start of the summer was randomly assigned to one of six groups—a primary group with 75% of the population and five research groups, each with 5% of the population. During each event, a control group of approximately 2,200 households was withheld to provide an estimate of energy load profiles absent activation of Power Manager. During the summer of 2017, over 45,000 households were actively participating in Power Manager and had load control devices.

Table 1-1 summarizes the reductions attained during each event in 2017, as estimated using the randomized control trial. The June 12, 2017 event included a side-by-side test of demand reduction under different dispatch hours during which 75% of customers were dispatched for the 4pm to 6pm event and four research groups were dispatched at different times. The July 20, 2017 event included side-by-side tests of emergency and normal operations in order to estimate the incremental demand reductions due to emergency operations.

A few key findings are worth highlighting:

- Demand reductions were 0.65 kW per household for the average general population event.
- Peak day impacts under normal operations averaged 0.61 kW per household over the course of the two hour dispatch window on July 20, 2017 (the day emergency operations were tested side by side with normal operations), when the daily maximum temperature was 90˚F.
- Emergency operations on July 20 produced larger impacts than normal operations, 0.90 kW vs. 0.60 kW per household for the same hour on the hottest day in 2017. Reductions from emergency operations exceeded those from normal operations by 50%.
- The magnitude of impacts varied slightly by dispatch window in absolute terms, but not so much as a percentage of available load. Demand reductions ranged from 0.43 to 0.73 kW per household on June 12, with larger impacts generally occurring later in the day. As a percentage of loads, the demand reductions varied less, ranging from 17.1% to 21.4%, suggesting that most of the differences by event window are a function of the underlying amount of air conditioner load.

- Demand reductions grow larger in magnitude when temperatures are hotter and resources are needed most.[1]
- The difference in impacts between customers who signed up for the lower and higher load control options was minimal and within the range of uncertainty.

Table 1-1: Randomized Control Trial Demand Reductions for Individual Events[2]

Event Date	Start Time	End Time	Load without DR	Impact	Std. error	90% Confidence Interval		% Impact	90% Confidence interval		Daily Max	Avg. Temp 24 Hours Prior to Event
						Lower bound	Upper bound		Lower Bound	Upper Bound		
6/12/2017	11:30 AM	1:00 PM	2.49	-0.43	0.05	-0.35	-0.51	-17.1%	-13.9%	-20.3%	90	79
	12:30 PM	2:00 PM	2.66	-0.45	0.05	-0.36	-0.53	-16.8%	-13.7%	-19.9%	90	79
	1:30 PM	4:00 PM	2.94	-0.55	0.05	-0.47	-0.63	-18.7%	-16.0%	-21.4%	90	80
	3:30 PM	6:00 PM	3.35	-0.72	0.04	-0.65	-0.78	-21.4%	-19.5%	-23.2%	90	80
	5:30 PM	8:00 PM	3.43	-0.73	0.05	-0.65	-0.81	-21.3%	-19.0%	-23.6%	90	80
7/12/2017	3:30 PM	6:00 PM	3.25	-0.67	0.04	-0.61	-0.73	-20.6%	-18.7%	-22.4%	89	76
7/20/2017	3:30 PM	6:00 PM	3.18	-0.61	0.04	-0.55	-0.66	-19.1%	-17.2%	-20.9%	90	81
7/20/2017	**4:00 PM**	**5:00 PM**	**3.06**	**-0.90**	**0.05**	**-0.82**	**-0.98**	**-29.5%**	**-26.9%**	**-32.0%**	**90**	**81**
7/21/2017	2:30 PM	5:00 PM	2.78	-0.44	0.03	-0.39	-0.50	-15.9%	-13.9%	-17.8%	90	82
8/16/2017	3:30 PM	5:00 PM	3.33	-0.76	0.03	-0.71	-0.81	-22.8%	-21.2%	-24.4%	91	76
8/16/2017	3:30 PM	6:00 PM	3.41	-0.72	0.03	-0.66	-0.77	-21.0%	-19.5%	-22.5%	91	76
9/21/2017	**2:30 PM**	**5:00 PM**	**2.31**	**-0.24**	**0.03**	**-0.19**	**-0.30**	**-10.6%**	**-8.4%**	**-12.8%**	**89**	**75**
9/22/2017	**2:30 PM**	**5:00 PM**	**2.95**	**-0.78**	**0.04**	**-0.72**	**-0.85**	**-26.6%**	**-24.5%**	**-28.6%**	**89**	**77**
9/25/2017	2:30 PM	5:00 PM	2.58	-0.45	0.03	-0.39	-0.51	-17.4%	-15.2%	-19.6%	89	77
9/26/2017	2:30 PM	5:00 PM	2.79	-0.53	0.03	-0.47	-0.58	-18.8%	-16.8%	-20.9%	89	77
Average General Population Event			**3.02**	**-0.59**	**0.01**	**-0.57**	**-0.60**	**-19.4%**	**-18.9%**	**-20.0%**	**90**	**78**

1.2 Time-Temperature Matrix and Demand Reduction Capability

A key objective of the 2017 evaluation was to quantify the relationship between demand reductions, temperature, hour of day, and cycling strategy—referred to as the time-temperature matrix. By design, a large number of events were called under different weather conditions, for different dispatch windows, using various cycling strategies so that demand reduction capability could be estimated for a wide range of operating and planning conditions. Because weather conditions did not vary significantly during the 2017 events, data from the 2016 evaluation was also used in the development of this time-temperature matrix.

[1] This observation is based on results from the 2016 Power Manager evaluation.

[2] Emergency operations noted with red text.

Figure 1-1: Demand Reduction Capability on a day with an 85˚F Average Temperature for the previous 24 hours with Emergency Dispatch

INPUTS	
Dispatch Type	Emergency Dispatch
Option	Overall
Event start (excludes phase in)	4 PM
Event duration (hours)	1
Previous 24 hr Avg Temp (F)	85
Homes	45,000

Event Window Avg. Impacts		
Load without DR	3.51	kW per house
Load with DR	2.28	kW per house
Impact per house	-1.23	kW per house
Impact (MW)	-55.3	MW
% Impact	-35%	%

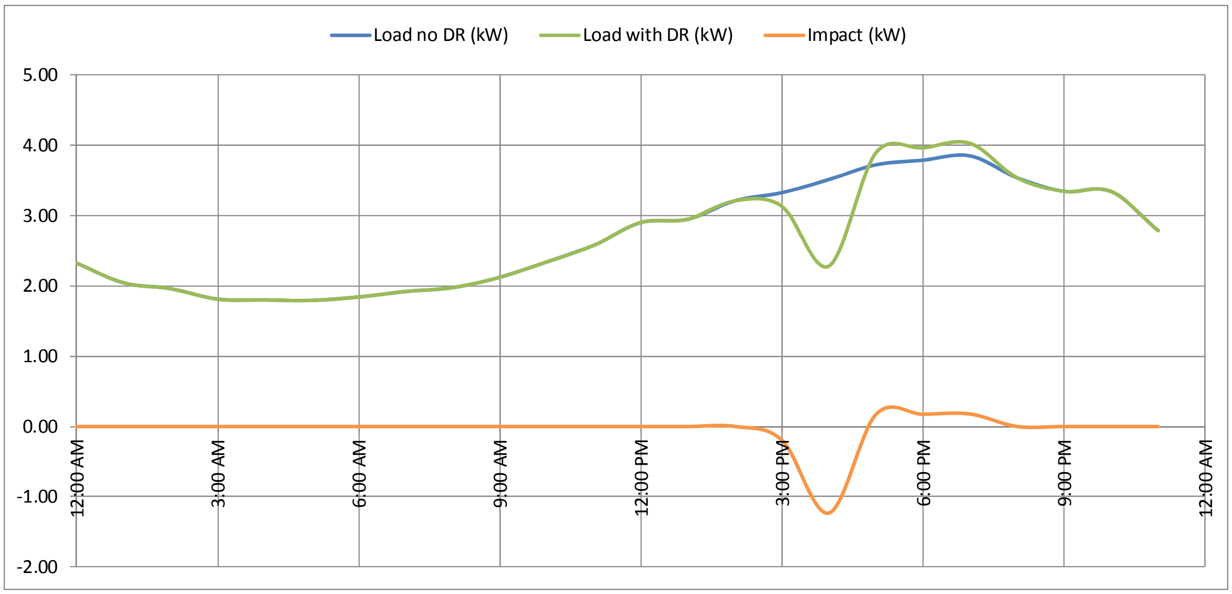


Figure 1-1 shows the demand reduction capability of the program if emergency shed becomes necessary on a day in which the previous 24 hours prior to the event have an 85˚F average temperature (which reflects the weather conditions experienced on the 2016 emergency shed test day) for a single hour. Individual customers are expected to deliver 1.23 kW of demand reduction. Because there are approximately 45,000 devices, the expected aggregate reductions total is 55.3 MW.

2 Introduction

This report presents the results the 2017 Power Manager impact evaluation for the Duke Energy Ohio (DEO) territory. Power Manager is a voluntary demand response program that provides incentives to residential customers who allow DEO to reduce the use of their central air conditioner's outdoor compressor and fan on summer days with high energy usage.

Because DEO has full deployment of smart meters and access to Power Manager customers' interval data, the impact evaluation is based on a randomized control trial that randomly assigned customers to six different groups. During each event, at least one of the groups was withheld to serve as a control group and provide an estimate of customer's energy profiles absent activation of Power Manager. The randomized control trial was employed during normal Power Manager operations and during specific tests designed to address key research questions.

In addition to estimating load impacts during 2017 events, this study determined the program capability under a range of weather and dispatch conditions. Average customer load reductions were calculated as a function of customer type, event type, event start time, event duration, and average temperature during the 24 hours preceding the event start.

2.1 Key Research Questions

The study data collection and analysis activities were designed to address the main impact evaluation research questions.

Impact Evaluation Research Questions

- What demand reductions were achieved during each event called in 2017?
- Did impacts vary for customers on moderate and high load control options?
- Do impacts vary based on the hours of dispatch and/or weather conditions? If so, how?
- What magnitude of load reduction is the program capable of delivering during extreme conditions?

2.2 Program Description

Power Manager is a voluntary demand response program that provides incentives to residential customers who allow DEO to reduce their central air conditioner's outdoor compressor and fans on summer days with high energy usage. All Power Manager participants have a load cycling switch device installed on at least one outdoor unit of qualifying air conditioners. The device enables the customer's air conditioner to be cycled off and on to reduce load when a Power Manager event is called. DEO initiates events by sending a signal to all participating devices through a corporate paging network. The signals instruct the switch devices to cycle the air conditioning system on and off, reducing the run time of the unit during events.

The program participates in the energy and capacity markets of the PJM market, but DEO generally limits participation in the energy market to days when the wholesale price exceeds $65/MWh. Duke regularly bids Power Manager into the capacity market, which means that the program must be available for PJM emergency events. Absent an emergency, the DEO operations team schedules and calls events for local emergency, economic, or testing reasons.

Power Manager events typically occur between May and September in DEO territory, but are not limited to these months. Participants receive financial incentives for their participation that depend on the amount of load control they experience during an event. At enrollment, Power Manager customers elect one of two load control options that are available—moderate or high load control. Approximately 84% of Power Manager devices in DEO are enrolled in the moderate option and the remaining 16% are enrolled in the higher load control option.[3] The payments received by participants include a one-time installation credit of $25 for the moderate load control option ($35 for high load control) plus bill credits for each cycling event that occurs. The minimum bill credit for 2017 participation was $12 for customers enrolled in the moderate option and $18 for customers enrolled in the high load control option.

Starting in 2017, DEO began using a new cycling algorithm known as *true cycle algorithm*. The algorithm uses learning days to estimate the run time (or duty cycle) of air conditioners as a function of hour of day and temperature at each specific site and aims to curtail use by a specified amount. In general, Power Manager events fall into two categories: economic events during which customers are cycled at 48% and 75% for moderate and high control customers, respectively, and emergency events during which customers are cycled at 66% and 75% for moderate and high control customers, respectively.

2.3 Participant Characteristics

The Duke Energy Ohio service territory is in the Southern portion of Ohio and centered in the Cincinnati area. By the end of summer 2017, over 47,000 air conditioner units were part of Power Manager. Of those units, 16% enrolled in the higher load control option. On average, customers enroll 1.06 air conditioner units per site.

DEO serves approximately 760,000 residential customers. To enroll on Power Manager, customers must be in DEO territory, own their single family home, and have a functional central air conditioning unit with an outside compressor. Based on the program rules and a residential appliance saturation survey Duke Energy implemented in 2016, approximately 54.7% of customers meet the eligibility criteria.[4] To date, DEO has enrolled approximately 10.9% of eligible customers. Figure 2-1 visualizes enrollment in Power Manager over time.

[3] Customers who ask to de-enroll are offered a low load control option to minimize attrition. Less than 1/15th of one percent of devices are enrolled in the low load control option.

[4] 77.3% of residential customer in the territory own single family homes and, of those, 82.7% have central air conditioners. The estimate does not include heat pumps.

Figure 2-1: Power Manager Participation Over Time

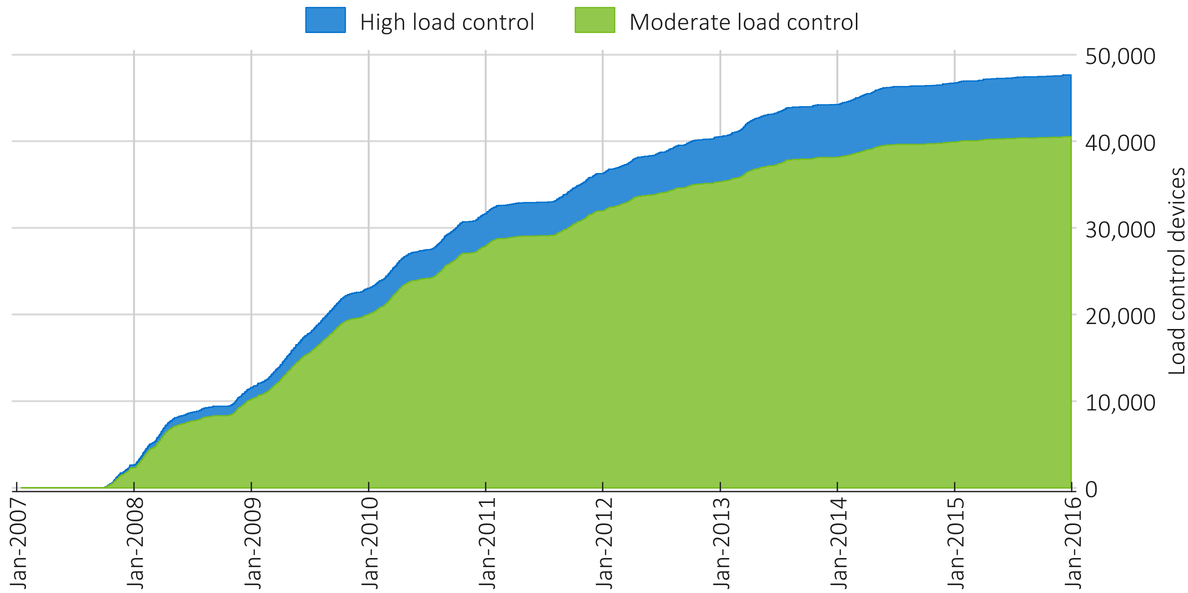


Figure 2-2: Distribution of Air Conditioner Peak Period Loads Amongst Power Manager Customers

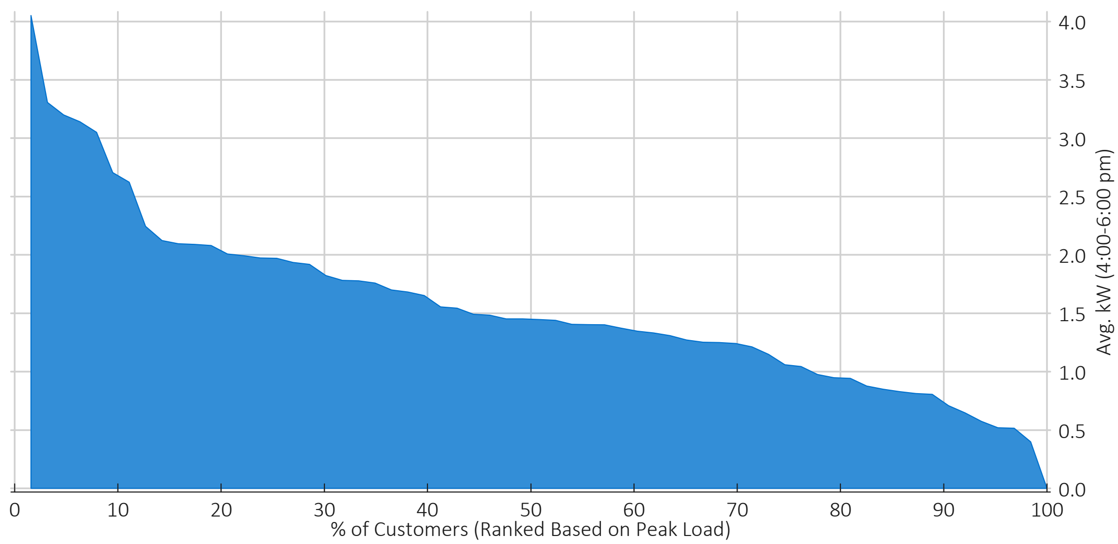
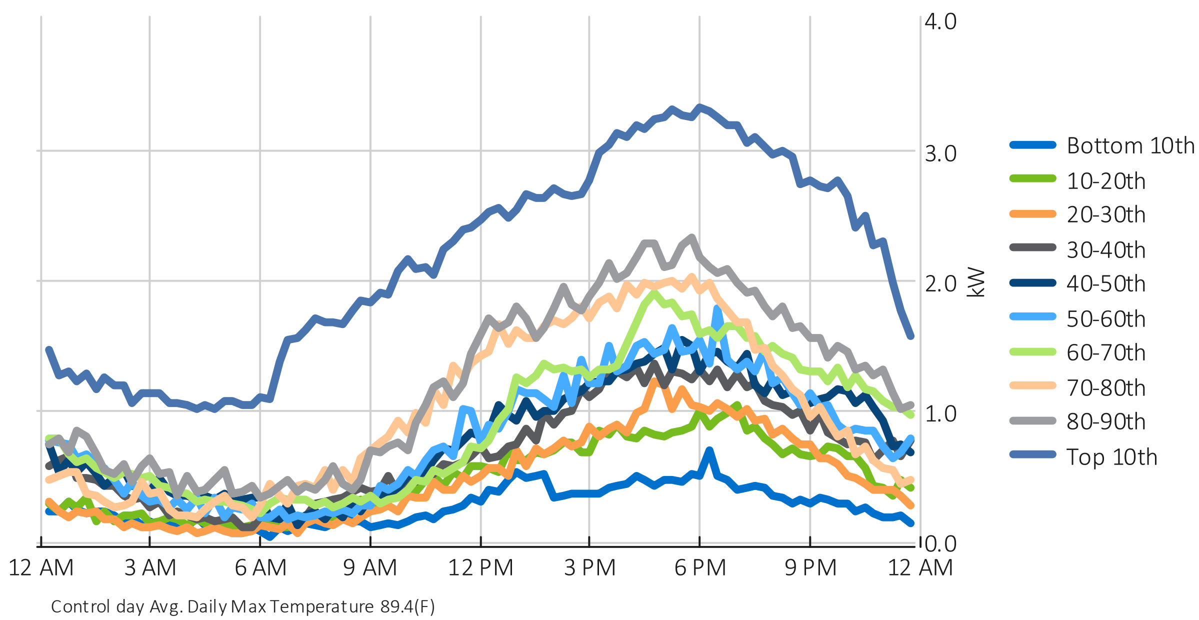


Figure 2-2 shows the distribution of air conditioner demand across customers on hot nonevent days, based on end use load data that was collected in 2016. We isolated the 4 to 6pm period because it aligns with the time period for most Power Manager events. Air conditioner use by Power Manager participants varied substantially, reflecting different occupancy schedules, comfort preferences, and thermostat use and settings. Roughly 40% of air conditioner loads exceeded 1.5 kW. As with any program, some customers who enrolled use little or no central air conditioners during late afternoon hours on hotter days. They are, in essence, free riders. The bulk of the costs for recruitment, equipment, and installation have already been sunk for these customers and, as a result, removing these customers may not improve cost effectiveness substantially. However, given the availability of smart meter data, we recommend assessing nonparticipant afternoon loads on hotter days prior to marketing in order to target customers who are cost effective to enroll.

Figure 2-3 provides additional detail and shows the hourly air conditioner end use loads for different customer groups. The customers were classified into 10 equally sized groups, known as deciles, based on their air conditioner use during hot nonevent days. Each line represents the hourly air conditioner loads for the average customer in each decile.

Figure 2-3: Air Conditioner End-use Hourly Loads by Size Decile



2.4 2017 Event Characteristics

In 2017, DEO dispatched Power Manager eight times for general population events in addition to the PJM test event, two research events, and an emergency operations test. The general population events all occurred either between 3:30 and 6:00pm or 2:30 and 5:00pm. DEO bids Power Manager resources into the PJM market during those time periods. The PJM event was prescheduled well in advance and happened to land on a cooler day with a daily maximum temperature of only 69˚F. During a PJM event, Power Manager customer loads needed to be less than the peak load contribution (PLC) minus the magnitude of DR resources bid into the capacity market.

Table 2-1: 2017 Event Operations and Characteristics

Event Date	Start Time	End Time	Daily Max (⁰F)	Type of Event	# of Customers	Customer dispatch	Control group	Notes
6/12/2017	11:30 AM	1:00 PM	90	Research	45,600	2,280	2,280	Group 1 dispatched
	12:30 PM	2:00 PM				2,280	2,280	Group 2 dispatched
	1:30 PM	4:00 PM				2,280	2,280	Group 3 dispatched
	3:30 PM	6:00 PM				34,200	2,280	Group 0 dispatched
	5:30 PM	8:00 PM				2,280	2,280	Group 5 dispatched
7/12/2017	3:30 PM	6:00 PM	89	GP Event	45,600	43,320	2,280	Group 1 held back
7/20/2017	3:30 PM	6:00 PM	90	GP and Shed Test	45,600	43,320	2,280	Group 3 held back; Group 5 shed test
7/21/2017	2:30 PM	5:00 PM	90	GP Event	45,600	43,320	2,280	Group 4 held back
8/16/2017	3:30 PM	6:00 PM	91	Research	45,600	4,560	41,040	Group 4 dispatched until 5pm; Group 2 dispatched until 6pm
9/7/2017	4:00 PM	5:00 PM	69	PJM Test	45,600	45,600	0	No control
9/21/2017	2:30 PM	5:00 PM	89	GP Event, then Emergency	45,200	42,940	2,260	Group 1 held back; Emergency Shed during 2nd hour w/ no Control
9/22/2017	2:30 PM	5:00 PM	89	GP Event, then Emergency	45,600	43,320	2,280	Group 2 held back; Emergency during 2nd hour
9/25/2017	2:30 PM	5:00 PM	89	GP Event	45,600	43,320	2,280	Group 2 held back
9/26/2017	2:30 PM	5:00 PM	89	GP Event	45,600	43,320	2,280	Group 4 held back

DEO overlaid three research experiments alongside the general population events on June 12, July 20, and August 16. On June 12, DEO implemented a side-by-side test of five groups to assess if and how demand reductions varied for different dispatch periods. On July 20, a research group was dispatched using emergency shed operations side-by-side with a control group and a group that experienced normal operations. The objective was to assess how the magnitude of the emergency shed compares to traditional operations. Emergency operations reflect the full demand reduction capability of the program, but are employed judiciously. On August 16, a group was dispatched from 3:30 to 5pm alongside a group that was dispatched from 3:30 to 6pm, to test how impacts are affected by event duration.

With the exception of emergency shed tests, the control of the air conditioner units is phased in, at random, over the first 30 minutes. Likewise, at the end of an event, instructions to resume normal operations are gradually sent to individual air conditioners. The demand reductions reported in this study are for the time period when units' full load reduction were achieved—that is, the phase in and phase out periods are excluded since they do not reflect the demand reduction capability.

3 Methodology and Data Sources

This section details the study design, data sources, sample sizes, and analysis protocols for the impact evaluation.

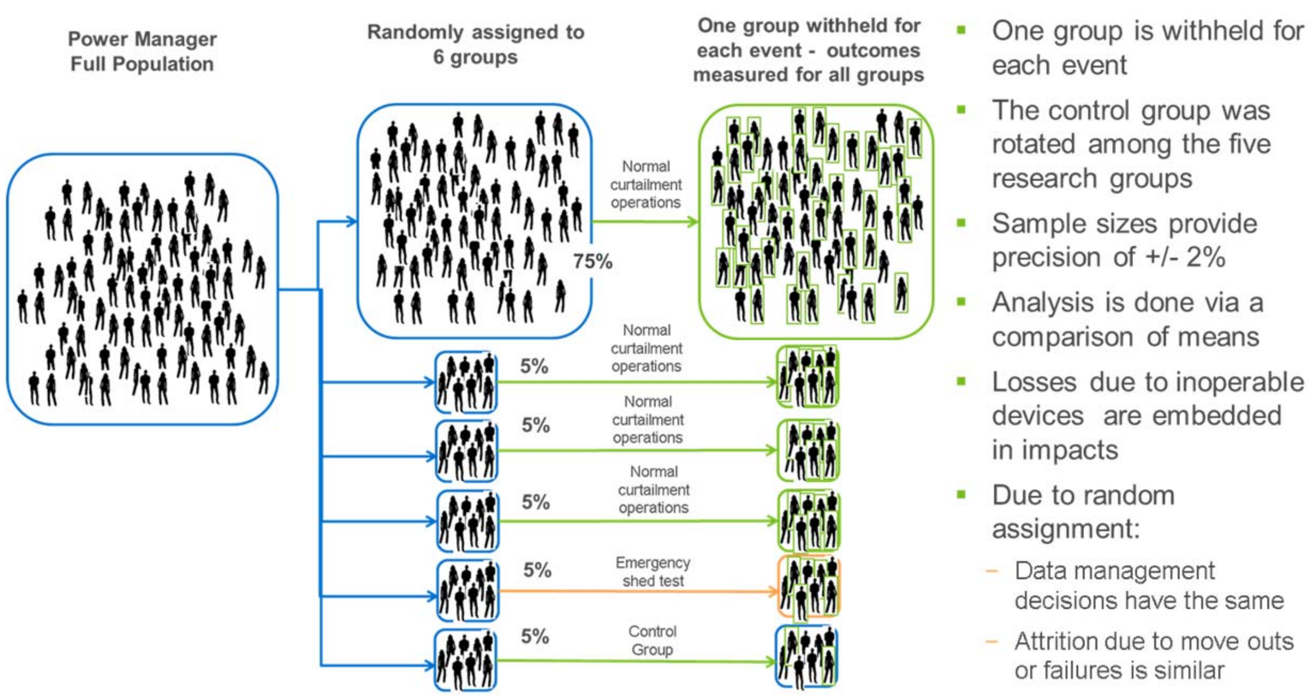
3.1 Randomized Control Trial Design and Analysis

Randomized control trials are well recognized as the gold standard for obtaining accurate impact estimates and have several advantages over other methods:

- They require fewer assumptions than engineering-based calculations;
- They allow for simpler modeling procedures that are effectively immune to any kind of model specification error; and
- They are guaranteed to produce accurate and precise impact estimates with proper randomization and large sample sizes.

The RCT design randomly separated the DEO Power Manager population into two groups—treatment and control—for each event day. On an event day, all load control devices in the treatment group were activated, while none of the devices in the control group were activated. Because of random assignment, the only systematic difference between the two groups is that one set of customers was curtailed and the other group was not. During research events, distinct operation strategies were employed to enable side-by-side testing, but in all instances a control group was withheld. Figure 3-1 shows the conceptual framework of the random assignment.

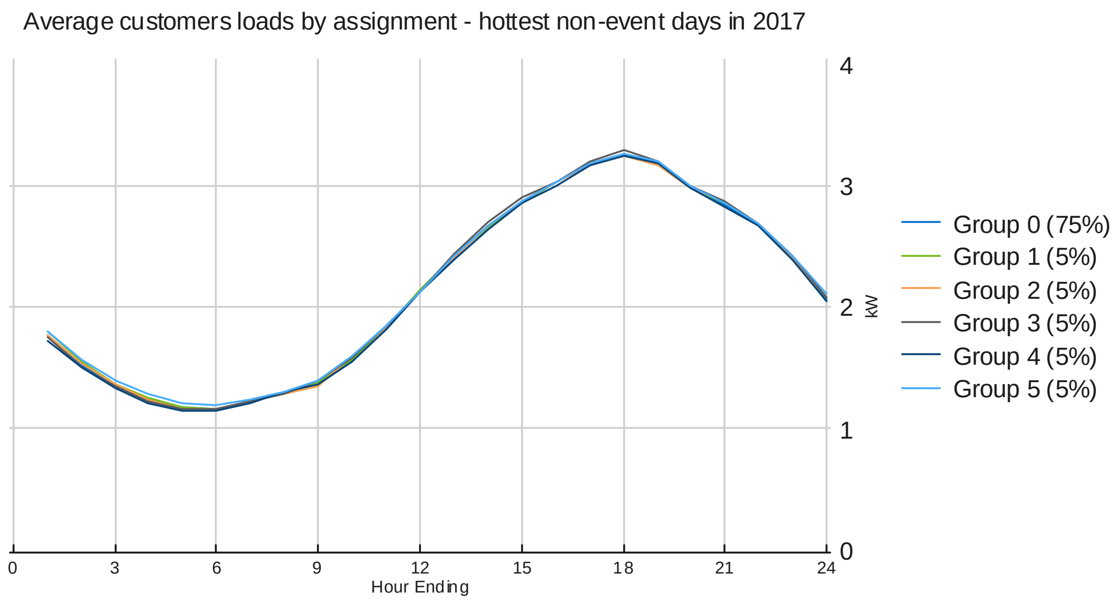
Figure 3-1: Randomized Control Trial Design



The Power Manager participant population with addressable load control devices was randomly assigned into six distinct groups prior to the 2016 summer based on the last two digits of the device serial number, with the randomization maintained for existing customers in 2017 and new customers similarly assigned to an experimental group.[5] At the beginning of the summer, the main general population group includes 75% of participants – approximately 34,000 participants. The remaining five research groups each include 5% of participants, or roughly 2,200 customers each. Before implementation, Nexant conducted simulation based power analysis using smart meter data for load control participants and concluded the sample sizes were sufficient to provide a ±2% Margin of Error with 90% confidence. The purpose of creating six distinctive randomly assigned groups was twofold. First, it allowed side-by-side testing of cycling strategies, event start times, or other operation aspects to help optimize the program. Second, it also allowed DEO to alternate the control group, increasing fairness but also helping avoid exhausting individual customers by dispatching them too often solely for research purposes.

To ensure the randomization was properly implemented, the loads for each of the six groups were compared to each other on all days when none of the groups experienced an event. Figure 3-2 shows average hourly loads for each group on the hottest, nonevent days (July 22, September 23, and September 27). The customer loads are nearly identical, which provides strong evidence that the assignment of devices into the six different groups was indeed random. It also reflects the precision of control group as a method for estimating the counterfactual.

Figure 3-2: Validation of Random Assignment and Precision — Loads on the Hottest Nonevent Day



5 Some households have multiple load control devices. In these instances the homes were randomly assigned such that all devices in a given home were in the same group.

For each event, one of the five research groups was withheld to serve as a control group and establish the counterfactual or baseline—the electricity load patterns in the absence of curtailment. Within the experimental framework of an RCT, the average usage for control group customers provides an unbiased estimate of what the average usage for treatment customers would have been if an event had not been called. Because of this, estimating the load impacts for an event requires simply calculating the difference in loads between the treatment and control groups during each interval, including the event period and hours following the event when snapback can occur. The demand reductions reflect net impacts and account for customer use of fans to compensate for curtailment of air conditioners, device failures, and paging network communication issues.

The standard error, used to calculate the confidence bands, is calculated using the formula shown in Equation 1.

Equation 1: Standard Error Calculations for Randomized control trial

$$Std. Error\ of\ Difference\ between\ Means_i = \sqrt{\frac{sd_c^2}{n_c} + \frac{sd_t^2}{n_c}}$$

Where *sd* is the stand deviation, *n* is the sample size, *t* and *c* are the treatment and control groups respectively, and *i* refers to individual time intervals.

4 Randomized Control Trial Results

The goals of this study include understanding the load impacts associated with the Power Manager program under a variety of conditions. General population event dates were selected to understand the available load reduction capacity under a variety of temperature conditions during normal operations, while emergency shed events demonstrated the available capacity for short-duration events during extreme conditions. In addition, one test day was used to understand how load reduction capacity varied as a function of dispatch window by signaling different customer groups at different times of day. This section presents the results for these event days. A comparison of load impacts by dispatch option (moderate versus high load control) is also presented.

4.1 Overall Program Results

The load impact estimates derived from the randomized control trial analysis for the general population events, as well as the research events that occurred side-by-side with normal operation of the program, are presented in Table 4-1. Results for the July 20 emergency event and the August 16 event duration test are presented as separate events from the general population event. The load impacts presented here, along with the accompanying confidence intervals, are the average changes in load during the indicated dispatch windows, excluding the first 30 minutes of dispatch for the normal operation events since this is the time period when devices are phased-in at random.

Table 4-1: Randomized Control Trial per Customer Impacts[6]

Event Date	Start Time	End Time	Load without DR	Impact	Std. error	90% Confidence Interval		% Impact	90% Confidence interval		Daily Max	Avg Temp 24 Hours Prior to Event
						Lower bound	Upper bound		Lower Bound	Upper Bound		
6/12/2017	11:30 AM	1:00 PM	2.49	-0.43	0.05	-0.35	-0.51	-17.1%	-13.9%	-20.3%	90	79
	12:30 PM	2:00 PM	2.66	-0.45	0.05	-0.36	-0.53	-16.8%	-13.7%	-19.9%	90	79
	1:30 PM	4:00 PM	2.94	-0.55	0.05	-0.47	-0.63	-18.7%	-16.0%	-21.4%	90	80
	3:30 PM	6:00 PM	3.35	-0.72	0.04	-0.65	-0.78	-21.4%	-19.5%	-23.2%	90	80
	5:30 PM	8:00 PM	3.43	-0.73	0.05	-0.65	-0.81	-21.3%	-19.0%	-23.6%	90	80
7/12/2017	3:30 PM	6:00 PM	3.25	-0.67	0.04	-0.61	-0.73	-20.6%	-18.7%	-22.4%	89	76
7/20/2017	3:30 PM	6:00 PM	3.18	-0.61	0.04	-0.55	-0.66	-19.1%	-17.2%	-20.9%	90	81
7/20/2017	**4:00 PM**	**5:00 PM**	**3.06**	**-0.90**	**0.05**	**-0.82**	**-0.98**	**-29.5%**	**-26.9%**	**-32.0%**	**90**	**81**
7/21/2017	2:30 PM	5:00 PM	2.78	-0.44	0.03	-0.39	-0.50	-15.9%	-13.9%	-17.8%	90	82
8/16/2017	3:30 PM	5:00 PM	3.33	-0.76	0.03	-0.71	-0.81	-22.8%	-21.2%	-24.4%	91	76
8/16/2017	3:30 PM	6:00 PM	3.41	-0.72	0.03	-0.66	-0.77	-21.0%	-19.5%	-22.5%	91	76
9/21/2017	**2:30 PM**	**5:00 PM**	**2.31**	**-0.24**	**0.03**	**-0.19**	**-0.30**	**-10.6%**	**-8.4%**	**-12.8%**	**89**	**75**
9/22/2017	**2:30 PM**	**5:00 PM**	**2.95**	**-0.78**	**0.04**	**-0.72**	**-0.85**	**-26.6%**	**-24.5%**	**-28.6%**	**89**	**77**
9/25/2017	2:30 PM	5:00 PM	2.58	-0.45	0.03	-0.39	-0.51	-17.4%	-15.2%	-19.6%	89	77
9/26/2017	2:30 PM	5:00 PM	2.79	-0.53	0.03	-0.47	-0.58	-18.8%	-16.8%	-20.9%	89	77
Average General Population Event			**3.02**	**-0.59**	**0.01**	**-0.57**	**-0.60**	**-19.4%**	**-18.9%**	**-20.0%**	**90**	**78**

[6] Emergency operations noted with red text.

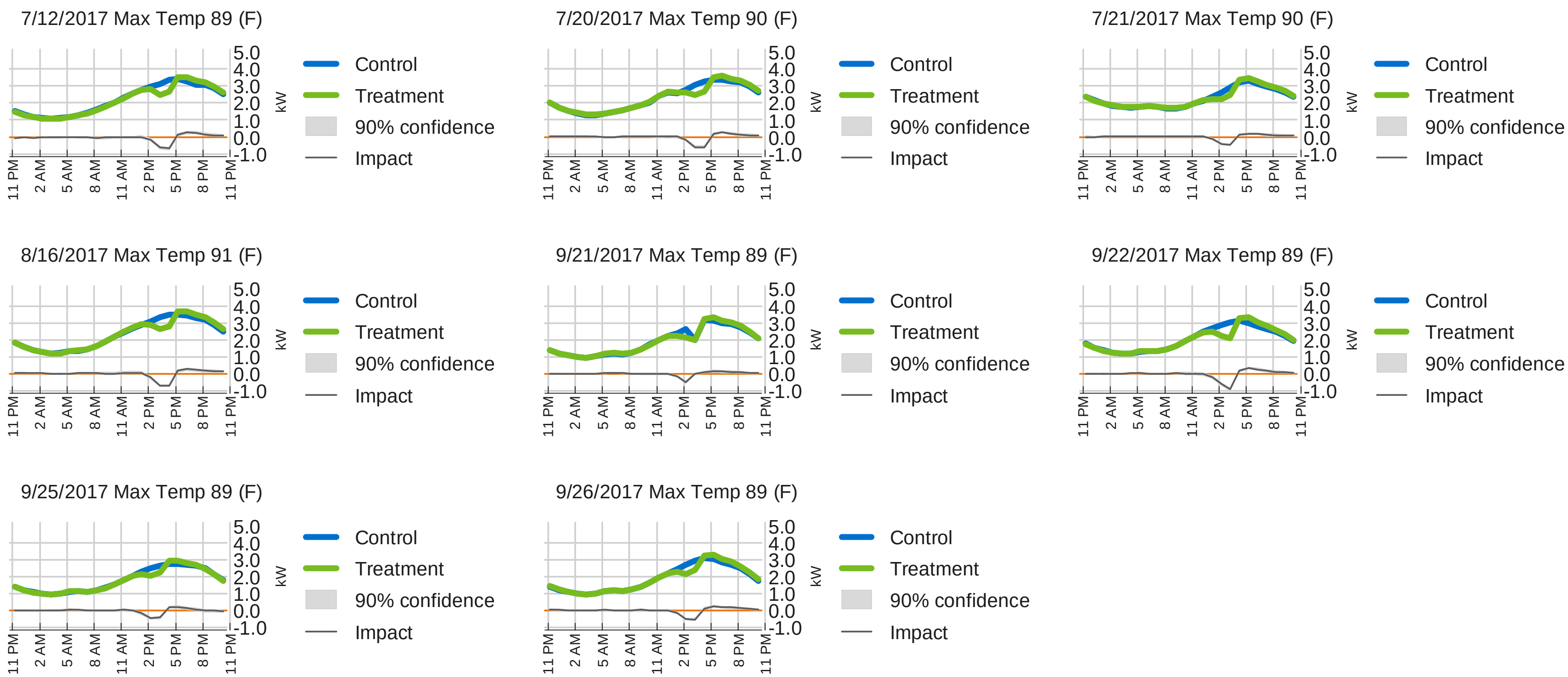
Overall load impacts for the average customer in the test group ranged between 0.24 kW and 0.78 kW during normal operations, though most events saw reductions of at least 0.45 kW. These impacts are considerably lower than what was observed in the prior year, likely due to cooler weather conditions. Although the aim was to call events during a range of temperature conditions, most event days saw very similar maximum daily temperatures which were overall cooler than what was experienced in 2016. The emergency shed event had a much higher load impact of 0.90 kW.

Except for the PJM test, at most, 95% of the sites were dispatched since at least 5% of the population was withheld to serve as a control group and establish the baseline. Had all resources been dispatched under normal operation on July 20, the emergency event day, the program would have delivered 27.5 MW. If instead, all resources had been dispatched using emergency operations, reduction would have been 40.5 MW, despite a relatively cool weather year.

Since all of the analysis included customers with inoperable devices, the results implicitly take device inoperability into account. Because we used random assignment, each of the test groups accurately represent the percentage of customers with inoperable devices among the entire population and the estimated load impacts are appropriately de-rated by the nonworking devices included in the test groups.

These same impacts are shown graphically in Figure 4-1, along with the average customer load profiles for the test and control groups. Compared to the control group load profile, there is a clear drop in test group load during the dispatch period, along with a small snapback in energy usage immediately after the events.

Figure 4-1: Load Profiles of Average Test and Control Group Customers on General Population Event Days



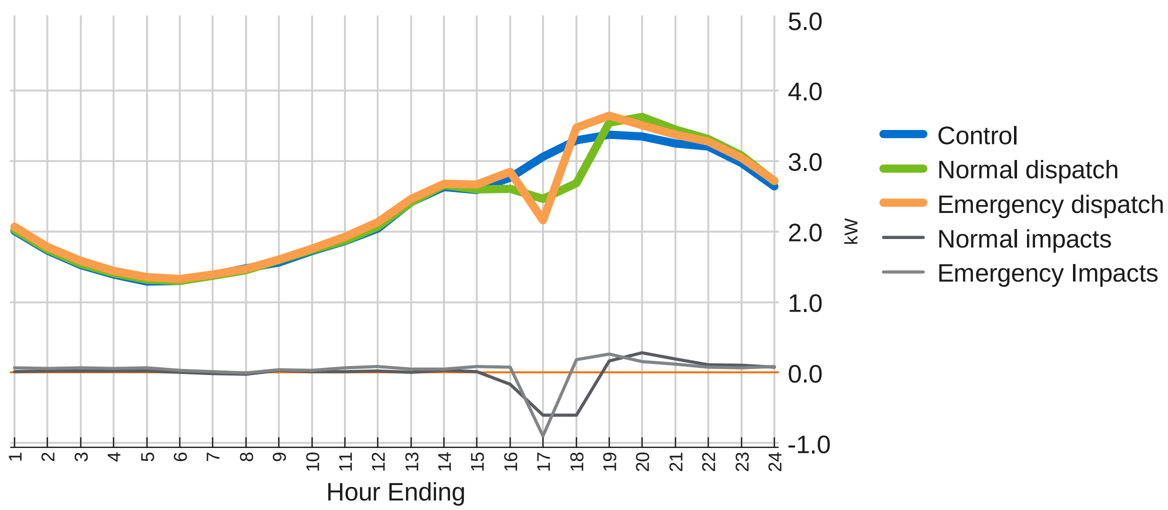
4.2 Normal Operations Versus Emergency Shed Test

Impacts for the July 20 event are presented in Figure 4-2 for both normal and emergency operations. As shown in the graph, the group that was dispatched via normal operations had a 30 minute period (3:30 to 4pm) during which devices were phased in randomly, whereas all of the devices in the emergency shed test group were dispatched simultaneously at the start of the 4pm event and instructed to implement 66% and 75% cycling for the moderate and high control customers, respectively. As a result, the magnitude of the overall load reduction was much greater for customers in the emergency shed group.

Emergency operations produced larger impacts than normal operations, 0.90 kW vs. 0.60 kW per household for the common dispatch hour from 4 to 5pm (average load reduction for normal operations during the entire two hour event window was 0.61 kW). Reductions from emergency operations exceeded those from normal operations by 50%.

The emergency shed event ended at 5pm, after which time the load for this dispatch group returned to nearly the same level as the control group, with some additional snapback. The normal operation group continued to show steady load drop until the end of its dispatch window at 6pm.

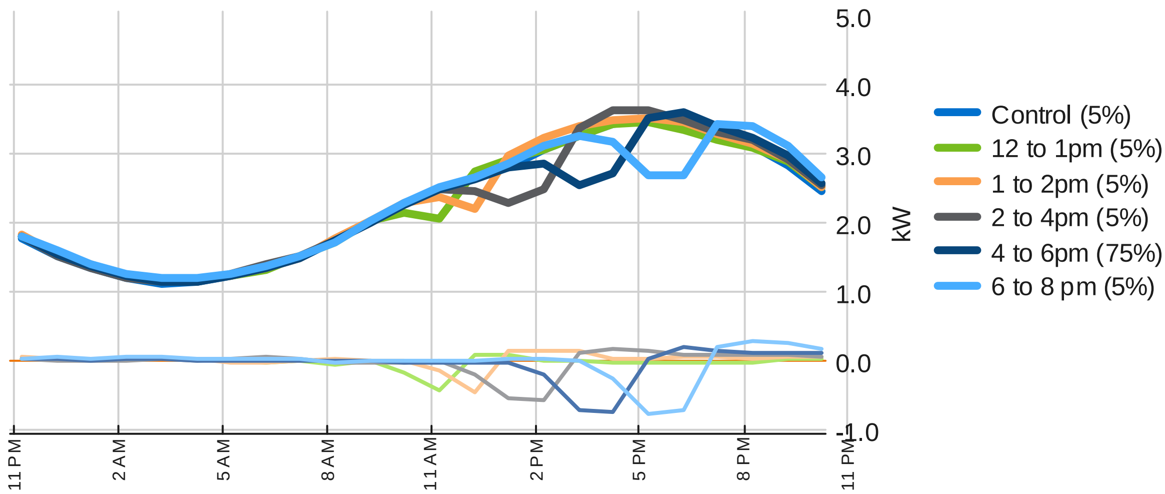
Figure 4-2: Load Profiles for Emergency and Normal Operations on July 20 Event



4.3 Impacts by Dispatch Period

Load profiles for the various test groups for the June 12 cascading event test are presented in Figure 4-3, along with the load profile for the control group. The plot shows the load reduction and accompanying snapback associated with each group's dispatch, as compared to the control group. As can be seen from the plot and from the prior table, there were slight differences in the estimated load impacts with larger per customer impacts occurring in the late afternoon hour, up to the last event which began at 6pm (excluding the 30 minute ramp-in period at the beginning of the event). Impacts during all dispatch windows were fairly steady throughout the events. While the magnitude of impacts varied by dispatch window (between 0.43 and 0.73 kW per household), the percent load reduction was actually fairly similar for each group. As a percentage of loads, the demand reductions varied less, ranging from 17.1% to 21.4%, suggesting that most of the differences by event window are a function of the underlying amount of air conditioner load.

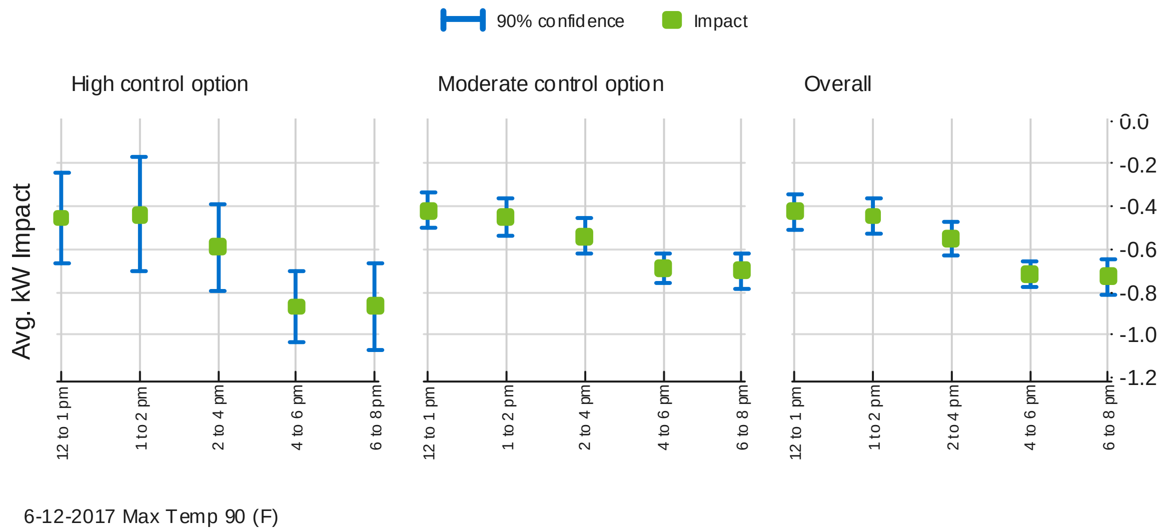
Figure 4-3: Load Profiles for June 12 Dispatch Window Test



The point estimates for the load impacts, along with the 90% confidence intervals, for each test group is presented in Figure 4-4. The results are broken down by program option (moderate versus high load control), as well as for program participants in general. Note that the width of the confidence intervals are largely driven by the sample sizes, and thus the confidence intervals for the higher load control option customers are much wider because only 15% of customers sign up for it and, as a result, treatment and control group sample sizes were smaller.

In all cases, the load impacts show the same pattern with average load reduction increasing for later dispatch windows. However, the difference in impacts between the first three event windows and the last two event windows is not great enough to rule out the possibility that it could be explained by estimation error, as indicated by the overlapping confidence intervals for the various dispatch windows.

Figure 4-4: Point Estimates and Confidence Intervals for June 12 Cascading Events



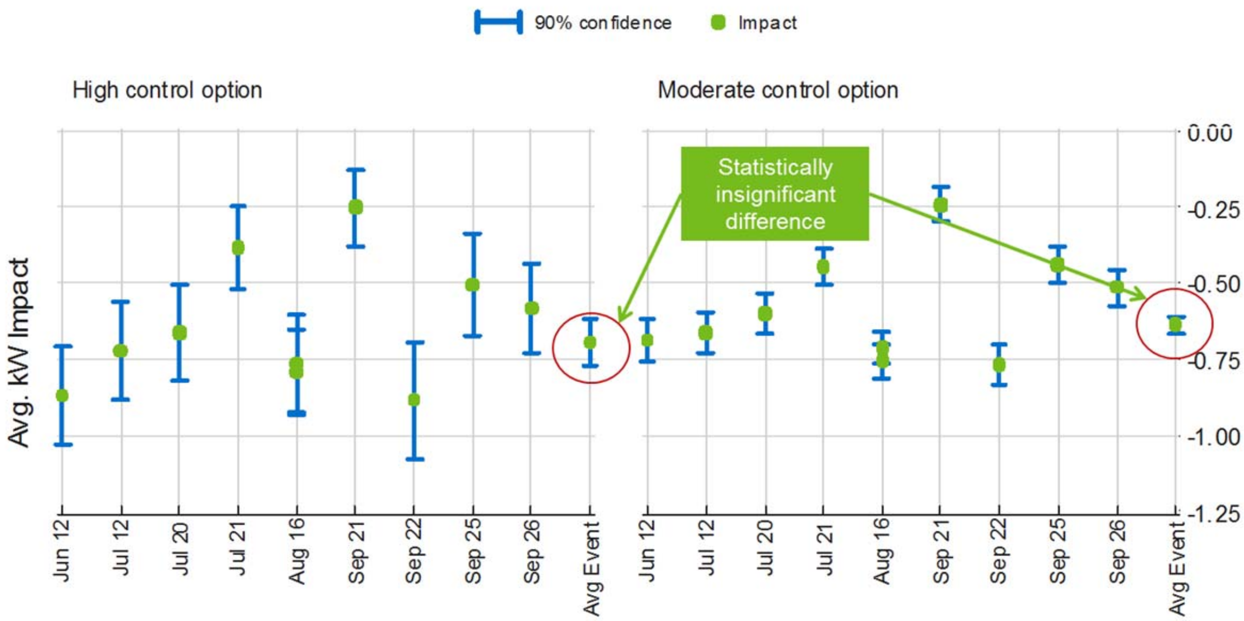
4.4 Weather Sensitivity of AC Load and Demand Reductions

Weather sensitivity analysis was not conducted this year due to the uniformity of the temperature conditions seen on event days. The weather sensitivity analysis from the previous evaluation has been placed in Appendix A for reference.

4.5 Impacts by Customer Load Control Option

Figure 4-5 compares the load impact estimates for customers enrolled in the moderate versus high load control option, along with the 90% confidence intervals for each event. In general, point estimates for load reduction are similar for high and moderate load control option customers on any given event day. In addition, because there were relatively fewer customers in the high load control option subgroup, the confidence intervals for these point estimates are quite wide. As a result, any differences in point estimates that do exist are statistically insignificant due to uncertainty. This is also reflected in the average event load impact for each group.

Figure 4-5: Comparison of Load Impact Results by Control Option for all Events



4.6 Key Findings

A few key findings are worth highlighting:

- Demand reductions were 0.65 kW per household for the average general population event.
- Peak day impacts under normal operations averaged 0.61 kW per household over the course of the two hour dispatch window on July 20, 2017, when the daily maximum temperature was 90˚F.
- Emergency operations produced larger impacts than normal operations, 0.90 kW vs. 0.60 kW per household for the same hour on the hottest day in 2017. Reductions from emergency operations exceeded those from normal operations by 50%.
- The magnitude of impacts varied slightly by dispatch window in absolute terms, but not so much as a percentage of available load. Demand reductions ranged from 0.43 to 0.73 kW per household on June 12, with larger impacts generally occurring later in the day. As a percentage of loads, the demand reductions varied less, ranging from 17.1% to 21.4%, suggesting that most of the differences by event window are a function of the underlying amount of air conditioner load.
- Demand reductions grow larger in magnitude when temperatures are hotter and resources are needed most.[7]
- The difference in impacts between customers who signed up for the lower and higher load control options was minimal and within the range of uncertainty.

[7] This observation is based on results from the 2016 Power Manager evaluation.

5 Demand Reduction Capability – Time-Temperature Matrix

A key objective of the 2017 evaluation was to quantify the relationship between demand reductions, temperature, hour of day, and cycling strategy—referred to as the time-temperature matrix. By design, plans called for a large number of events to be called under different weather conditions, for different dispatch windows, using various cycling strategies so that demand reduction capability could be estimated for a wide range of operating and planning conditions. Because weather conditions did not vary significantly during the 2017 events, data from the 2016 evaluation was also used in the development of this time-temperature matrix.

Weather conditions vary substantially from year to year. Because 2017 conditions did not approach the weather conditions experienced on the emergency event day in 2016, the reductions capability had to be estimated based on conditions experienced on the 2016 emergency event day. It was also found that relying on maximum daily temperature to estimate demand reductions does not reflect heat buildup and its impact on AC usage. Rather than estimating load reductions and defining emergency weather conditions based on maximum daily temperature, this study relies on average temperature over the 24 hour period preceding an event. Using this weather metric, the weather conditions experienced on the 2016 emergency event day was an average of 85˚F during the 24 hours prior to the event.

5.1 Methodology

Figure 5-1 illustrates the essential trends and challenges associated with time-temperature matrix development. Not only do Power Manager demand reductions grow on a percentage basis with hotter weather and with deeper cycling, but so do the air conditioner loads available for curtailment. The implication is that larger percent reductions are attainable from larger loads when temperatures are hotter.

Figure 5-1: Both Air Conditioning Loads and Percent Demand Reductions are Weather Sensitive

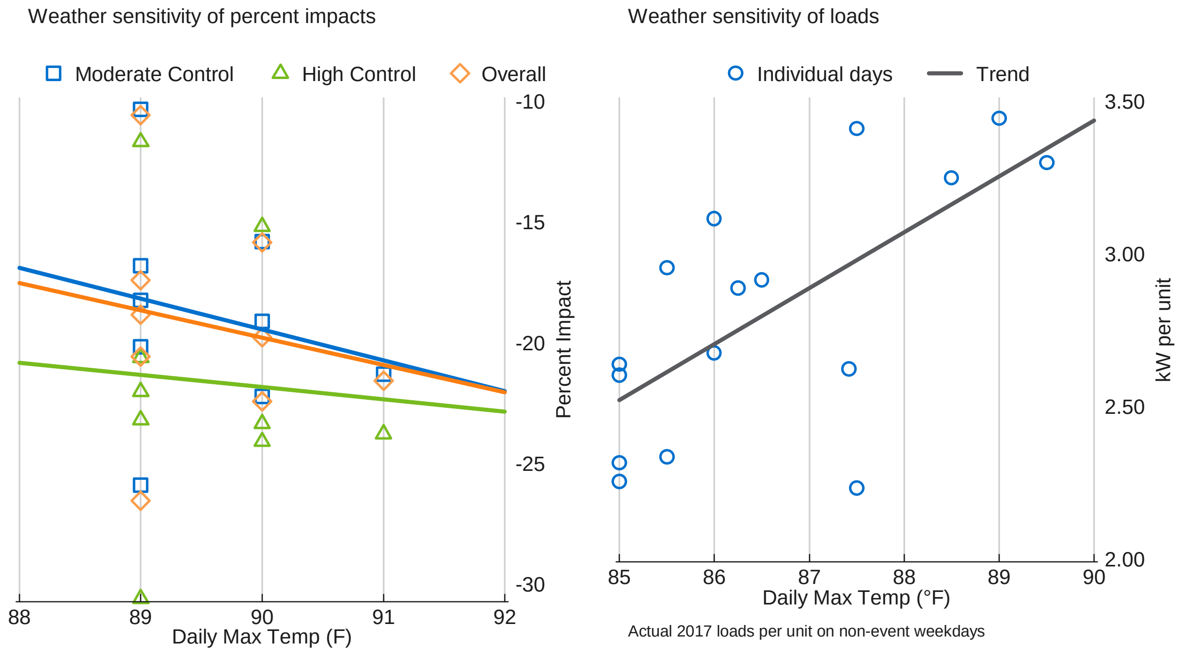


Figure 5-2: Time Temperature Matrix Development Process

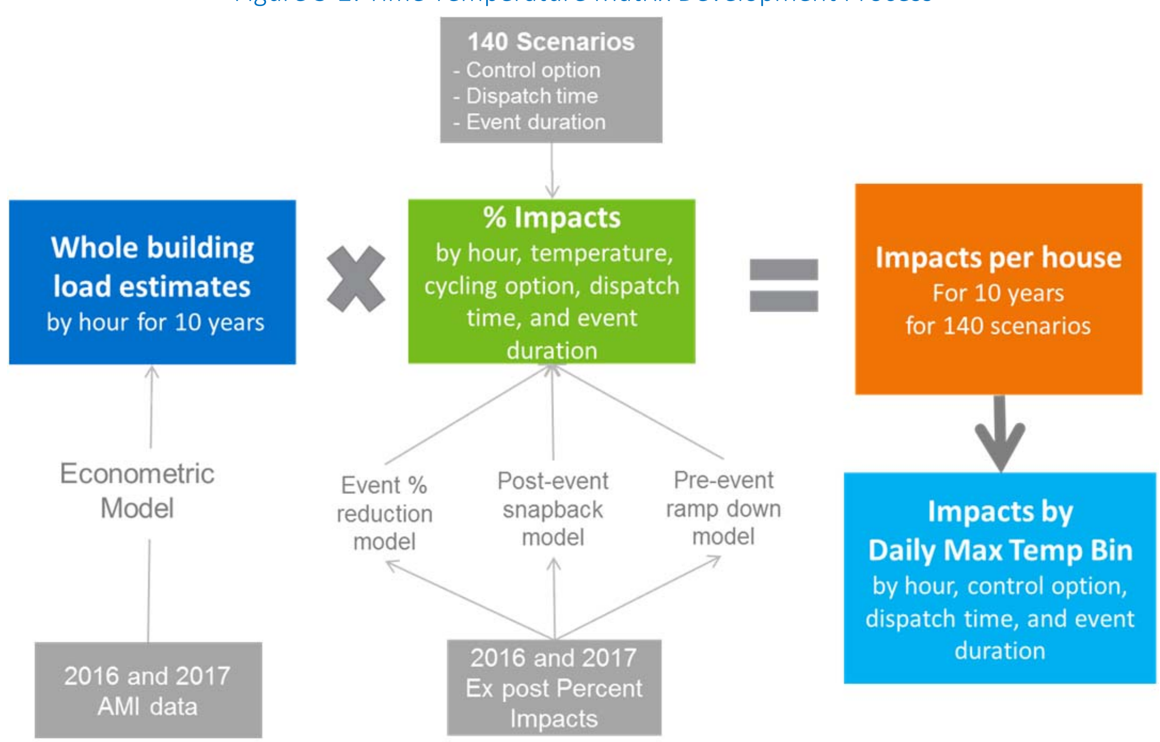


Figure 5-2 illustrates the process used to estimate the demand reduction capability under various conditions:

- Estimates of air conditioner loads were developed using the 2016 and 2017 AMI data and using the same regression models used to estimate impacts. All weekdays with daily maximum temperatures above 75˚F were included in the models. The models were used to estimate air conditioner load patterns for 1,314 days in 10 years. Because the models were based on 2016 and 2017 data, they reflect current usage patterns and levels of efficiency. The 2016 and 2017 air conditioner patterns were applied to actual weather patterns experienced in past 10 years and not hypothetical weather patterns.
- Estimates of the percent reductions were based on three distinct econometric models: load control phase in, percent reductions during the event, and post-event snapback. The models were based on the percent impacts and temperatures experienced during 2016 and 2017 events.
- A total of 140 scenarios were developed to reflect various cycling/control strategies, event dispatch times, and event lengths.
- Estimated impacts per device were produced. This was done by combining the estimated air conditioner loads, estimated percent reductions, and dispatch scenarios. The process produced estimated hourly impacts for each of 1,314 hotter weekdays in 2007-2017 under 140 scenarios each.
- Multiple days in narrow temperature bins were averaged to produce an expected reduction profile. Days with the similar daily maximum temperature can have distinct temperature profiles and the heat buildup influenced the amount of air conditioner load.

5.2 Demand Reduction Capability for Emergency Conditions

While Power Manager is typically dispatched for economic reasons or research, its primary purpose is to deliver demand relief during extreme conditions when demand is high and capacity is constrained. Extreme temperature conditions can trigger Power Manager emergency operations where all devices are instructed to instantaneously shed loads and deliver larger demand reductions than normal cycling events (emergency shed). While emergency operations are rare and ideally avoided, they represent the full demand reduction capability of Power Manager.

Figure 5-3: Demand Reduction Capability for an event with an 85˚F Average Temperature 24 hours prior to the Emergency Dispatch

INPUTS	
Dispatch Type	Emergency Dispatch
Option	Overall
Event start (excludes phase in)	4 PM
Event duration (hours)	1
Previous 24 hr Avg Temp (F)	85
Homes	45,000

Event Window Avg. Impacts		
Load without DR	3.51	kW per house
Load with DR	2.28	kW per house
Impact per house	-1.23	kW per house
Impact (MW)	-55.3	MW
% Impact	-35%	%

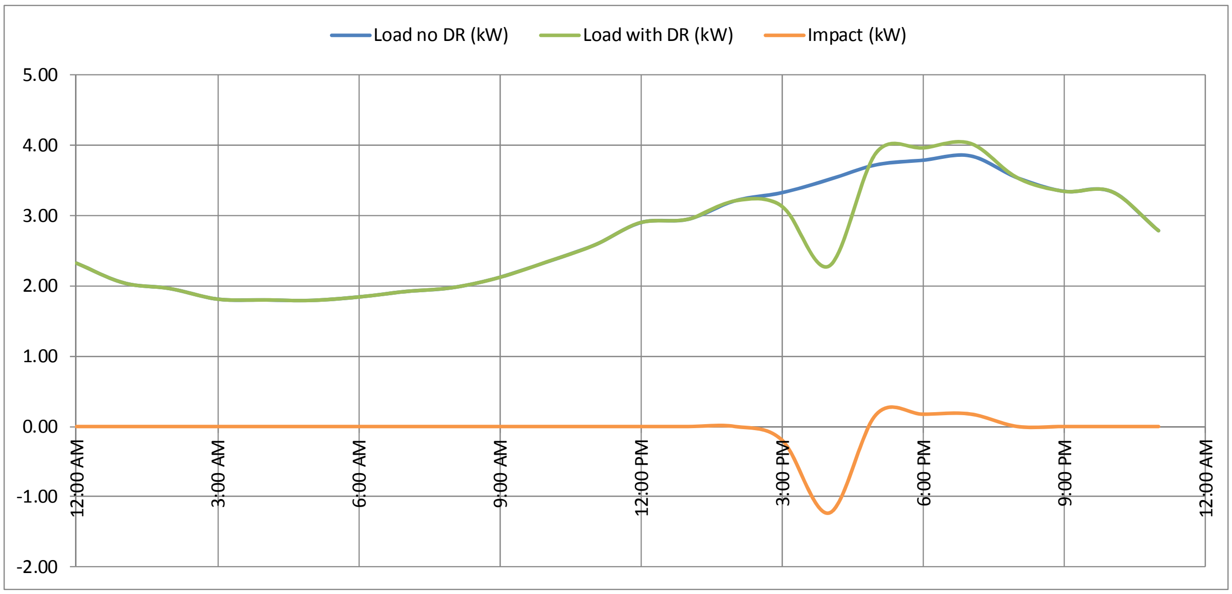


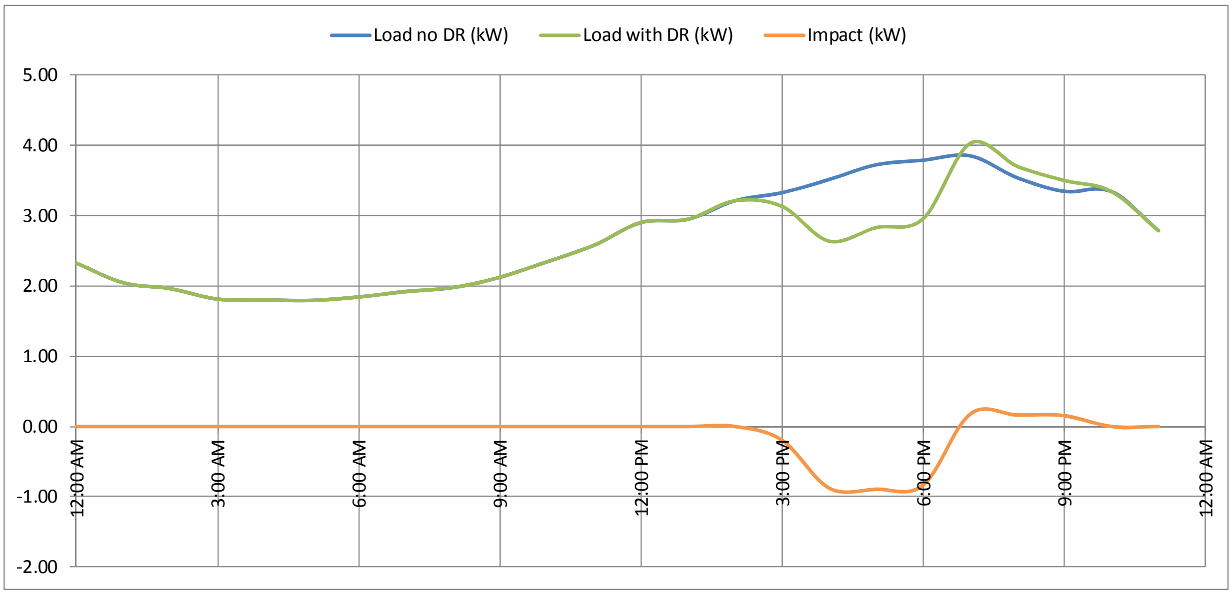
Figure 5-3 shows the demand reduction capability of the program if emergency shed becomes necessary when there is an 85˚F average temperature 24 hours prior to the event. Individual customers are expected to deliver 1.23 kW of demand reduction for the hour. Because there are approximately 45,000 customers, the expected aggregate reductions total is 55.3 MW.

Power Manager can deliver substantial demand reductions under emergency conditions, even if emergency shed operations are not employed and economic dispatch is employed. With a three hour economic dispatch event, demand reductions average 39.0 MW across the dispatch hours, as shown in Figure 5-4. With longer events, reductions vary slightly across each hour but are generally larger when air conditioner use is highest.

Figure 5-4: Demand Reduction Capability for an event with an 85˚F Average Temperature 24 hours prior to the Economic Dispatch

INPUTS	
Dispatch Type	Economic Dispatch
Option	Overall
Event start (excludes phase in)	4 PM
Event duration (hours)	3
Previous 24 hr Avg Temp (F)	85
Homes	45,000

Event Window Avg. Impacts		
Load without DR	3.67	kW per house
Load with DR	2.81	kW per house
Impact per house	-0.87	kW per house
Impact (MW)	-39.0	MW
% Impact	-24%	%



5.3 State Bill 310 Compliance

In the state of Ohio, electric distribution utilities (EDUs), including DEO, are required to achieve a cumulative annual energy savings of more than 22% by 2027 in additional to achieving an additional .75% of peak demand reductions (PDR) in 2017-2020 per Ohio Senate Bill (SB) 310. Under current law, EDUs must implement PDR programs designed to achieve a 1% PDR and an additional 0.75% PDR each year through 2018. SB 310 also introduced new mechanisms that adjust how EDUs may estimate their energy savings or PDR achieved through demand side management programs. Specifically, SB 310 requires the Ohio Public Utilities Commission (PUC) to permit EDUs to account for energy-efficiency or PDR savings estimated on whichever value is higher between an "as-found" or a deemed basis. In the case of the 2017 Power Manager evaluation, which was associated with cooler events and lower impacts relative to the 2016 evaluation, the "deemed" approach will be applied with the 2016 results being incorporated into the time-temperature matrix to support estimation of the deemed values. The relevant language for SB310 is provided in Appendix B.

Table 5-1 provides the deemed peak demand reductions that DEO will claim per SB 310 for the Power Manager 2017 program year.

Table 5-1: SB 310 Compliance Peak Demand Reductions

Event Conditions	Number of Customers	Average Impact per Customer	Aggregate Impact	Source
Emergency Shed	45,000	1.23 kW	55.3 MW	Time-Temperature Matrix based on 2016 and 2017 impacts

5.4 Key Findings

Key findings from the development of the time temperature matrix include:

- While emergency operations are rare and ideally avoided, they represent the full demand reduction capability of Power Manager;
- Not only do Power Manager demand reductions grow on a percentage basis with hotter weather and with deeper cycling, but so do the air conditioner loads available for curtailment;
- If emergency shed becomes necessary on an 85˚F average temperature day, Power Manager can deliver 1.23 kW of demand reductions per household;
- Because there are approximately 45,000 Power Manager customers, the expected aggregate reductions total 55.3 MW;
- Reductions are larger with hotter temperatures and more aggressive load control operations; and
- The event start time also influences the magnitude of reductions which, generally, are larger during hours when air conditioner loads are highest.

Appendix A Weather Sensitivity of AC Load and Demand Reductions

Replicated from the 2016 evaluation- the load reduction capacity of Power Manager is dependent on weather conditions, as shown in Figure A-1. The plot shows the estimated average customer impact for each event as a function of daily maximum temperature. There is a clear correlation between higher temperatures and greater load reduction capacity, with the greatest load reductions occurring on the hottest day. Both emergency and normal operation impacts are displayed on this plot for that day, with the greater magnitude impacts attributable to the emergency operations customers.

While the weather correlation is clear, the question remains: How much of the bigger reduction capacity is due to larger air conditioners loads versus larger demand reductions? Both percent reduction and air conditioner loads grow with hotter temperatures. The whole house reductions were 18.9% on the coolest event day (87°F) and 26.1% on the hottest day (93°F). Figure A-2 shows the weather sensitivity of whole house load for the average customer in Power Manager. All nonevent weekdays with a daily high above 70°F were classified into two degree temperature bins. The plot shows how the loads vary by hour as temperatures grow hotter.

The key finding is simple. Demand reductions grow larger in magnitude when temperatures are hotter and resources are needed most. Because peak loads are driven by central air conditioner use, the magnitude of air conditioner loads available for curtailment grows in parallel with the need for resources. Not only are air conditioner loads higher, but the program performs at its best when it is hotter.

Figure A-1: Weather Sensitivity of Load Reduction based on Randomized Control Trial Analysis

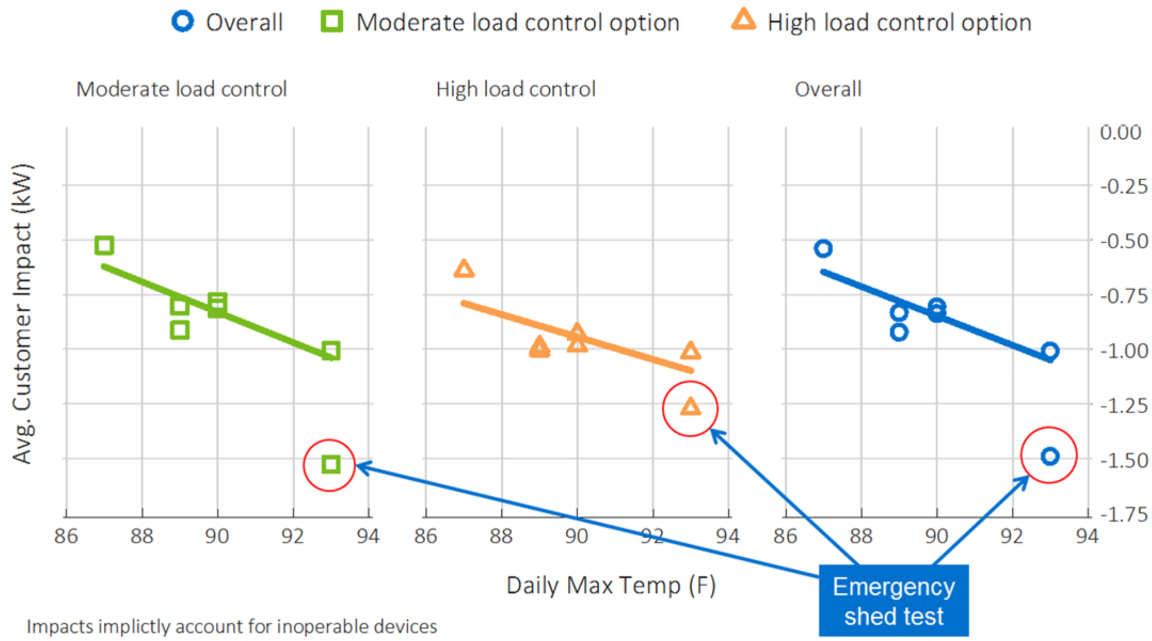
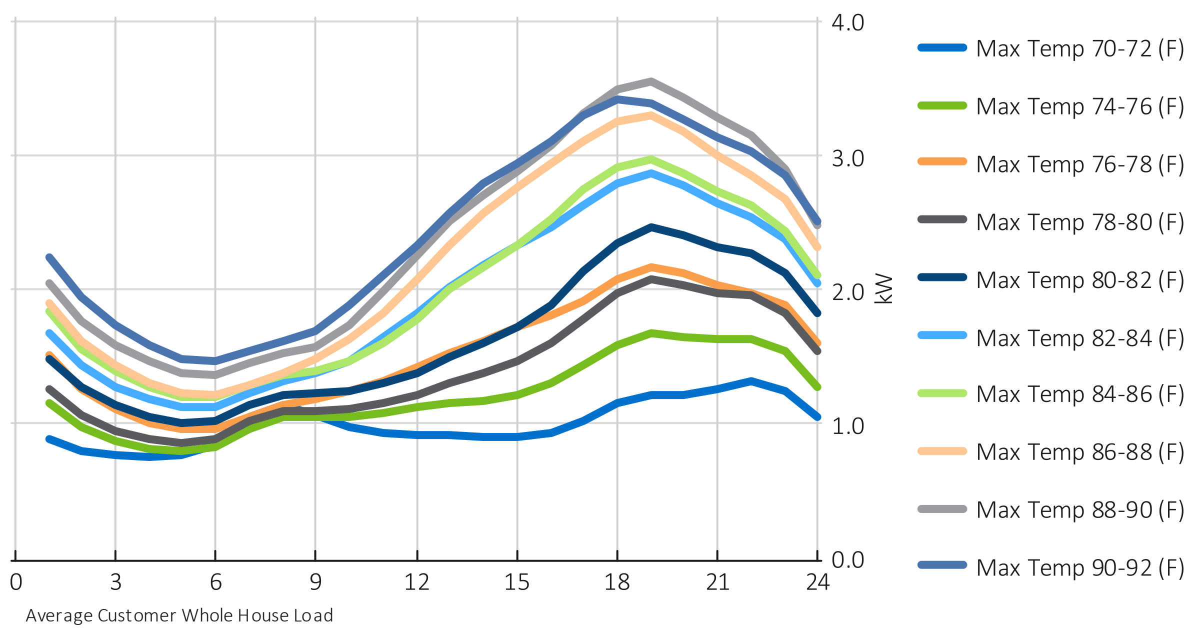


Figure A-2: Weather Sensitivity of Average Customer Loads



Appendix B Senate Bill 310 Legislation on Energy Efficiency Accounting

130th General Assembly Senate Bill Number 310

Sec. 4928.662. For the purpose of measuring and determining compliance with the energy efficiency and peak demand reduction requirements under section 4928.66 of the Revised Code, the public utilities commission shall count and recognize compliance as follows:

(A) Energy efficiency savings and peak demand reduction achieved through actions taken by customers or through electric distribution utility programs that comply with federal standards for either or both energy efficiency and peak demand reduction requirements, including resources associated with such savings or reduction that are recognized as capacity resources by the regional transmission organization operating in Ohio in compliance with section 4928.12 of the Revised Code, shall count toward compliance with the energy efficiency and peak demand reduction requirements.

(B) Energy efficiency savings and peak demand reduction achieved on and after the effective date of S.B. 310 of the 130th general assembly shall be measured on the higher of an as found or deemed basis, except that, solely at the option of the electric distribution utility, such savings and reduction achieved since 2006 may also be measured using this method. For new construction, the energy efficiency savings and peak demand reduction shall be counted based on 2008 federal standards, provided that when new construction replaces an existing facility, the difference in energy consumed, energy intensity, and peak demand between the new and replaced facility shall be counted toward meeting the energy efficiency and peak demand reduction requirements.

(C) The commission shall count both the energy efficiency savings and peak demand reduction on an annualized basis.

(D) The commission shall count both the energy efficiency savings and peak demand reduction on a gross savings basis.

(E) The commission shall count energy efficiency savings and peak demand reductions associated with transmission and distribution infrastructure improvements that reduce line losses. No energy efficiency or peak demand reduction achieved under division (E) of this section shall qualify for shared savings.

(F) Energy efficiency savings and peak demand reduction amounts approved by the commission shall continue to be counted toward achieving the energy efficiency and peak demand reduction requirements as long as the requirements remain in effect.

(G) Any energy efficiency savings or peak demand reduction amount achieved in excess of the requirements may, at the discretion of the electric distribution utility, be banked and applied toward achieving the energy efficiency or peak demand reduction requirements in future years.

APPENDIX E - POWERSHARE EVALUATION

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2017 Evaluation Report for the Duke Energy Ohio PowerShare® Program

Prepared for:

Duke Energy

May 8, 2018

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EXECUTIVE SUMMARY

This document presents Navigant's evaluation for the Duke Energy Ohio (DEO) PowerShare Program for Program Year 2017. PowerShare is a demand response (DR) program offered to commercial and industrial customers that is part of the portfolio of demand side management and energy efficiency (DSM/EE) programs offered by Duke Energy. PowerShare offers participating companies and agencies a financial incentive to reduce their electricity consumption when called upon by Duke Energy.

The DEO program offers customers two options to choose between: CallOption and QuoteOption.

- **CallOption:** In exchange for a monthly availability bill credit and event performance credits[1], participants reduce and maintain a predetermined load level during Emergency Curtailment events.
- **QuoteOption:** Customers nominate amounts of curtailable load based on upon price and timing offers from Duke Energy. Customers receive bill credits for actual load curtailed during the event. QuoteOption is not addressed further in this report because no QuoteOption events were called during this evaluation period.

Participants enrolled in CallOption must further select one of three seasonal participation periods[2]:

1. **Summer Only** – A maximum of 10 emergency events may occur from June 1 to September 30. Events may only be called on non-holiday weekdays from 12 noon to 8 pm and events may be a maximum of 6 hours in length.
2. **Extended Summer** – No limit is placed on the number of emergency events that may occur from June 1 to October 31, 2017 plus May of 2018. Events may be called on any day during those months and an event may last no more than 10 hours.
3. **Annual** – No limit is placed on the number of events, and events may occur any day through the year (June 1, 2017 to May 31, 2018). Events may last no more than 10 hours.

CallOption participants may choose between one of two compliance options: that of having curtailment evaluated based on a "Firm" demand level ("down to") or a "Fixed" demand reduction ("down by"). CallOption participants must further choose between one of two energy options: "Capacity Only" (may also participate in PJM energy markets) and "Emergency Full" (Duke acts as the participant's sole curtailment service provider).

In the period of analysis, DEO PowerShare participants were subject to only test events. Participants are only required to respond to a single test event per season, and most of the participants elected to participate in the first test event on September 7, 2017.

Evaluation Objectives

The research objectives of this evaluation are as follows:

[1] Event performance energy credits are provided only to participants that select the "Emergency Full" energy option. See body of report for more details.
[2] Participation periods shown are specific to a given calendar period, as specified in the program literature.

- Review updates to the SAS code used by Duke Energy to estimate baseline as well as monthly and seasonal capability.
- Audit the hourly kW DR event load shed for participating customers by replicating the Schneider Electric Energy Profiler Online™ (EPO) methods used to calculate the energy (kWh) and demand (kW) impacts used to determine settlement payments.

To complete the first objective, Navigant reviewed updates to the SAS code used by Duke Energy to determine participant baselines and monthly and seasonal capability. To complete the second objective, Navigant replicated the EPO energy and demand calculations used by Duke Energy to determine settlement payments.

Key Findings

This section presents Navigant's key evaluation findings for the two principal evaluation objectives:

Duke Energy Baseline SAS Code Audit

Duke Energy Applied Updates Per Navigant's Recommendations. During the 2016 PowerShare evaluation, Navigant performed a detailed audit of the SAS code used by Duke Energy to calculate settlement baselines, as well as monthly and seasonal capabilities. As an outcome of this audit, Navigant provided Duke Energy with several recommendations to improve the functionality and organization of the SAS code. For 2017, Navigant again reviewed the SAS code and found that Duke Energy appropriately implemented the changes recommended by Navigant.

Verification and Validation of Settlement Energy and Demand Calculations

Settlement calculations verified as correct. Duke Energy uses EPO to determine the energy (kWh) and capacity (kW) values that are the basis for calculating monthly settlement amounts. Navigant replicated the calculations for all of the participants in the period from June through October of 2017**.** Because no customers were enrolled in the QuoteOption program, this report only includes results for CallOption participants.

Initially, Navigant found a number of discrepancies between its energy and capacity settlement calculations and those provided by Duke Energy. After several discussions with Duke Energy, Navigant identified the following causes of discrepancies:

- Interval data issues related to power outages (caused most of the discrepancies)
- Missing usage data

Upon resolving those discrepancies, Navigant found that all of Duke Energy's estimates are accurate per the settlement algorithms defined by the program literature. A summary of the validation results, by credit type, may be found in Table E- 1 below. The program-level energy and demand impacts are shown in Table E- 2 and Table E- 3, respectively.[3]

[3] A total of 13 participants were enrolled for the Extend Summer option that includes October. However, no events were called in October so it is omitted from Table E-3.

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Table E- 1. Verification of EPO Calculations

Program Option	Credit Type	Customers	# of Unique Account Numbers	# of EPO Results Replicated[a]	Average % Absolute Error[b]
CallOption	Energy	41	41	41	0.00%
CallOption	Capacity	41	41	164	0.00%

a. *The number of calculations reproduced by Navigant for this analysis. For energy there is one credit calculated per participating account per event. For capacity there is one credit calculated per participating account per month. The period of analysis for this evaluation included four months and three test curtailment events.*

b. *The absolute error represents the difference between Navigant's replicated settlement results and the EPO estimates used by Duke Energy. The near-zero error demonstrates that Navigant was able to replicate settlement calculations using the algorithms provided by Duke Energy.*

Source: EPO Settlement Data and Navigant analysis

Table E- 2. Summary of 2017 Event Energy Impacts at the Meter (Total Program MWh per Event)

Program Name	September 7th	September 21st	September 26th	Total
Total Energy Curtailed (MWh)	54	0.4	0.5	55
# of Participants	38	2	1	41

Source: EPO Settlement Data and Navigant analysis

Table E- 3. Total Monthly Capacity for 2017 at the Meter (MW)

Program Name	June	July	August	September	Average
CallOption	45	47	50	49	48

Source: EPO Settlement Data and Navigant analysis

1. INTRODUCTION

This document presents Navigant's evaluation for the Duke Energy Ohio (DEO) PowerShare® Program for Program Year 2017. The PowerShare Program is a demand response program offered to commercial and industrial customers that is part of Duke Energy's portfolio of demand side management and energy efficiency (DSM/EE) programs. PowerShare offers participating customers a financial incentive to reduce their electricity consumption when called upon by Duke Energy.

1.1 Program Overview

The customer contracts for DEO's PowerShare Program commence on the first day of the month and the initial contract term varies between four months (CallOption – Summer Only) to one year (all other options).

The DEO program offers customers two options to choose between: CallOption and QuoteOption.

- **CallOption:** In exchange for a monthly availability bill credit and event performance credits[4], participants reduce and maintain a predetermined load level during Emergency Curtailment events.
- **QuoteOption:** Customers nominate amounts of curtailable load based on upon price and timing offers from Duke Energy. Customers receive bill credits for actual load curtailed during the event. QuoteOption is not addressed further in this report because no QuoteOption events were called during this evaluation period.

Participants enrolled in CallOption must further select one of three seasonal participation periods[5]:

1. **Summer Only** – A maximum of 10 emergency events may occur from June 1 to September 30. Events may only be called on non-holiday weekdays from 12 noon to 8 pm and events may be a maximum of 6 hours in length.
2. **Extended Summer** – No limit is placed on the number of emergency events that may occur from June 1 to October 31, 2017 plus May of 2018. Events may be called between 10:00am and 10:00pm on any day during those months and an event may last no more than 10 hours.
3. **Annual** – No limit is placed on the number of events, and events may occur any day through the year (June 1, 2017 to May 31, 2018). Events may last no more than 10 hours.

In the period of analysis, DEO PowerShare participants were subject to only test events. Participants are only required to respond to a single test event per season, and most of the participants elected to participate in the first test event on September 7, 2017.

The PowerShare Program is designed to encourage participating customers to reduce their electricity consumption on days of high electric demand and/or high energy market prices. Duke Energy contracts with Schneider Electric to calculate monthly customer settlements for the PowerShare Program. Schneider Electric is a specialized firm providing services in energy management and automation. The PowerShare settlements are calculated with the use of Schneider Electric's EPO, a hosted software application designed to assist utilities with energy data analysis. EPO uses participant interval data,

[4] Event performance energy credits are provided only to participants that select the "Emergency Full" energy option. See body of report for more details.

[5] Participation periods shown are specific to a given calendar period, as specified in the program literature

Duke Energy-generated participant baselines, and a set of program option-specific formulas to calculate the event energy (kWh) and monthly capacity (kW) values that determine participant settlement payments.

1.2 Evaluation Objectives

The research objectives of this evaluation are:

1. Review updates to the SAS code used by Duke Energy to estimate baseline as well as monthly and seasonal capability.
2. Audit the hourly kW DR event load shed for participating customers by replicating the Schneider Electric EPO methods used to calculate the energy (kWh) and demand (kW) impacts that are used to determine settlement payments.

1.2.1 Review Updates to SAS Code Used for DR Baseline and Capability Calculations

During the 2016 PowerShare evaluation, Navigant performed a detailed audit of the SAS code used by Duke Energy to calculate settlement baselines, as well as monthly and seasonal capabilities. As an outcome of this audit, Navigant provided Duke Energy with several recommendations to improve the functionality and organization of the SAS code. For 2017, Navigant again reviewed the SAS code and found that Duke Energy appropriately implemented the changes recommended by Navigant. Navigant reviewed about 70 files as part of this process, which included code scripts and extracts. Navigant did not execute the code; however the Navigant analyst performed a detailed assessment of output extracts from each section of the code, and coordinated closely with the Duke Energy SAS code author throughout the review process.

1.2.2 Verify Energy and Demand Calculations Used for Settlement

To complete the second objective, Navigant replicated Duke Energy's energy and demand calculations to determine settlement payments, and compared these with the energy and demand values reported in the program's operational tracking database containing settlement reports exported from EPO.

Schneider Electric's EPO outputs a settlement report for each participant (monthly capacity and event energy settlements). Each report contains the data (including the Duke Energy baseline and the participant actuals) used and the arithmetic applied to calculate the settlement payment.

To fulfill this task, Duke Energy directed Navigant to replicate the settlement arithmetic for all PowerShare participants from June through October of 2017. The purpose of this replication was to audit the process and ensure that all algorithms were applied as specified in the program literature. A detailed methodology and findings are presented later in this report.

1.3 Program Rules

This sub-section provides some additional detail regarding the program rules, specifically, those rules that define how much DR participants are required to provide, and a summary of the participant credits.

This information is a summary of the DEO PowerShare Program brochure to which interested readers should refer for additional detail.[6]

As noted earlier, there are two PowerShare program options in DEO territory, but no QuoteOption events were called during the period covered by this evaluation so only CallOption is addressed further.

The CallOption has, itself, a high degree of optionality for participants. Participants enrolled in CallOption must select:

- A compliance plan ("Fixed" or "Firm");
- A participation period ("Summer Only", "Extended Summer", or "Annual"), and;
- An energy option ("Capacity Only" or "Emergency Full").

Details of each of these options are discussed in the text immediately below, and in Table 1, which follows.

Compliance Plan. Participants in the CallOption must select one of two compliance plans:

- Fixed. A "Fixed" compliance plan is a "down by" requirement (i.e., when called participants must reduce demand by X kW).
- Firm. A "Firm" compliance plan is a "down to" requirement (i.e., when called participants must reduce demand to X kW).

Participation Period. The participation period selected determines the contract term, potential periods of interruption and the payment schedule. Details of these differences are presented in Table 1, below.

Energy Option. CallOption participants may choose either the:

- "Capacity Only" option, in which case they may participate in the PJM energy markets but do not receive any energy payments from Duke Energy; or,
- "Emergency Full" option which precludes the participant from participating in other curtailment programs.

All PowerShare options, compliance plans, participation periods and energy options require participants to commit to curtailing a minimum of 100kW per event.

CallOption curtailment may only be called as required by PJM capacity constraints.

Table 1, below, presents some additional detail regarding the program rules for the three PowerShare options in DEO territory with enrolled participants.

[6] Duke Energy Ohio, *PowerShare Ohio 2016 - 2017* (Program Brochure), Accessed 2017 https://www.duke-energy.com/business/products/powershare

Table 1: Detailed PowerShare Option Rules

	CallOption – Summer Only	CallOption – Extended Summer	CallOption – Annual
Eligibility	Available to customers served on rate schedules DS, DP, and TS.	Available to customers served on rate schedules DS, DP, and TS.	Available to customers served on rate schedules DS, DP, and TS.
Notice	30 Minutes	30 Minutes	30 Minutes
Curtailment Frequency and Timing	Curtailment may occur between noon and 8pm for up to 6 hours on non-holiday weekdays from June through September. No more than 10 emergency events may be called during the summer.	Curtailment may occur between 10am and 10pm for up to 10 hours on any day from June through October 2017, and May 2018. There is no limit on the number of events that may be called.	Curtailment may occur between 10am and 10pm for up to 10 hours on any day from June through October 2017, and May 2018. Curtailment may also occur between 6am and 9pm on any day from November through April. There is no limit on the number of events that may be called.
Energy Payment	Emergency Full option participants receive credit at a rate equivalent to 85% of the real-time LMP observed during the event.	Emergency Full option participants receive credit at a rate equivalent to 85% of the real-time LMP observed during the event.	Emergency Full option participants receive credit at a rate equivalent to 85% of the real-time LMP observed during the event.
Capacity Payment	$36 per kW/year	$48 per kW/year	$54 per kW/year
Penalty	Failure to reduce to Firm Demand levels incurs a penalty of the Real-Time cost of energy (LMP + 10%). All penalties charged by PJM and include potential for removal from the program.	Failure to reduce to Firm Demand levels incurs a penalty of the Real-Time cost of energy (LMP + 10%). All penalties charged by PJM and include potential for removal from the program.	Failure to reduce to Firm Demand levels incurs a penalty of the Real-Time cost of energy (LMP + 10%). All penalties charged by PJM and include potential for removal from the program.

Source: Duke Energy program literature

2. EVALUATION METHODS

This section of the PowerShare evaluation outlines the methods employed by the evaluation team to complete the evaluation.

This section is divided into two sub-sections:

- **Duke Energy Baseline SAS Code Audit.** This sub-section describes Navigant's approach to auditing the SAS code developed by Duke Energy to estimate participant baselines and calculate capabilities.
- **Replication of EPO Calculations**. This sub-section describes the approach and data used to replicate the EPO calculations that deliver the energy and demand used by Duke Energy to determine settlement payments.

2.1 Duke Energy Baseline SAS Code Audit

Navigant's approach to reviewing the SAS code was to focus on the changes implemented to the code based on the recommendations provided by Navigant during the 2016 evaluation. Navigant requested and reviewed a number of files containing SAS coding script and other extracts from the code. Navigant did not run the code.

2.2 Replication of EPO Calculations

This sub-section describes the approach and data used by Navigant to replicate the EPO calculations for energy and demand used by Duke Energy to determine settlement payments.

It is divided in two parts:

- **Input Data** - This section lists the key data and documents used as inputs for this analysis.
- **Description of EPO calculations** - This section provides the algebraic descriptions of the calculations replicated by Navigant.

2.2.1 Input Data

Navigant used the following key input data and documents to replicate the EPO settlement calculations:

1. EPO settlement results data
2. DEO PowerShare participants' interval consumption data
3. DEO PowerShare Program brochure[7]
4. The Schneider Electric summary of data required to complete settlement algorithms, provided to Navigant by Duke Energy.
5. PowerShare program guidelines, provided to Navigant by Duke Energy.

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[7] The DEO PowerShare Program brochure can be found at https://www.duke-energy.com/business/products/powershare

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2.2.2 Description of EPO Calculations

This section summarizes Navigant's replication of the EPO calculations that estimate the energy and demand values used by Duke Energy to determine settlement. There are several key terms that are worth formally defining in order to clarify their use in equations that follow. These terms are:

- **Proforma Demand**: Demand level specified in CallOption participants' agreement
- **Firm Demand Compliance Option**: CallOption participants may choose one of two compliance options. For the Firm demand option, participants agree to reduce load **by** a certain kW level when called.
- **Fixed Demand Compliance Option**: CallOption participants may choose one of two compliance options. For the Fixed demand option, participants agree to reduce load **to** a certain kW level when called.

Navigant applied the equations in this section to the interval consumption data resulting in the relevant energy or capacity credits. Navigant then compared the calculated credits to the EPO settlement data and verified that the results were essentially identical for each calculation.[8]

Event Energy Credits (Applies to "Emergency Full" CallOption Participants)

$$LR = \sum_h [MAX(0, MIN(1000, P_h - A_h))]$$

Where:

LR	=	Load reduction,
P_h	=	Proforma demand in hour h,
A_h	=	Actual demand in hour h

Monthly Capacity Credits (Applies to CallOption Participants)

The calculation of monthly capacity differs by compliance option.

Firm Demand Compliance Option

$$NEOL = MAX(0, A_i - F)$$

$$EOL = MAX(0, P - F)$$

Where:

NEOL	=	Non-event option load, used for months in which no event occurred,
EOL	=	Event option load, used for months in which an event occurred,
A_i	=	Average demand for month i during the exposure period,
F	=	Firm demand,
P	=	Average proforma demand during curtailment period

[8] Some small insignificant differences in individual calculations were found due to rounding effects.

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Fixed Demand Compliance Option

$$NEOL = MAX(0, MIN(A_i, FDR))$$

$$EOL = MIN(P, FDR)$$

Where:

NEOL	=	Non-event option load, used for months in which no event occurred,
EOL	=	Event option load, used for months in which an event occurred,
A_i	=	Average demand for month i during the exposure period,
FDR	=	Fixed demand reduction,
P	=	Average proforma demand during curtailment period

3. EVALUATION FINDINGS AND RESULTS

This section describes the findings and results of Navigant's evaluation. It is divided into two sections:

- **Duke Energy Baseline SAS Code Audit.** This section describes Navigant's findings and recommendations based on our audit of the Duke Energy baseline SAS code.
- **PowerShare Impacts and Findings from Navigant's Replication of EPO Calculations.** This section describes Navigant's findings based on our analysis of the program tracking database[9] and the replication of the EPO calculations that deliver the energy and demand impacts used by Duke Energy to determine settlement payments.

3.1 Duke Energy Baseline SAS Code Audit

Navigant found that Duke Energy addressed all recommendations from the 2016 PowerShare EM&V reports. This resulted in improvements to the code that should enhance the usability and mitigate the potential for errors.

3.2 PowerShare Impacts and Findings from Navigant's Replication of EPO Calculations

Navigant replicated the EPO calculations for all of the participants in the period from June through October of 2017. Initially, Navigant found a number of discrepancies between its energy and capacity settlement calculations and those provided by Duke Energy. After several discussions with Duke Energy, Navigant identified the following causes of discrepancies:

- Interval data issues related to power outages (caused most of the discrepancies)
- Missing data

Upon resolving those discrepancies, Navigant found that all of Duke Energy's estimates are accurate per the settlement algorithms defined by the program literature. A comparison of Navigant's replicated calculations with the output of the EPO revealed no deviations beyond what could be expected as a result of rounding error, meaning that Duke Energy's estimates are accurate. A summary of the validation results, by credit type may be found in Table 2 below.

[9] The "program tracking database" refers to the documentation provided by Duke Energy outlining the reported capacity and energy values used by Duke Energy for settlement payment.

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Table 2. Verification of EPO Calculations

Program Option	Credit Type	Customers	# of Unique Account Numbers	# of EPO Results Replicated[a]	Average % Absolute Error[b]
CallOption	Energy	41	41	41	0.00%
CallOption	Capacity	41	41	164	0.00%

a. *The number of calculations reproduced by Navigant for this analysis. For energy there is one credit calculated per participating account per event. For capacity there is one credit calculated per participating account per month. The period of analysis for this evaluation included four months and three test curtailment events. CallOption participants are required only to participate in one test event per season.*

b. *The absolute error represents the difference between Navigant's replicated settlement results and the EPO estimates used by Duke Energy. The near-zero error demonstrates that Navigant was able to replicate settlement calculations using the algorithms provided by Duke Energy.*

Source: EPO Settlement Data and Navigant analysis

Navigant calculated verified values according the EPO algorithms described above using Duke Energy's participant baselines and participant interval data. Only CallOption Emergency events (as opposed to test events) were called in the period of analysis. Since participants are required to participate only in a single test event during the DR season, most only participated in the first event. This resulted in most energy impacts being observed in that event. The total energy impacts per event for the summer of 2017 by PowerShare option are summarized in Table 3, below.

Table 3: Summary of 2017 Event Energy Impacts at the Meter (Total Program MWh per Event)

Program Name	September 7th	September 21st	September 26th	Total
Total Energy Curtailed (MWh)	54	0.4	0.5	55
# of Participants	38	2	1	41

Source: EPO Settlement Data and Navigant analysis

The PowerShare Program paid out capacity credits to participants for an average monthly capacity of approximately 48 MW during the summer of 2017**.** This value is calculated according the EPO algorithms described above using Duke Energy's participant baselines and participant interval data. The total DR capacity per month for the summer of 2017 for PowerShare CallOption participants is summarized in Table 4, below.[10]

[10] A total of 13 participants were enrolled for the Extend Summer option that includes October. However, no events were called in October so it is omitted from Table 4.

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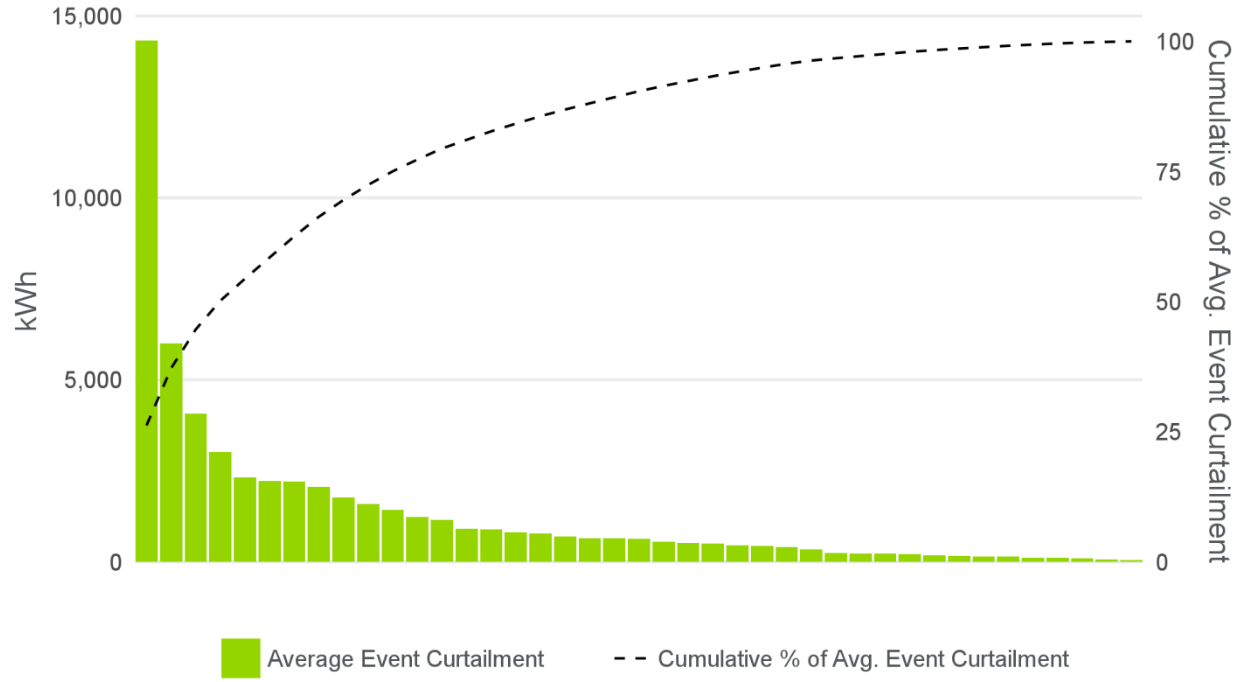
Table 4: Total Monthly Capacity for 2017 at the Meter (MW)

Program Name	June	July	August	September	Average
CallOption	45	47	50	49	48

Total program impacts are driven by curtailment for individual meters. Figure 1 shows each meter's average event energy reduction across the analysis period with a single accout driving much of the curtailment.

Figure 1: Average Event Curtailment by Participant



Source: EPO Settlement Data and Navigant analysis

Average monthly capacity is driven by a small percentage of meters. Figure 2 shows that the top three meters in terms of average monthly capacity account for 48% of total average monthly capacity. The ranking of participants by their average monthly capacity is nearly identical to that of their average event reduction.

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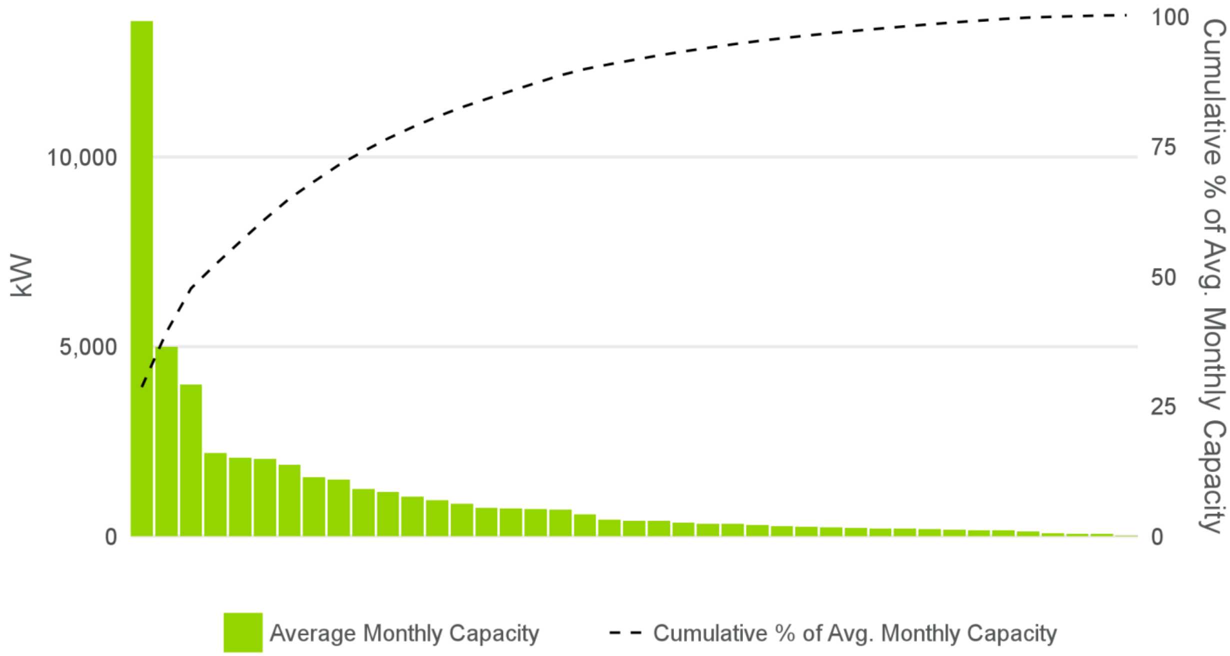
Figure 2: Average Monthly Capacity by Participant[11]



Source: EPO Settlement Data and Navigant analysis

[11] The bar chart shows each participant's average capacity only across the months in which they participated in events.

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4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Duke Energy Baseline SAS Code Audit

Navigant's detailed review of Duke Energy's SAS code determined that Duke Energy addressed all recommendations from the 2016 EM&V report for improving the organization and functionality of the code. The evaluation team believes the code is functioning correctly and does not need further review or updates at this time.

4.2 Verification and Validation of Settlement Energy and Demand Calculations

Although Navigant initially encountered some discrepancies when replicating Duke Energy's settlement calculations, these discrepancies were eventually resolved, and Navigant found that Duke Energy's settlement calculations were accurate per the algorithms defined in Section 2.2. This finding confirms that Duke Energy's procedure for calculating impacts is functioning in accordance with the program definitions, and therefore there will be limited value in continuing to audit settlement calculations using the methods described in this report.

If future evaluation efforts include similar efforts to replicate the settlement calculations, Navigant recommends that Duke Energy implement a detailed process for tracking all outages such that it can easily be determined when missing interval data was replaced with pro forma figures to minimize the initial discrepancies and expedite the evaluation.

APPENDIX F - SMALL BUSINESS ENERGY SAVER EVALUATION

EM&V Report for the Small Business Energy Saver Program

Duke Energy Ohio

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August 29, 2018

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1. EVALUATION SUMMARY

1.1 Program Summary

The Small Business Energy Saver (SBES) Program is part of a portfolio of energy efficiency programs operated by Duke Energy. Duke Energy selected SmartWatt Energy to implement the SBES program in the Duke Energy Ohio (DEO) jurisdiction. The program caters specifically to small business customers and offers a performance-based incentive up to 80 percent of the total project cost, inclusive of both materials and installation, on high-efficiency lighting and refrigeration equipment.

The SBES Program generates energy savings and peak demand reductions by offering eligible customers a streamlined service including marketing outreach, technical expertise, and performance incentives to reduce equipment and installation costs from market rates on high-efficiency lighting, refrigeration, and HVAC equipment. The SBES Program seeks to bundle all eligible measures together and offer them as a single project in order to maximize the total achievable energy and demand savings, while working with customers to advise equipment selection to meet their unique needs.

1.2 Evaluation Objectives and High Level Findings

Evaluation, Measurement, and Verification (EM&V) involves the use of a variety of analytic approaches, including on-site verification of installed measures and application of engineering models. EM&V also encompasses an evaluation of program processes and customer feedback, typically conducted through participant surveys and program staff interviews. This report details the EM&V activities that Navigant Consulting, Inc. (Navigant) performed on behalf of Duke Energy for the SBES Program covering the period between March 1, 2016 through June 30, 2017, referenced simply as PY2016.

The primary purpose of the evaluation assessment is to estimate net annual energy and peak demand impacts associated with SBES activity. Net savings are calculated as the reported "gross" savings from Duke Energy, verified and adjusted through EM&V, and netted for free ridership (i.e., savings that would have occurred even in the absence of the program) and spillover (i.e., additional savings attributable to the program but not captured in program records).

- Navigant performed impact and process evaluations for this EM&V assessment. The impact evaluation consists of engineering analysis and on-site field verification and metering to validate energy and demand impacts of reported measure categories, as well as a participant survey to assess net impacts.
- For the process evaluation, Navigant completed online surveys with 110 participants and interviews with program staff and the implementation contractor (IC) to characterize the program delivery and identify opportunities to improve the program design and processes. The evaluation team also used the participant survey data to estimate free ridership and spillover to calculate an NTG ratio.

The evaluation team verified gross energy savings at 104 percent of deemed reported energy savings, and gross summer peak demand reductions at 74 percent. A net-to-gross (NTG) ratio was estimated at 1.02, yielding total verified net energy savings of 27,688 megawatt-hours (MWh), net summer peak demand reductions of 3.4 megawatts (MW), and net winter peak demand reductions of 4.0 megawatts (MW) (Table 1-1 through Table 1-4). It is important to note that although the gross realization rate was

104 percent, there was variability in the verified savings at the individual project level that is explored further in section 4 of this report. The NTG ratio of 1.02 indicates that the program is directly responsible for energy and demand savings, and that savings would not have occurred in the absence of the program.

Table 1-1. Program Claimed and Evaluated Gross Energy Impacts

	Claimed	Evaluated	Realization Rate
Gross Energy Impacts (MWh)	26,021	27,145	1.04

Source: Navigant analysis and Duke Energy tracking data, totals subject to rounding.

Table 1-2. Program Claimed and Evaluated Gross Peak Demand Impacts

	Claimed	Evaluated	Realization Rate
Gross Summer Peak Demand Impacts (MW)	4.5	3.3	0.74
Gross Winter Peak Demand Impacts (MW)	4.7	3.9	0.83

Source: Navigant analysis and Duke Energy tracking data, totals subject to rounding.

Table 1-3. Program Net Energy Impacts

	MWh
Net Energy Impacts (MWh)	27,688

Source: Navigant analysis, totals subject to rounding.

Table 1-4. Program Net Peak Demand Impacts

	MW
Net Summer Peak Demand Impacts (MW)	3.4
Net Winter Peak Demand Impacts (MW)	4.0

Source: Navigant analysis, totals subject to rounding.

Additionally, consistent with Ohio SB310, the higher of the evaluated estimates of energy efficiency impacts or the deemed values are applied prospectively to adjust subsequent impact assumptions until superseded by new EM&V results. The evaluated energy impacts reported for the SBES program were found to be higher than the deemed savings and therefore the evaluated results shall be applied to the rider in the month following the completion of this EM&V report. The evaluated summer demand impact realization rate, however, was found to be lower than the verified realization rate, therefore the deemed results shall be applied. Alternatively, the evaluated winter demand realization rate was found to be higher than the deemed realization rate, therefore the evaluated realization rate will be applied. The evaluated results will also be used to estimate future target achievement levels for development of estimated incentives and in future cost-effectiveness evaluations. Table 1-5 below summarizes the program claimed, deemed, and evaluated values.

Table 1-5. Program Impact Summary

	Energy (MWh)	Summer Demand (MW)	Winter Demand (MW)
Gross Claimed Impacts	26,021	4.5	4.7
Deemed Impacts (1 kWh/kwh)	26,021	4.5	4.7
Deemed Realization Rate	**1.00**	**.77**	**.59**
Evaluated Impacts	27,145	3.3	3.9
Evaluated Realization Rate	**1.04**	**0.74**	**0.83**

Source: Navigant analysis, totals subject to rounding.

1.3 Evaluation Parameters and Sample Period

To accomplish the evaluation objectives, Navigant performed a variety of primary and secondary research activities including:

- Engineering review of measure savings algorithms
- Field verification and metering to assess installed quantities and characteristics
- Participant surveys with customers to assess satisfaction and decision-making processes.

Table 1-6 summarizes the evaluated parameters. The targeted sampling confidence and precision was 90 percent ± 10 percent, and the achieved was 90 percent ± 2.7 percent for energy savings, 11.6 percent for summer and 4.3 percent for winter peak demand reductions.[1]

Table 1-6. Evaluated Parameters

Evaluated Parameter	Description	Details
Efficiency Characteristics	Inputs and assumptions used to estimate energy and demand savings	1. Lighting wattage 2. Operating hours 3. Coincidence factors 4. HVAC interactive effects 5. Baseline characteristics
In-Service Rates	The percentage of program measures in use as compared to reported	1. Measure quantities found onsite
Satisfaction	Customer satisfaction with various stages of their project	1. Overall satisfaction with program 2. Satisfaction with implementation and installation contractors 3. Satisfaction with program equipment

[1] Navigant designed the impact sample to achieve 90/10 confidence and precision using the industry-standard coefficient of variation of 0.5, results from previous (PY2013 through PY2015) SBES program evaluations in other Duke Energy jurisdictions, and Navigant judgement. The final precision was different due to natural variation in individual site level characteristics.

Free Ridership	Fraction of reported savings that would have occurred in the absence of the program	
Spillover	Additional, non-reported savings that occurred as a result of participation in the program	1. Inside spillover (at same facility as program measures) 2. Outside spillover (at different facility as program measures)

Source: Navigant analysis

This evaluation covers program participation from March 2016 through June 2017. Table 1-7 shows the start and end dates of Navigant's sample period for evaluation activities.

Table 1-7. Sample Period Start and End Dates

Activity	Start Date	End Date
Field Verification and metering	September 18, 2017	November 30, 2017
Participant Email Surveys	October 1, 2017	November 30, 2017

Source: Navigant analysis

1.4 Recommendations

The evaluation team recommends six discrete actions for improving the SBES Program, based on insights gained through the evaluation effort. These recommendations, summarized in Table 1-7, provide Duke Energy with a roadmap to fine-tune the DEO SBES Program for continued success.

Table 1-8. Summary of PY2016 SBES Recommendations

Increasing Program Participation and Satisfaction
1. **Increase and improve program communications.** This is the most common challenge or drawback received from participants, with several customers noting specific communication issues regarding the responsibility for and timeline of recycling pickup. Additional education from both SmartWatt and Duke Energy account managers should help customers better understand the program participation process.
2. **Prioritize customer satisfaction training for installation contractors and customer follow-up services.** A minority of customers reported issues with installation and lighting equipment quality. Notably, overall satisfaction was higher for customers that received follow-up inspections from the implementation contractor than those that did not. There appears to be an opportunity to increase satisfaction by performing additional follow-up visits, although this must be balanced against increased cost. Additionally, this helps customers resolve equipment issues in a timely manner.
3. **Phase out T8 fluorescent lighting systems in favor of linear LED kits.** Linear LED lighting offers substantial savings above high-performance/reduced wattage T8 lamps and ballasts, which are increasingly perceived as outdated.
Improving Accuracy of Reported Savings
4. **Track project facility types by using the same list of facility types specified in the Pennsylvania TRM.** This will reduce uncertainty in assigning facility types by the EM&V team based on SIC codes, and facilitate more direct application of HVAC interactive effects and coincidence factors. The Pennsylvania TRM facility types should be used only because the HVAC interactive effects applied by the EM&V team are drawn from this document.

5. **Track burnout lamps and fixtures during the initial audit.** It is likely that some burnouts were present and tolerated by customers, and may contribute to customers not realizing expected savings on their energy bills.

6. **Add connected load to occupancy sensor savings estimates.** Occupancy sensor savings were missing details on connected fixture load. This is a key input to the savings estimation, and should be recorded.

Source: Navigant analysis

2. PROGRAM DESCRIPTION

The Small Business Energy Saver (SBES) Program is part of a portfolio of energy efficiency programs operated by Duke Energy. The program launched in the DEO jurisdiction in late 2014, and first claimed energy savings in January 2015. Duke Energy follows best practices from the successful SBES program operating in other Duke Energy jurisdictions since 2013.

2.1 Program Design

The SBES Program is available to qualifying commercial customers with less than 100 kilowatts (kW) demand service. After completing the program application to assess participation eligibility, customers receive a free energy assessment to identify equipment for upgrade. SmartWatt Energy reviews the energy assessment results with the customer, who then chooses which equipment upgrades to perform. Qualified contractors complete the equipment installations at the convenience of the customer.

The SBES Program recognizes that customers with lower savings potential may benefit from a streamlined, one-stop, turnkey delivery model and relatively high incentives to invest in energy efficiency. Additionally, small businesses may lack internal staffing dedicated to energy management and can benefit from energy audits and installations performed by an outside vendor.

The program offers incentives in the form of a discount for the installation of measures, including high-efficiency lighting, and refrigeration and HVAC equipment. These incentives increase adoption of efficient technologies beyond what would occur naturally in the market. In PY2016, the SBES Program achieved the majority of program savings from lighting measures, which tend to be the most cost-effective and easiest to market to potential participants. The SBES program also achieved program savings from refrigeration measures, namely LED case lighting and upgraded motors, and Wifi thermostats.

The program offers a performance-based incentive up to 80 percent of the total project cost, inclusive of both materials and installation. Multiple factors drive the total project cost, including selection of equipment and unique installation requirements.

2.2 Reported Program Participation and Savings

Duke Energy and the implementation contractor maintain a tracking database that identifies key characteristics of each project, including participant data, installed measures, and estimated energy and peak demand reductions based on assumed ("deemed") savings values. In addition, this database contains measure level details that are useful for EM&V activities.

In addition to the aforementioned measure level tracking database, Duke Energy maintains demand savings ratios (kW/kWh) by measure that are used to calculate the final claimed summer and winter demand savings estimates. These ratios are based on the energy savings (kWh) values reported in the implementation contractor tracking database and include average adjustments for coincidence factors and other parameters affecting demand savings. For this report, Navigant based the analysis of verified demand savings on the implementation contractor tracking database, while calculating final demand realization rates by comparing verified demand savings to reported demand savings calculated from these ratios. This was done in an effort to both provide accurate demand realization rates and attempt to reduce sampling uncertainty.

Table 2-1 provides a summary of the gross reported energy and demand savings and participation for PY2016.

Table 2-1. Reported Participation and Gross Savings Summary

Reported Metrics	PY2016
Participants	912
Measures Installed	56,942
Gross Annual Energy Savings (MWh)	26,021
Average Quantity of Measures per Project	62
Average Gross Savings Per Project (MWh)	28.5

Source: SBES Tracking Database

Duke Energy uses assumptions and algorithms primarily from the Pennsylvania Technical Reference Manual[2] (PA TRM) as the basis for reported (deemed) energy and demand savings for all lighting and refrigeration measures. In addition, the Illinois Technical Reference Manual[3] (IL TRM) is used for Wifi thermostat measures because these measures are not detailed in the PA TRM. Both of these TRMs are robust, well-established, and follow industry best practices for the measures found in the SBES program. The team used the PA TRM rather than the draft Ohio TRM because it receives annual updates that reflect ongoing research into energy savings parameters, such as annual hours of use, coincidence factors, HVAC interactive effects, and appropriate baseline wattages, whereas the draft Ohio TRM has not been updated since 2010.The evaluation team believes the PA TRM is an appropriate basis for estimating savings in the DEO jurisdiction based on Navigant's assessment of the underlying energy savings assumptions and similarities in climate, building stock characteristics.

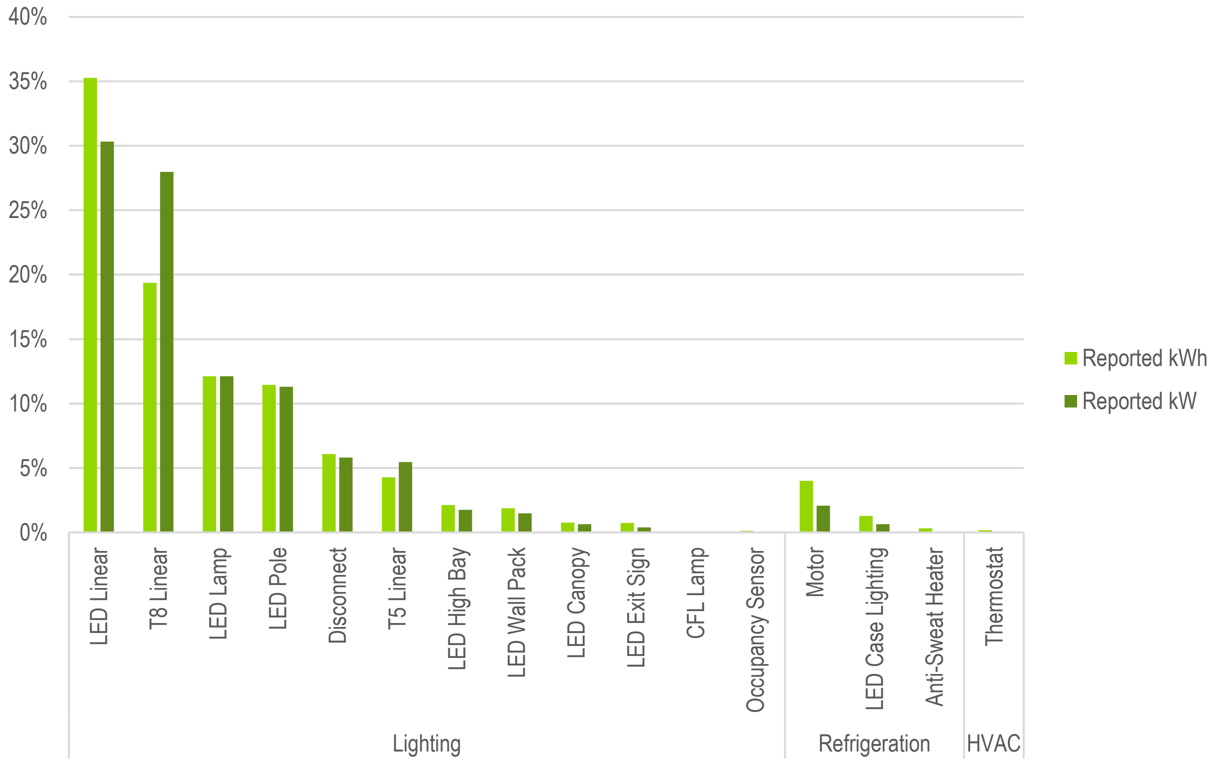
2.2.1 Program Summary by Measure

Efficient LED linear lighting retrofits were the highest contributor to program energy and demand savings in PY2016, followed by T8 linear fluorescent lighting measures and a variety of other LED lighting measures. In addition, refrigeration measures (including EC motors, LED case lighting, and anti-sweat heaters), and smart: programmable thermostats also contributed to savings. Overall, lighting measures contribute 94 percent of reported program energy savings, refrigeration measures contribute 6 percent, while HVAC measures contribute less than one percent. Figure 2-1 shows the reported gross savings by measure category as reported by Duke Energy.

[2] TECHNICAL REFERENCE MANUAL. State of Pennsylvania Act 129: Energy Efficiency and Conservation Program & Act 213: Alternative Energy Portfolio Standards. June 2015.

[3] Illinois Statewide Technical Reference Manual for Energy Efficiency Version 5.0 Volume 2: Commercial and Industrial Measures. http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Version_5/Final/IL-TRM_Effective_060116_v5.0_Vol_2_C_and_I_021116_Final.pdf

Figure 2-1. Reported Gross Energy Savings by Measure Category

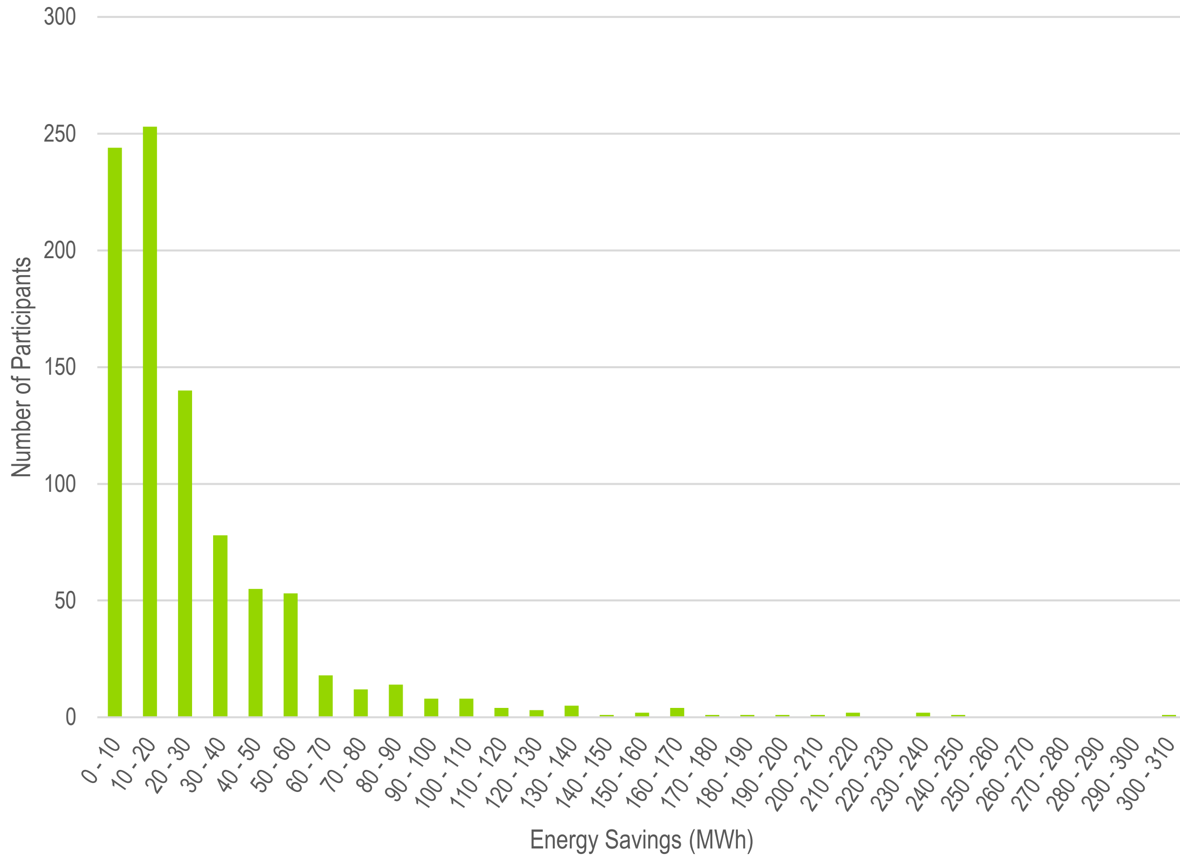


Source: SBES Tracking Database

2.2.2 Savings by Project

Because the SBES program is limited to small business customers only, the variations in project energy and peak demand savings and the quantity of measures installed exhibit a more narrow spread than typical large business program offerings. Nevertheless, there is still a mix of various project sizes, as shown in Figure 2-2, with very few project sites reporting savings over 200 MWh per year. The largest sites reported savings of 307 MWh per year, and were eligible to participate in the SBES program because they consisted of several smaller projects that qualified individually. The largest projects typically consisted of several independent customer accounts, meters, or buildings completed as a single energy efficiency project.

Figure 2-2. Histogram of Reported Energy Savings per Project

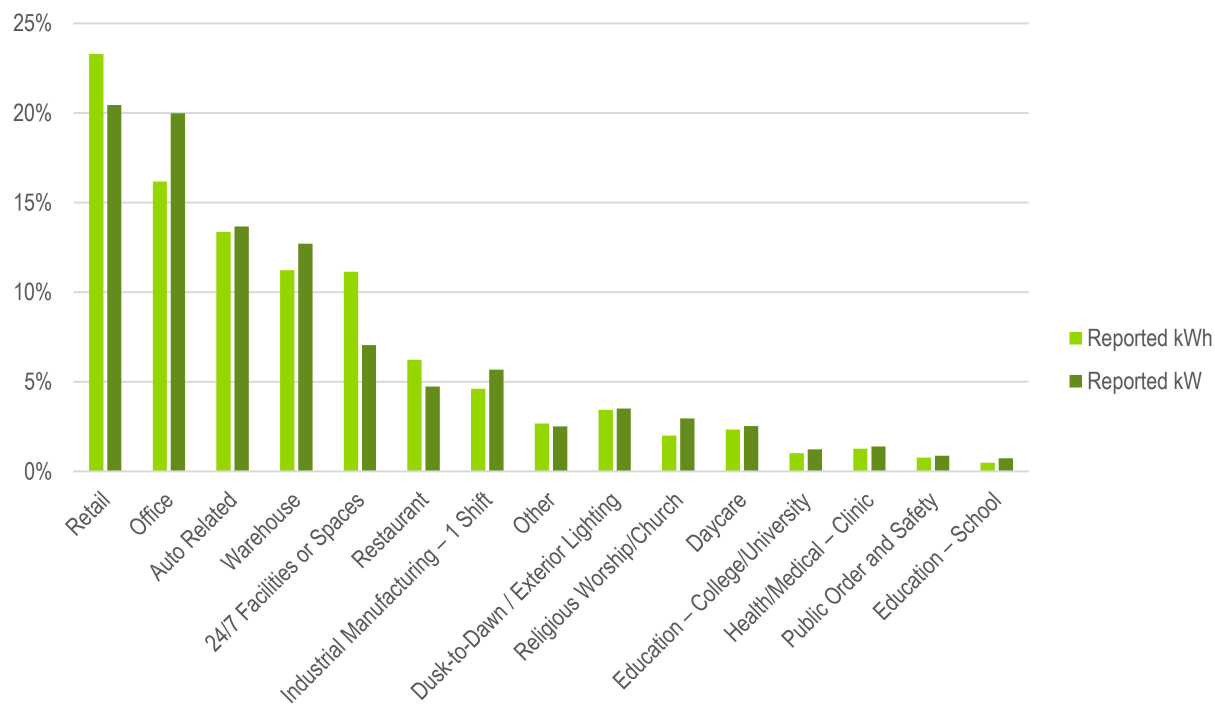


Source: SBES Tracking Database

2.2.3 Savings by Facility Type

Navigant reviewed the business type data in the tracking database to understand the participant demographics. The business type data tracks established SIC codes, which results in many unique detailed building types. In order to apply assumptions from the PA TRM, such as HVAC interactive effects and coincidence factors, Navigant mapped the SIC codes to the facility types detailed in the PA TRM. These facility types are shown below in Figure 2-3. The distribution of facility types is representative of a large variety of small business customers, indicating that the program is successfully recruiting participants across several sectors. The retail, office and auto related facilities represent the largest contributors or energy and demand savings.

Figure 2-3. Reported Energy Savings by Facility Type



Source: SBES Tracking Database

3. KEY RESEARCH OBJECTIVES

As outlined in the Statement of Work (SOW), the primary purpose of the EM&V activities is to estimate verified gross and net annual energy and peak demand impacts associated with program activity for PY2016. Additional research objectives include the following:

3.1 Impact Evaluation

The impact evaluation focuses on quantifying the magnitude of verified energy savings and peak demand reductions. Objectives include:

- Verify deemed savings estimates through review of measure assumptions and calculations.
- Perform on-site verification of measure installations, and collect data for use in an engineering analysis.
- Estimate the amount of observed energy and peak demand savings (both summer and winter) by measure via engineering analysis.

3.2 Net-to-Gross Analysis

The net-to-gross analysis focuses on estimating the share of energy savings and peak demand reductions that can be directly attributed to the SBES program itself. Objectives include:

- Assess the Net-to-Gross ratio by addressing spillover and free-ridership in participant surveys.

3.3 Process Evaluation

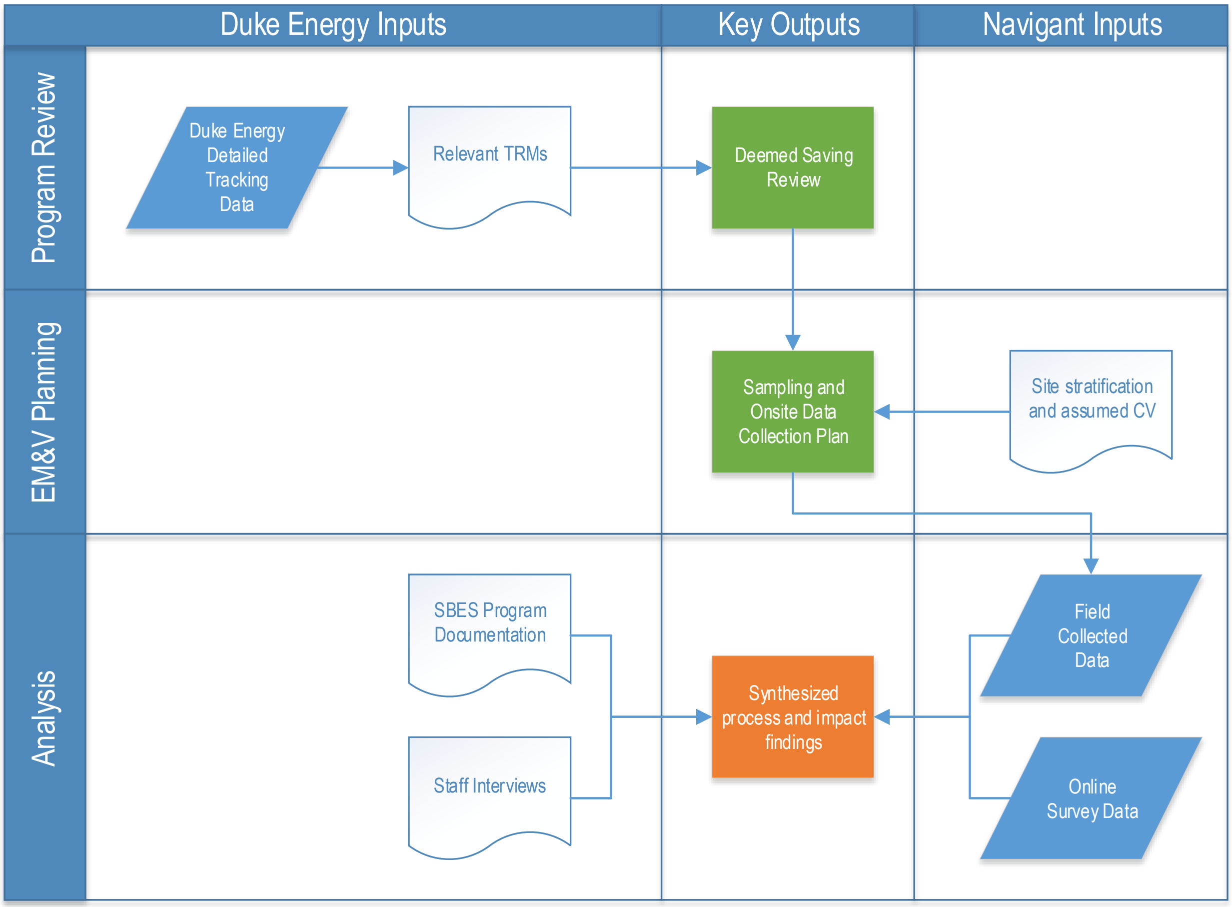
The process evaluation focuses on the program implementation and the customer experience. Objectives include:

- Perform interviews with program management and Implementation Contractor.
- Perform participant surveys with customers.
- Identify barriers to participation in the program, and how the program can address these barriers.
- Identify program strengths and the potential for introducing additional measures.

3.4 Evaluation Overview

Figure 3-1 outlines the high-level approach used for evaluating the SBES Program, which is designed to address the research objectives outlined above. The impact, net-to-gross, and process sections provide further detail for each of the individual EM&V activities.

Figure 3-1. Evaluation Process Flow Diagram



Source: Navigant analysis

4. IMPACT EVALUATION

The purpose of this impact evaluation is to quantify the verified gross and net energy and demand savings estimates for the SBES Program. Table 4-1 shows high-level program results of Navigant's impact analysis. Ultimately, Duke Energy can use these results as an input to system planning. As noted above, although the program-level gross realization rate is 104 percent, Navigant found variability in site-level results.

Table 4-1. PY2016 SBES Summary of Program Impacts

	Energy Savings (MWh)	Summer Peak Demand Reductions (MW)	Winter Peak Demand Reductions (MW)
Reported Gross Savings	26,021	4.5	4.7
Realization Rate	1.04	0.74	0.83
Verified Gross Savings	27,145	3.3	3.9
NTGR	1.02	1.02	1.02
Verified Net Savings	27,688	3.4	4.0

Source: Navigant analysis, totals subject to rounding.

4.1 Impact Methodology

The methodology for assessing the gross energy savings and peak demand reductions follows IPMVP Option A (Retrofit Isolation: Key Parameter Measurement)[4]. This involved an engineering-based approach for estimating savings, supplemented by key parameter measurements. This also included using time-of-use lighting loggers to directly measure operating hours and coincidence factors for program-incented lighting measures. Note that for the refrigeration measures, verification activities were performed on-site to assess installation and operation.

The evaluation team employed the following steps to conduct the impact analysis:

1. **Review Field Data and Design Sample** – First, the team analyzed the tracking data to determine the most appropriate sampling methodology. The team created four strata based on reported energy savings (small, medium, and large lighting, and refrigeration) to ensure that a variety of different businesses and measures were captured in the site visits. A subset of each strata was selected for more detailed data logger deployment (20 of 60 total sites visits were logged). The sample was designed to utilize double-ratio techniques to meet a precision target of 90/10 at the program level while attempting to minimize sample sizes.
2. **Pull Sample** – Next, the team pulled a sample from the four strata and scheduled site visits, including several backup sites in the event that a visitation could not be arranged.
3. **Perform Participant Site Visits** – The evaluation team used an electronic data collection system in the field to ensure consistency and decrease data processing time. For all site visits, Navigant

[4] International Performance Measurement & Verification Protocol Concepts and Options for Determining Energy and Water Savings Volume I. http://www.nrel.gov/docs/fy02osti/31505.pdf

field technicians uploaded all collected site data to the online system as soon as they were completed. Navigant performed quality control verifications for all field data collection forms and online data entry. This included a thorough inspection of each site's building characteristic inputs, operating schedules, measure-level in-service rates, and descriptions. The following steps were taken at each participant site:

a. The team first determined the in-service rate (ISR) of the equipment for each measure found. The field technicians accomplished this by visually verifying and counting all equipment included in the project documentation.

b. The team then calculated the difference in watts between the base-case fixtures and the energy-efficient fixtures for each fixture type installed on-site. The team verified efficient fixture wattage through visual inspection, while deriving base-case fixture wattage from customer-provided data found in the documentation review, if available, or from information found by field technicians during the site visits. There is typically little to no information about the specifications of base-case equipment that has been removed from a site. If both customer data and field data were insufficient, the team utilized the tracking data and assessed the reasonableness of their assumptions.

c. Operating hours were determined from a detailed customer interview for each unique lighting schedule in the building, and adjusted for holiday building closures. For the subset of sites that received logging, the EM&V team left time-of-use loggers in place for roughly four weeks and then returned to retrieve the logging equipment.

d. Coincidence factors and HVAC interactive factors were taken from the PA TRM. For logged sites, the team calculated both summer and winter coincidence factors from the logger data.

4. **Calculate Project-Level Savings** – The team calculated project-level energy and demand savings for each site in the sample based on operational characteristics found on site and engineering-based parameter estimates. The project-level savings represent the total of all of the individual measure-level savings at each site.

Calculate Program-Level Savings – The team calculated verification rates for all sites and applied a ratio, representing the adjustment based on the logger data, resulting in final verified savings for each sampled site. Next, the team calculated stratum-level realization rates, consisting of the sum of the verified savings divided by the deemed reported savings. Last, the team applied the stratum-level realization rates to the deemed reported savings for each respective strata, and arrived at final program-level realization rates. Note that for demand savings, final program-level realization rates were calculated by comparing verified demand savings to reported demand savings using the demand ratios outlined in Section 1.Key evaluation parameters came primarily from on-site data; however, where this data was lacking or was deemed unusable, customer application data was used in its place. As there are many parameter inputs to the savings calculation for each site, this approach ensures that the best available data is used for each site's savings estimate. Table 4-2 below details the final site visit disposition.

Table 4-2. Onsite Sample Summary

Strata	Population Size	Onsite Verification Sample Size	Onsite Metering Sample Size (Subset of Verification Sample)
Lighting Large	60	13	5
Lighting Medium	174	11	4
Lighting Small	509	19	7

Refrigeration	169	17	4
Total	**912**	**60**	**20**

Source: Navigant analysis

4.2 Algorithms and Parameters

Navigant used data collected from the field and the engineering review to calculate site-level energy and demand savings, using the following algorithms. Table 4-3, Table 4-4, and Table 4-5 show the algorithms that the evaluation team used to calculate verified savings for lighting measures and refrigeration measures, respectively. The impact evaluation effort focused on verifying the inputs for these algorithms. Detailed descriptions of each parameter and any related assumptions are outlined in the following section, along with relevant findings.

Table 4-3. Verified Savings Algorithms for Lighting Measures

Measure	Energy Savings Algorithm	Coincident Peak Demand Savings Algorithm
Lighting Measures	kWh = Qty * HOU * Watts_Reduced * IF_Energy	kW = Qty * CF * Watts_Reduced * IF_Demand
Qty = quantity of equipment verified on-site		
HOU = annual operating hours		
Watts_Reduced = difference between efficient and baseline watts		
CF = coincidence factor		
IF_Energy = heating, ventilating, and air conditioning (HVAC) interaction factor for energy savings calculations		
IF_Demand = HVAC interaction factor for demand savings calculations		

Source: Navigant analysis and PA TRM

Table 4-4. Verified Savings Algorithms for Refrigeration Measures

Measure	Energy Savings Algorithm	Coincident Peak Demand Savings Algorithm
Refrigeration ECM Motors	kWh = kW * HOU	kW = Qty * Watts_Reduced * LF * DC * (1 / DG / COP)
Anti-Sweat Heater Controls	kWh = kW / DoorFt * 8760 * HA * (1 + Rh / COP)	kW = kW / DoorFt * HP * (1 + Rh / COP) * DF
Qty = quantity of equipment verified on-site		
Watts_Reduced = difference between efficient and baseline watts		
LF = Load factor (0.9)		
DC = Duty cycle (1.00 for coolers, 0.944 for freezers)		
DG = Degradation factor of compressor COP (0.98)		
COP = Coefficient of performance (2.5 for coolers, 1.3 for freezers)		
HOU = Hours of use (8760, or less with defined facility closures)		
HA = Percent of time case ASH with controls will be off annually (0.85 for coolers, 0.75 for freezers)		
HP = Percent of time case ASH with controls will be off during the peak period (0.2 for coolers, 0.1 for freezers)		
Rh = Residual heat fraction (0.65)		
DF = Demand diversity factor (1.0)		

Source: Navigant analysis and PA TRM

Table 4-5. Verified Savings Algorithms for HVAC Measures

Measure	Energy Savings Algorithm	Coincident Peak Demand Savings Algorithm
Programmable Wifi Thermostats	kWh_Verified = [Baseline Energy Use (kWh/Ton) – Proposed Energy Use (kWh/Ton)] * Cooling Capacity (Tons)	NA
Baseline Energy Use (kWh/Ton) = estimate of baseline energy use from Il TRM		
Proposed Energy Use (kWh/Ton) = estimate of proposed energy use from Il TRM		
Cooling Capacity (Tons) = Capacity of cooling system in tons		

Source: Navigant analysis and IL TRM

4.3 Key Impact Findings

The energy realization rates by strata are shown in Table 4-6. This shows the verification realization rate, the metering realization rate, and the final realization rate by strata. The total realization rate for each strata is calculated by multiplying the verification realization rate to the metering realization rate adjustment. This method in effect extrapolates the project-specific results to the stratum-level, which implicitly assumes that these findings in aggregate are representative of other sites within their stratum. In addition, the weighted final realization rate for the program is shown, which represents the total program savings as a weighted result of each stratum. Additional information specific to the metering realization rate adjustments is provided in Section 4.4.2 and 9.APPENDIX A

Table 4-6. Energy Impacts by Strata

Strata	Verification Realization Rate (kWh)	Metering Realization Rate Adjustment (kWh)	Total Realization Rate (kWh)
Lighting Large	1.00	0.93	0.93
Lighting Medium	1.00	1.07	1.07
Lighting Small	1.07	1.13	1.21
Refrigeration	1.02	0.97	0.99
Total	**1.01**	**0.97**	**1.04**

Source: Navigant analysis, totals subject to rounding.

The summer and winter peak demand reductions are shown in Table 4-7 and Table 4-8. There is a reduction in the realization rates for both summer and winter demand savings due to application of coincidence factors based on both deemed values from the PA TRM and logger data. Navigant notes that these realization rates are calculated by comparing verified savings with the Duke Energy reported savings calculated from demand ratios rather than reported in the detailed measure database.

Table 4-7. Summer Peak Demand Impacts by Strata

Strata	Verification Realization Rate (Summer kW)	Metering Realization Rate Adjustment (Summer kW)	Total Realization Rate (Summer kW)
Lighting Large	0.68	0.92	0.62
Lighting Medium	0.59	0.98	0.57
Lighting Small	1.02	1.01	1.03
Refrigeration	0.80	0.97	0.77
Total	**0.78**	**0.96**	**0.74**

Source: Navigant analysis, totals subject to rounding

Table 4-8. Winter Peak Demand Impacts by Strata

Strata	Verification Realization Rate (Winter kW)	Metering Realization Rate Adjustment (Winter kW)	Total Realization Rate (Winter kW)
Lighting Large	1.07	0.96	1.03
Lighting Medium	0.79	0.77	0.61
Lighting Small	0.85	1.00	0.84
Refrigeration	0.98	0.95	0.94
Total	**0.89**	**0.94**	**0.83**

Source: Navigant analysis, totals subject to rounding

Overall, the realization rates are 1.04 for energy savings, and 0.74 and 0.83 for summer and winter peak demand reductions, respectively. This indicates that the program is very closely reporting energy impacts at the aggregate program level, despite varying realization rates for each individual stratum. The demand reductions reported by the program are consistently higher than those found by the evaluation team as well.

4.4 Detailed Impact Findings

This section examines findings from the evaluation of lighting measures in order to identify the main drivers of the verified savings values. The evaluation team uses the Field Verification Rate (FVR) to describe the overall verified savings relative to the reported savings for each measure. FVRs reflect differences between the quantity of equipment installed on-site and the quantity reported in the tracking database, as well as differences between operating characteristics verified in the field and assumed operating characteristics in the program deemed savings estimates. The team calculates the field verification rate as the verified savings divided by the reported savings by measure, which is driven by a combination of the in-service rate, the hours of use adjustment rate, the lighting power adjustment rate, the HVAC interactive effect adjustment rate, and the coincidence factor, described as follows:

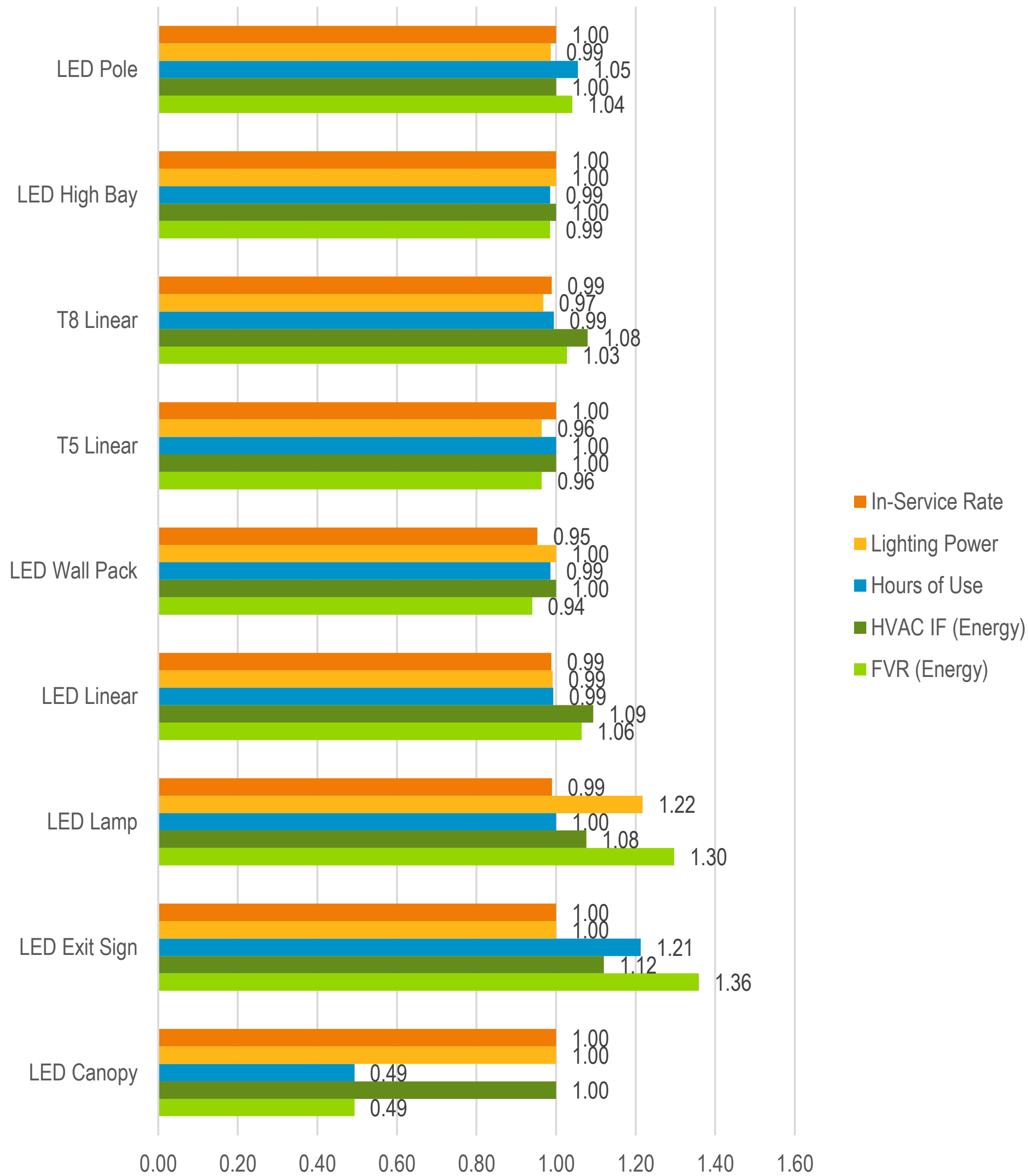
1. **In-Service Rate**[5] **(ISR)** is the ratio of the verified (i.e., installed) quantity to the reported quantity.
2. **Hours of Use (HOU) Adjustment Rate** reflects discrepancies between reported and verified operating hours.
3. **Lighting Power Adjustment Rate** is a ratio of the verified wattage difference between the efficient and baseline equipment to the reported wattage difference between the efficient and baseline equipment.
4. **HVAC Interactive Effect (IE) Adjustment Rate** is a multiplier that reflects HVAC interactive effects due to space heating and cooling loads caused by a reduction in heat output from efficient lighting. Note that the IC did not deem HVAC IE for any measures so this adjustment is equal to the average HVAC IE itself. There are separate adjustments for energy savings and peak demand reduction.
5. **Coincidence Factor** represents the portion of installed lighting that is on during the peak utility hours. This affects only summer and winter peak demand reductions, not energy savings.

Figure 4-1 below shows the relative effect of each of the aforementioned adjustment rates on the measure-level FVR for energy savings, which the following subsections describe in further detail. Note that FVR cannot be used to derive program level realization rates. This is because the contributions of each parameter update are described relative to their reported value (from the detailed measure tracking dataset), while the program analysis was structured to stratify savings by participant energy savings per site rather than by individual measures.

Overall, the FVR values indicate that, across the different lighting measure types, in-service rates, lighting power, and hours of use adjustments tend to result in minor decreases to the verified energy savings, while HVAC interactive effects result in an increase in savings. These effects roughly cancel each other out in aggregate.

[5] In-Service Rate is an industry-standard term that describes verified quantities of installed equipment relative to reported quantities.

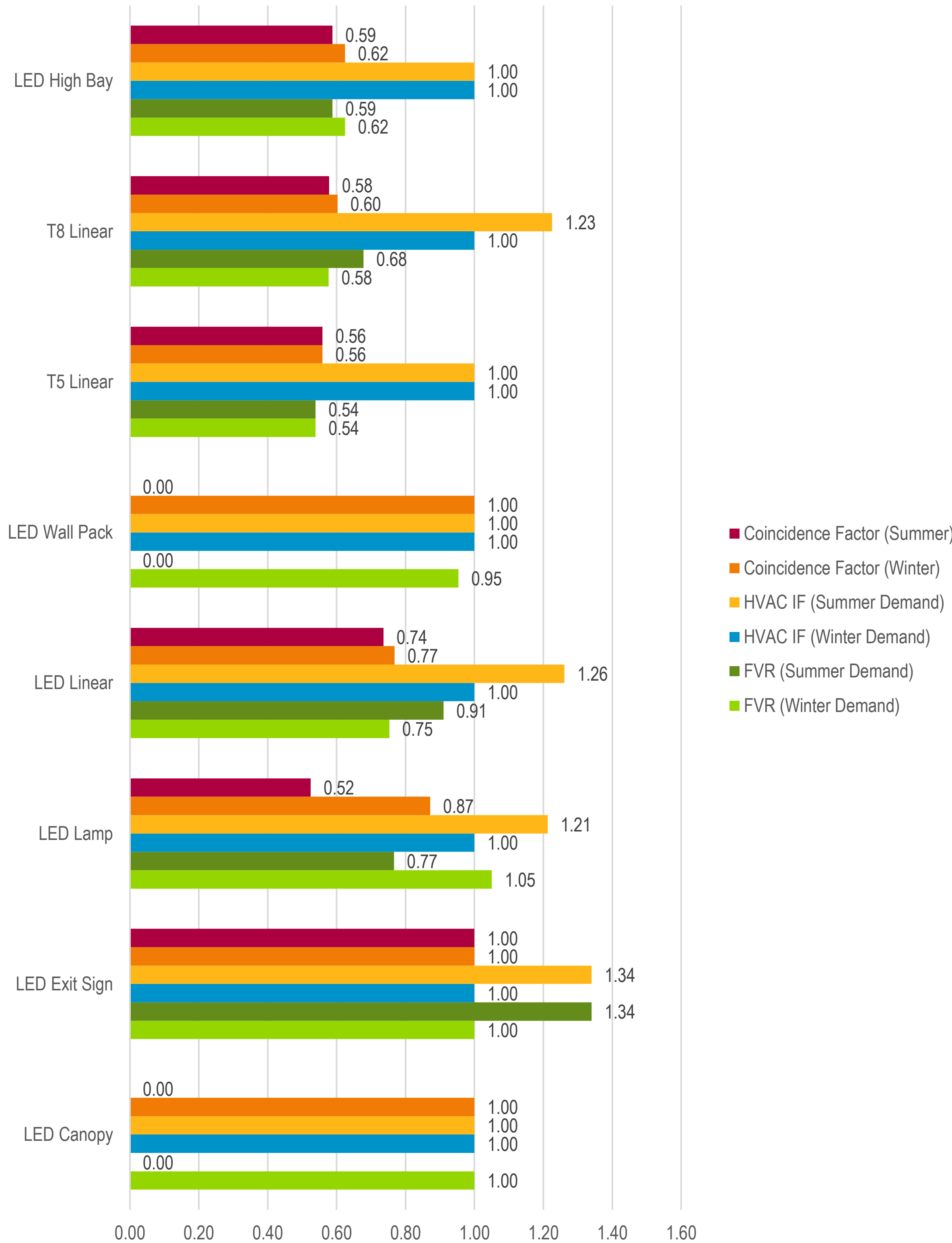
Figure 4-1. Gross Energy Savings Field Verification Rates



Source: Navigant analysis

Figure 4-2 below shows the relative effect of each of the aforementioned adjustment rates on the measure-level FVR for summer peak demand reductions, which the following subsections describe in further detail. Overall, application of the coincidence factor decreases both summer and winter peak demand reductions, while HVAC interactive effects increase summer peak demand reductions.

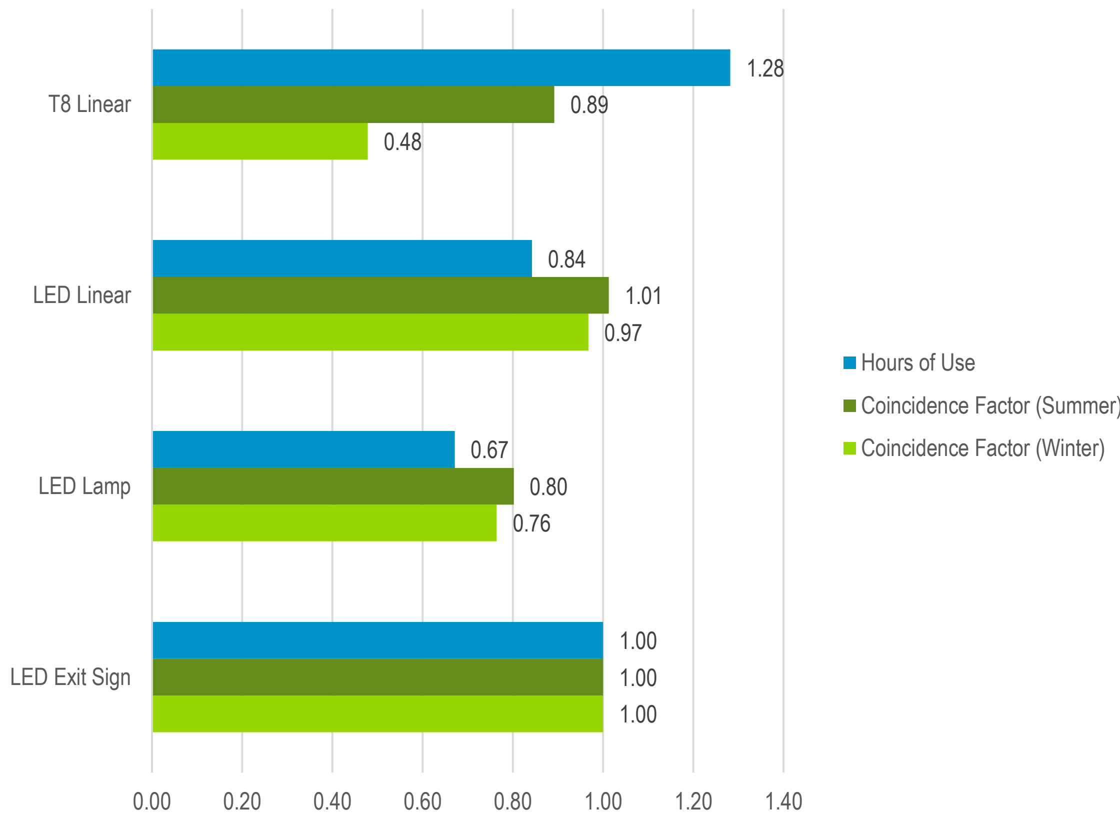
Figure 4-2. Gross Peak Demand Reductions Field Verification Rates



Source: Navigant analysis

The final adjustment to develop site-specific verified gross savings is the ratio of metered HOU and coincidence factors compared to estimated (or deemed) HOU and CF used for verification. The results of these adjustments, analogous to FVR, are shown in Figure 4-3 below. The metered data results in a downward adjustment of HOU for LED linear retrofits and LED lamps, but an upward adjustment of HOU for T8 linear retrofits. Overall, there is a decrease in both summer and winter coincidence factors for most lighting measures. Note that these adjustments are relative to the evaluation team's verified energy and demand savings estimates rather than the tracking data.

Figure 4-3. HOU and CF Adjustments from Metered Data



Source: Navigant analysis

The remainder of this section discusses in more detail the parameters that are part of the energy and peak demand savings algorithms: ISR, HOU, lighting power, HVAC interactive effects and coincidence factors.

4.4.1 In-Service Rates

The Navigant evaluation team visually counted fixtures on-site to quantify the quantity and type of lighting equipment installed. The team calculated the ISR as the ratio between the findings from the on-site verification compared to the quantity reported in the program-tracking databases. On-site verifications determined the total count of installed equipment.

As shown in Figure 4-1 above, the ISR for each measure varies from 0.95 for LED wall packs and 1.00 for the majority of the remaining lighting measures. Overall the ISR values are very high and indicate that the program is accurately tracking installed measures.

4.4.2 Hours-of-Use Adjustments

The EM&V team performed customer interviews and installed data loggers to make adjustments to hours of use to estimate final verified impacts. For all sample sites, the EM&V team performed interviews with customers using a similar approach as the IC. This relies on the customer to self-report hours on a daily or weekly basis, and rolls them up to an basis which is also corrected for holidays, seasonal variations in use, and any other change in operating characteristics. The purpose of validating the self-reported hours of use is to confirm whether the estimates provided by the customer during implementation is what actually makes it into the tracking database. The EM&V also installed data loggers at a nested sample of sites to measure the accuracy of the self-reported hours. For logged sites, the team extrapolated the time of use logger data to develop annual hours of operation.

During the on-site participant interviews, the EM&V team found that the hours of use that site technicians reported was close to the HOU reported in the tracking database, with adjustment values ranging from 0.49 for LED canopy fixtures and 1.21 for LED exit signs. Overall, these findings suggest that the tracking data is accurately reflecting what customers estimate their operating hours to be. However, it is well-known that estimating operation hours for lighting is difficult, and many evaluations have found that customers tend to overestimate operation hours for lighting. Therefore, the EM&V team used results from the data loggers to adjust impacts.

Additional adjustments based on logger data range from 0.67 for LED lamps and 1.28 for T8 linear retrofits, as shown in Figure 4-3. This demonstrates that although the IC is reasonably characterizing hours of use based on customer interviews, but the data loggers show that customers tended to overestimate hours of use for LED linear lighting measures and underestimate HOU for T8 linear lighting measures. Additional care should be used to ensure that lights that are on 24/7, such as LED exit signs, are credited with the correct HOU.

4.4.3 Lighting Power

The evaluation team based the lighting power parameter on the best estimates available for actual power draw of the baseline and efficient equipment. The baseline equipment is assumed to be as-found lighting installed and in use at the time of the audit; however, because the baseline equipment was no longer present at the participant sites, the team could not verify the baseline power draw and defaulted to the values provided by the IC.

The evaluation team verified the efficient equipment wattage from manufacturer specification sheets to provide a more accurate lighting power figure than the deemed values that the IC used. Overall lighting power level differences were minor across the measure categories, between 0.96 for T5 linear retrofits and 1.22 for LED lamps.

The evaluation team would like to note that it was often difficult or impossible to record efficient wattages due to the prevalence of exterior, canopy, and high bay LED fixtures installed in PY2016. In addition, the newer linear LED systems can be configured in a variety of ways, including with or without an electronic ballast. The manufacturer specifications for these systems typically do not account for every installation scenario with different ballast brands, models, and configurations possible. The team did not perform power measurements as part of this evaluation, but encourages the IC team to ensure that the power consumption of these systems is accurately characterized as their contribution to total program savings grows.

4.4.4 HVAC Interactive Effects

The evaluation team applied HVAC interactive effects for both energy, summer and winter peak demand. The deemed values are based on the facility heating and cooling system types as verified in the field for the sample sites. Note that the IC did not apply HVAC interactive effects for any of the lighting measures claimed in PY2016. This adjustment is between 1.00 and 1.12 for energy and 1.00 and 1.34 for summer peak demand. Deemed values are described in Section 9 for energy and summer peak demand, and are based on the PA TRM; winter peak demand interactive effects were assumed to be 1.0 for all measures.

4.4.5 Coincidence Factors

Similar to the HVAC interactive effects, the team applied coincidence factors based on the deemed values found in the PA TRM. This factor takes into account that not all lights are on for the duration of the peak demand period. Coincidence factors range from 0.0 and 1.0, based on building type, and are detailed in Section 9. The IC did not apply coincidence factors for lighting measures, and did not separately report winter demand savings. The metered data further validates the deemed coincidence factors. Note that although the detailed IC database does not include a coincidence factor, the demand ratios provided by Duke Energy and used as the final reported deemed savings implicitly include these assumptions.

LED exit signs that are on all day receive a CF on 1.0, while exterior lights receive a CF of 0.0 (summer) and 1.0 (winter). For logged sites, the team extrapolated the time of use logger data to develop coincidence factors. As shown in Figure 4-3, the CF adjustments based on metered data range from 0.89 to 1.01 for summer, and 0.48 to 1.00 for winter. The overall effect on demand savings from metering was an decrease in both summer and winter savings compared to the coincidence factors applied in the verification phase based on the PA TRM. The overall effect of applying coincidence factors is also a decrease from reported savings, and is the primary driver of the demand realization rates.

4.4.6 Refrigeration Measure Parameters

For refrigeration measures, the engineering analysis follows a deemed savings methodology based on the PA TRM. The PA TRM assumptions and parameters used to estimate reported energy savings and peak demand reductions were deemed appropriate by the evaluation team. The team verified that the measures were installed and operational during on-site visits to projects that installed efficient refrigeration equipment.

The evaluation team focused their deemed savings review on LED case lighting, EC motor upgrades, and anti-sweat heater controls. Onsite, the team verified LED case lighting and EC motor upgrades, but no anti-sweat heater controls because they did not fall into the onsite sample. For LED case lighting, the team applied HVAC interactive effects and coincidence factors from the PA TRM, which differ from the general lighting parameters. The values used are summarized below in Table 4-9, and result in an increase in LED case lighting savings.

Table 4-9. LED Case Lighting Savings Parameters

LED Case Lighting Parameter	Value
HVAC Interactive Effects (Both Energy and Summer/Winter)	1.41 (Cooler) / 1.52 (Freezer)
Coincidence Factor	0.92

Source: PA TRM

4.4.7 Thermostat Measure Parameters

There were eight total programmable Wifi thermostat measures claimed during the PY2016 evaluation period. For these thermostat measures, the engineering analysis follows a deemed savings methodology based on the IL TRM. The reported energy savings accurately followed the methodology outlined in the IL TRM, although Navigant believes that the programmable thermostat measures likely overestimate energy savings based on the following assumptions:

1. The claimed energy savings range from 3% to 53% (23% average) of the total customer energy bill for a 12-month cycle. Space cooling, ventilation and heating typically make up roughly 20-30% of total electricity use[6], while Wifi thermostats are claimed to save up to 10% of the HVAC energy usage[7]. Therefore, Navigant would expect the total energy bill savings of approximately 2-3% as a reasonable estimate for energy savings. Navigant acknowledges that in total energy usage reported in the tracking database may not accurately reflect total customer usage, however, due to additional meters on site and changes in operation.
2. The energy savings algorithm derives the majority of savings due to running the HVAC system in automatic fan mode rather than continuous fan mode during the unoccupied portions of the day. It is unclear from the tracking data and audit whether this represents the true operational characteristics. A 2012 ACEEE paper[8] focused on small business Wifi thermostats found that

[6] EIA estimates 25.9% commercial and 26.6% residential use for space heating, cooling and ventilation (US average) https://www.eia.gov/energyexplained/index.cfm?page=electricity_use

[7] Ten percent savings is a rough estimate from the DOE. Navigant recognizes there is significant potential for variation site to site, however. https://energy.gov/energysaver/thermostats

[8] http://aceee.org/files/proceedings/2012/data/papers/0193-000237.pdf

only roughly one-quarter of energy savings from these thermostats were realized, and indicated that operational characteristics are both a key input to energy savings and difficult to accurately assess due to customer behavior.

3. The Belleville, IL (Zone 4) climate is most closely aligned to Cincinnati, OH based on cooling degree days, and is an appropriate approximation.

The system size (tons cooling) is not detailed in the tracking data, but appears reasonable from back-calculations and was used in a separate thermostat workbook provided to the evaluation team.

5. NET-TO-GROSS ANALYSIS

The impact analysis described in the preceding sections addresses *gross program savings*, based on program records, modified by an engineering review, field verification, and metering of measure installations. *Net savings* incorporate the influence of free ridership (savings that would have occurred even in the absence of the program) and spillover (additional savings influenced by the program but not captured in program records) and are commonly expressed as a NTG ratio applied to the verified gross savings values.

Table 5-1 shows the results of Navigant's NTG analysis. Navigant anticipated low free ridership and spillover based on previous findings from evaluations of SBES in other Duke Energy territories.

Table 5-1. PY2016 Net-to-Gross Results

	Lighting	Refrigeration	Lighting & Refrigeration
Estimated Free Ridership	0.04	0.06	0.04
Estimated Spillover	0.04	0.14	0.06
Estimated NTG	**1.00**	**1.08**	**1.02**

Source: Navigant analysis, totals subject to rounding.

This report provides definitions, methods, and further detail on the analysis and findings of the net savings assessment. The discussion is divided into the following three sections:

- Defining free ridership, spillover, and net-to-gross (NTG) ratio
- Methods for estimating free ridership and spillover
- Results for free ridership, spillover, and NTG ratio

5.1 Defining Free Ridership, Spillover, and Net-to-Gross Ratio

The methodology for assessing the energy savings attributable to a program is based on a NTG ratio. The NTG ratio has two main components: free ridership and spillover.

Free ridership is the share of the gross savings that is due to actions participants would have taken even in the absence of the program (i.e., actions that the program did not induce). This is meant to account for naturally occurring adoption of energy efficient technology. The SBES Program covers a range of energy efficient lighting and refrigeration measures and is designed to move the overall market for energy efficiency forward. However, it is likely that some participants would have wanted to install, for various reasons, some high efficiency equipment (possibly a subset of those installed under the SBES Program), even if they had not participated in the program or been influenced by the program in any way.

Spillover captures program savings that go beyond the measures installed through the program. Spillover adds to a program's measured savings by incorporating indirect (i.e., non-incentivized) savings and effects that the program has had on the market above and beyond the directly incentivized or directly induced program measures.

Total spillover is a combination of non-reported actions to be taken at the project site itself (*within-facility spillover*) and at other sites (*outside-facility spillover*). Each type of spillover is meant to capture a different aspect of the energy savings caused by the program, but not included in program records.

The **overall NTG ratio** accounts for both the net savings at participating projects and spillover savings that result from the program but are not included in the program's accounting of energy savings. When the NTG ratio is multiplied by the estimated gross program savings, the result is an estimate of energy savings that are attributable to the program (i.e., savings that would not have occurred without the program).

The basic equation is shown in Equation 1.

Equation 1. Net-to-Gross Ratio

$$NTG = 1 - Free\ Ridership + Spillover$$

The underlying concept inherent in the application of the NTG formula is that *only* savings caused by the program should be included in the final net program savings estimate but that this estimate should include *all* savings caused by the program.

5.2 Methods for Estimating Free Ridership and Spillover

5.2.1 Estimating Free Ridership

Data to assess free ridership were gathered through the self-report method—a series of survey questions asked of SBES participants. Free ridership was asked in both direct questions, which aimed at obtaining respondent estimates of the appropriate free ridership rate that should be applied to them, and in supporting or influencing questions, which could be used to verify whether the direct responses are consistent with participants' views of the program's influence.

Respondents were asked three categories of program-influence questions:

- **Likelihood:** to estimate the likelihood that they would have incorporated lighting measures "of the same high level of efficiency," if not for the assistance of the SBES Program. In cases where respondents indicated that they might have incorporated some, but not all, of the measures, they were asked to estimate the share of measures that would have been incorporated anyway at high efficiency. This flexibility in how respondents could conceptualize and convey their views on free ridership allowed respondents to give their most informed response, thus improving the accuracy of the free-ridership estimates.
- **Prior planning:** to further estimate the probability that a participant would have implemented the measures without the program. Participants were asked the extent to which they had considered installing the same level of energy-efficient lighting prior to participating in the program. The general approach holds that if customers were not definitively planning to install all of the efficiency lighting prior to participation, then the program can reasonably be credited with at least a portion of the energy savings resulting from the high-efficiency lighting. Strong free ridership is reflected by those participants who indicated they had already allocated funds for the purchase and selected the lighting and an installer.
- **Program importance:** to clarify the role that program components (e.g., information, incentives) played in decision-making, and to provide supporting information on free ridership. Responses to

these questions were analyzed for each respondent, not just in aggregate, and were used to identify whether the direct responses on free ridership were consistent with how each respondent rated the "influence" of the program.

Free-ridership scores were calculated for each of these categories[9] and then averaged and divided by 100 to convert the scores into a free-ridership percentage. Next, a timing multiplier was applied to the average of the three scores to reflect the fact that respondents indicating that their energy efficiency actions would not have occurred until far into the future may be overestimating their level of free ridership. Participants were asked, without the program, when they would have installed the equipment. Respondents who indicated that they would not have installed the lighting for at least two years were not considered free riders and had a timing multiplier of 0. If they would have installed at the same time as they did, they had a timing multiplier of 1; within one year, 0.67; and between one and two years, 0.33. Participants were also asked when they learned about the financial incentive; if they learned about it after the equipment was installed, then they had a free ridership ratio of 1.

5.2.2 Estimating Spillover

The basic method for assessing participant spillover (both within-facility and outside-facility) was an approach that asked a set of questions to determine the following:

- **Whether spillover exists at all.** These were yes/no questions that asked, for example, whether the respondent incorporated energy efficiency measures or designs that were not recorded in program records. Questions related to extra measures installed at the project site (within-facility spillover) and to measures installed in non-program projects (outside-facility spillover) within the service territory.
- **The share of those savings that could be attributed to the influence of the program.** Participants were asked if they could estimate the energy savings from these additional extra measures to be less than, similar to, or more than the energy savings from the SBES program equipment.
- **Program importance.** Estimates were derived from a question asking the program importance, on a 0 to 10 scale. Participants were also asked how the program influenced their decisions to incorporate additional energy efficiency measures.

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[9] Scores were calculated by the following formulas:

» Likelihood: The likelihood score is 0 for those that "definitely would NOT have installed the same energy efficient measure" and 1 for those that "definitely WOULD have installed the same energy efficient measure." For those that "MAY HAVE installed the same energy efficient measure," the likelihood score is their answer to the following question: "On a scale of 0 to 10 where 0 is DEFINITELY WOULD NOT have installed and 10 is DEFINITELY WOULD have installed the same energy efficient measure, can you tell me the likelihood that you would have installed the same energy efficient measure?" If more than one measure was installed in the project, then this score was also multiplied by the respondent's answer to what share they would have done.

» Prior planning: If participants stated they had considered installing the measure prior to program participation, then the prior planning score is the average of their answers to the following two questions: "On a scale of 0 to 10, where 0 means you 'Had not yet planned for equipment and installation' and 10 means you 'Had identified and selected specific equipment and the contractor to install it', please tell me how far along your plans were" and "On a scale of 0 to 10, where 0 means 'Had not yet budgeted or considered payment' and 10 means 'Already had sufficient funds budgeted and approved for purchase', please tell me how far along your budget had been planned and approved."

» Program importance: This score was calculated by taking the maximum importance on a 0 to 10 scale of the four program importance questions and subtracting from 10 (i.e., the higher the program importance, the lower the influence on free ridership).

If respondents said no, they did not install additional measures, they received a zero score for spillover. If they said yes, then the individual's spillover was estimated as the self-reported savings as a share of project savings, multiplied by the program-influence score. Then, a 50 percent discount was applied to reflect uncertainty in the self-reported savings and divided by 10 to convert the score to a spillover percentage.

5.2.3 Combining Results across Respondents

The evaluation team determined free ridership and spillover estimates for each of the following:

- Individual respondents, by evaluating the responses to the relevant questions and applying the rules-based approach discussed above
- Measure categories:
  - For free ridership: by taking the average of each respondent's score within each category, weighted by the respondent's share of savings within the measure category
  - For spillover: by taking the sum of the individual spillover results (in kWh) for each measure category and dividing by the category's total program savings in the sample
- The program as a whole, by combining measure-level results:
  - For free ridership: measure category results were subsequently weighted by each category's share of total program savings
  - For spillover: similarly, measure category results were subsequently weighted by each category's share of total program savings

5.3 Results for Free Ridership, Spillover, and Net-to-Gross

This section presents the results of the attribution analysis for the SBES Program. Specifically, results are presented for free ridership and spillover (within-facility and outside-facility), which are used collectively to calculate an NTG ratio.

5.3.1 Review of Data Collection Efforts for Attribution Analysis

The EM&V team conducted 110 surveys with SBES participants to estimate free ridership, spillover, and NTG ratios. Table 5-2 shows the number of completions, by measure group.

Table 5-2. Attribution Survey Completes by Project Type

Measure Category	Surveys
Lighting	102
Refrigeration	8
Total	**110**

Source: Navigant analysis

5.3.2 Free-Ridership Results

The evaluation team asked participants a series of questions regarding the likelihood, scope, and timing of the investments in energy-efficient lighting if the respondent had not participated in the program. The purpose of the surveys was to elicit explicit estimates of free ridership and perspectives on the influence of the program. The evaluation team estimates free-ridership for the SBES Program at 4 percent of program-reported savings.

5.3.3 Spillover Results

The SBES Program influenced approximately 16 percent of participants to install additional energy efficiency measures on-site and influenced 10 percent of participants to install additional measures at other locations. Based on the survey findings, the evaluation team estimates the overall program spillover to be 6 percent of program-reported savings. Participants reported a variety of spillover measures installed, including lighting (most common) and water heaters.

5.3.4 Net-to-Gross Ratio

As stated above, the NTG ratio is defined as follows in Equation 2 below.

Equation 2. Net-to-Gross Ratio

$$NTG = 1 - \text{free ridership} + \text{spillover}$$

Using the overall free ridership value of 4 percent and the overall spillover value of 6 percent, the NTG ratio is 1 – 0.04 + 0.06 = 1.02. The estimated NTG ratio of 1.02 implies that for every 100 megawatt-hours (MWh) of realized savings recorded in SBES records, 102 MWh is attributable to the program.

Table 5-3. SBES Free Ridership, Spillover, and NTG Ratio

	Free Ridership	Spillover	NTG Ratio
SBES Program Total	0.04	0.06	1.02

Source: Navigant analysis, totals subject to rounding.

6. PROCESS EVALUATION

The purpose of the process evaluation is to understand, document and provide feedback on the program implementation components and customer experience for the Small Business Energy Saver (SBES) Program in the DEO jurisdiction.

6.1 Process Methodology

The evaluation team conducted in-depth interviews with SBES Program staff and IC staff and customer participant surveys, as noted previously. The process findings summarized in this document are based on the results of:

- Customer journey mapping with program participants;
- Participant surveys with 110 program participants;
- Interviews with the Duke Energy Program Manager and the Implementation Contractor (IC) staff; and
- A review of the program documentation.

6.2 Customer Journey Mapping

The Customer Journey Mapping analysis aimed to gather qualitative data about customer experiences with the SBES Program to understand customer sentiments and perspectives on program performance and establish a deeper understanding of customer satisfaction throughout the program process. Key aspects of journey mapping involved the development of a process map and the identification of the journey mapping lenses. In conversations with program staff, Navigant explored staff perceptions concerning the use of a variety of potential journey mapping lenses. Journey mapping lenses included a set of overarching questions and potential customer satisfaction concerns as the core focus of this research effort and were included in participant interviews. To conduct the customer journey analysis, Navigant completed seven steps, working closely with Duke Energy staff:

1. Program document review and conversations with program staff
2. Development of a process map and identification of journey mapping lenses
3. Development of a sampling plan, recruitment strategy and interview guide
4. Fielding of interviews
5. Analysis of interview notes
6. Development of Journey Map and other findings

In total, Navigant interviewed 8 Duke Energy Ohio SBES Program customers across various building types and measures. The final participant sample included a diverse mix of office, retail, warehouse and restaurant owners or managers who participated in upgrading their lighting or lighting and refrigeration equipment through the SBES Program. All interviewees installed lighting measures and one installed refrigeration measures in addition to the lighting measure. Table 6-1 shows specific customer characteristic information.

Table 6-1. SBES Interviewee Characteristics

Building Type	Business Type	Lighting	Refrigeration	Lighting KWh*	Refrigeration KWh*
Restaurant	Pizza Parlor	X	X	Medium	Low
Restaurant	Restaurant	X	--	Medium	--
Retail	Outdoor Equipment Store	X	--	Medium	--
Retail	Auto Repair Shop	X		High	--
Retail	Picture Framing Store	X		Medium	--
Retail	Apothecary Shop	X		Low	--
Warehouse	Warehouse	X		Medium	--
Office	Information Technology (IT) Service Company	X	--	Low	--

**Low = <10,000 KWh; Medium = 10,000-30,000 KWh; High = >30,000 KWh*
Source: Navigant analysis

6.3 Participant Survey Sampling Plan and Achievements

The participant survey targeted a random sample of all PY2016 program participants broken out by measure family. The two measure families are lighting and refrigeration. Navigant weighed customer responses by their stratum savings for net-to-gross findings as described in the preceding section. The process evaluation findings presented in this section are not weighted.

The survey effort successfully completed surveys with 110 customers, of which 102 were participants that only installed lighting measures and 8 were participants that installed some refrigeration measures. The survey targets were loosely designed to achieve 90/10 confidence and precision, with significant oversampling due to the relatively inexpensive per-survey cost.

6.4 Program Review

The evaluation team designed the program review task to understand changes and updates to the program design, implementation and energy and demand savings assumptions. The key program characteristics include the following:

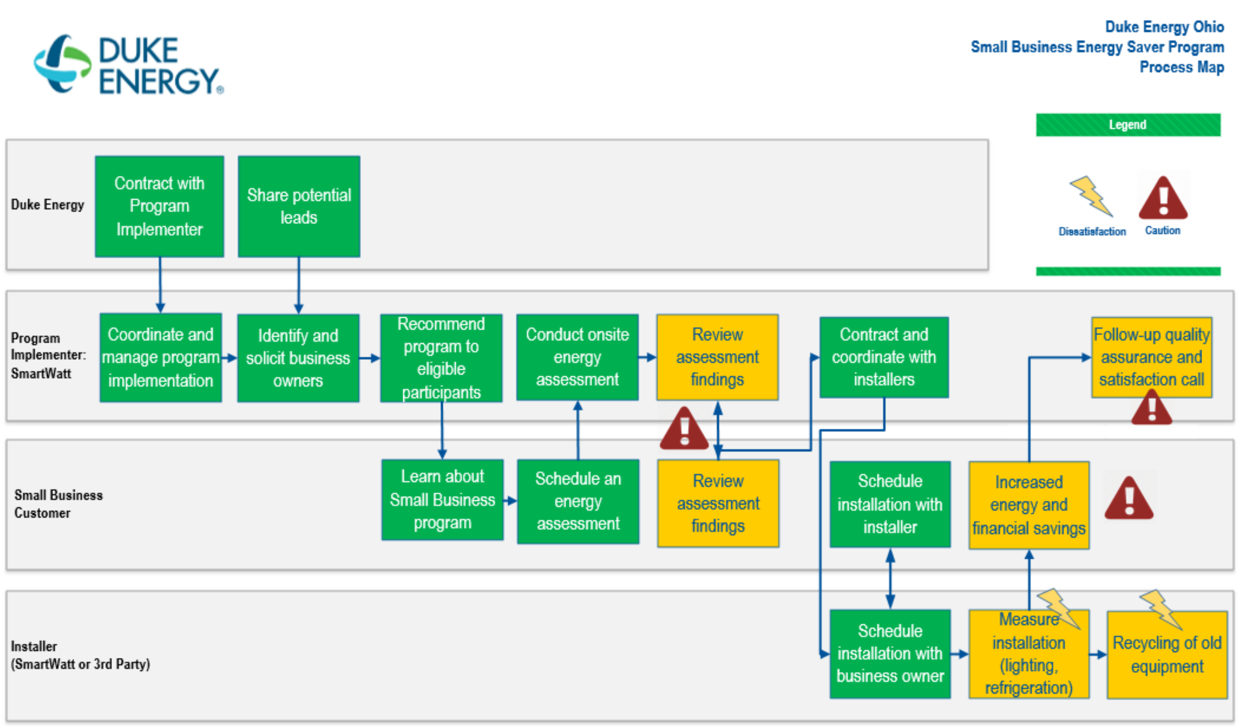
- **Program Design** – The SBES program is designed to offer high incentives (up to 80 percent of the total cost of the project) on efficient equipment to reduce energy use and peak demand. It specifically targets small business customers that are typically difficult for utilities to reach and often do not pursue energy efficiency on their own. The SBES program formally launched in DEO in 2014 (although savings were all claimed starting in 2015), and Duke Energy utilized expertise gained from managing similar programs in other jurisdictions.

- **Program Implementation** – A third-party contractor, Smart Watt Energy, administers the SBES program on Duke Energy's behalf. The Implementation Contractor, (IC) handles all aspects of the program, including customer recruitment, facility assessments, equipment installation (through independent installers contracted by the IC), and payment and incentive processing. The IC reports energy and peak demand reduction estimates to Duke Energy. The program had a successful launch in DEO and was able to exceed their energy savings goal while scoring high on customer satisfaction. Several quality control checks were carried over from similar programs in other jurisdictions.
- **Incentive Model** – The IC offers potential participants a recommended package of energy efficiency measures along with equipment pricing and installation costs. The incentive is proportional to estimated energy savings and can be as high as 80 percent of the total cost of the project.
- **Savings Estimates** – Energy and peak demand savings are estimated on a per-measure basis, taking into account existing equipment, proposed equipment, and operational characteristics unique to each customer. The savings estimates are derived from assumptions in the PA TRM.

6.5 Customer Journey Map Findings

Navigant developed a process map detailing the journey of the customer's experience through the SBES program (see Figure). Findings depicted in the process map below indicate isolated instances of dissatisfaction with the measure installation and recycling of old equipment processes. Potential customer dissatisfaction and areas of concerns are seen in the presentment onsite energy assessment findings and post-installation bill savings understanding phases.

Figure 6-1. Duke Energy Ohio SBES Process Map



Source: Navigant analysis

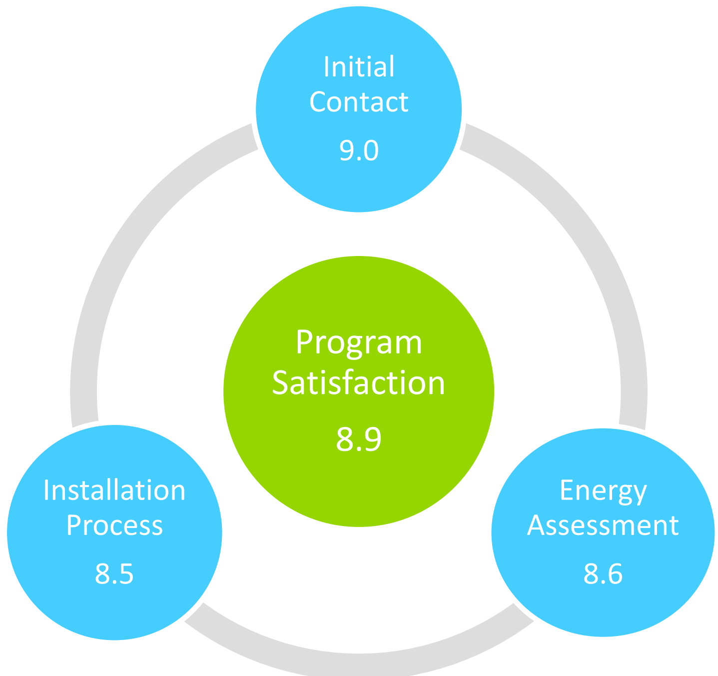
More specifically, participant interviews offered insight into the overall customer satisfaction with the SBES program and certain steps in the program participation process. Navigant examined the six process customer journey phases within the SBES program: 1) the Initial Contact; 2) the Energy Assessment; 3) the Installation Process; 4) Recycling of Old Equipment; 5) Equipment Performance; and 6) Savings. The list below outlines the key findings for each of these customer journey phases.

1. **Initial Contact** – Respondents felt highly satisfied with their initial contact and introduction into the program. Interviewees cited knowledgeable and personable sales representatives and Duke Energy's financial incentives as a major reason for their participation in the program and high satisfaction in this phase.
2. **Energy Assessment** – Similar to the Initial Contact phase, respondents reported high satisfaction with the Energy Assessment process overall. Many thought the assessments were thorough and quick. Despite the high satisfaction ratings overall, some interviewees felt that the representatives did not present the assessment clearly and tried to sell the program too aggressively.
3. **Installation Process** – Similar to the previous two phases, participants expressed high satisfaction ratings for the Installation Process overall. In general, respondents were pleased that installers worked around employees and customers, minimizing disruption to the business. However, a couple respondents noted isolated issues with the installation process, including unprofessional behavior, untimely installations, and scheduling snafus.
4. **Recycling of Old Equipment** – Although a couple participants noted that installers did not clean up after the installation and the recycling contractors collected equipment in an untimely manner, most respondents felt satisfied with the post-installation and cleanup process.
5. **Equipment Performance** – A small portion of interviewees had issues with equipment failures and product mis-specifications, causing discontent. Respondents also mentioned that they did not know who to call when issues arose.
6. **Energy Savings** – The energy savings experienced by customers received mixed reviews. While some felt they were saving money on their electric bills, others felt the initial energy assessment oversold savings.

Although respondents provided positive feedback overall, the findings indicate isolated problems throughout the process. This fact indicates inconsistencies in the program participation process, mostly as a result of poor performances from program subcontractors.

In general, interviewees reported high satisfaction ratings with the SBES program in Ohio despite program inconsistencies. Out of a 1-10 rating scale, customer program satisfaction averaged 8.9. Overall customer satisfaction with their initial contact with SmartWatt was a 9.0 and the energy assessment rated 8.6. Interviewee satisfaction of equipment installation was 8.5 as a result of the isolated problems, such as equipment failure and unprofessional installers. In general, most customers felt that the program process went smoothly and produced tangible savings. Figure 6-2 below shows the average satisfaction ratings from interviewees by program component through the installation process.

Figure 6-2. Overall Program Satisfaction



6.6 Participant Survey Findings

The following sections detail the process findings from all relevant sources of program information, including interviews with Duke Energy and IC staff and the results of the customer surveys, organized by topic. This discussion addresses 1) overall customer experience; 2) implementation contractor; 3) installation contractor; 4) program benefits; 6) upgraded equipment; and 7) participant suggested improvements.

The feedback received indicates that the SBES Program serves Duke Energy's customers well and represents an important component of Duke Energy's portfolio of business energy efficiency programs. Key findings are as follows:

- A majority of SBES participants were satisfied with the program. On a scale of 0 to 10, where 0 indicates "not satisfied at all" and 10 indicates "extremely satisfied":
  - 79 percent of participants indicated 8-10 for satisfaction with overall program experience.
  - 79 percent of participants indicated 8-10 for satisfaction with the contractor's quality of work.
  - 83 percent of participants indicated 8-10 for satisfaction with the energy efficiency assessment conducted by SmartWatt Energy.
- The post-installation inspection appears to be a significant driver of overall program satisfaction.
- Eighty-three percent of participants stated that equipment offered through the program allowed them to upgrade all of the equipment they wanted at the time.

The following sections detail the process findings and addresses the following topics:

1. Overall customer experience;
2. Implementation contractor;
3. Installation contractor;
4. Program benefits;
5. Upgraded equipment; and
6. Suggested improvements.

6.6.1 Customer Experience

Customers reported very high satisfaction with their overall program experience. Just 7% rated their overall satisfaction as less than 5, and 79% rated their satisfaction as an 8, 9, or 10.

Navigant identified some correlations with overall program satisfaction that provide insight into drivers of high satisfaction:

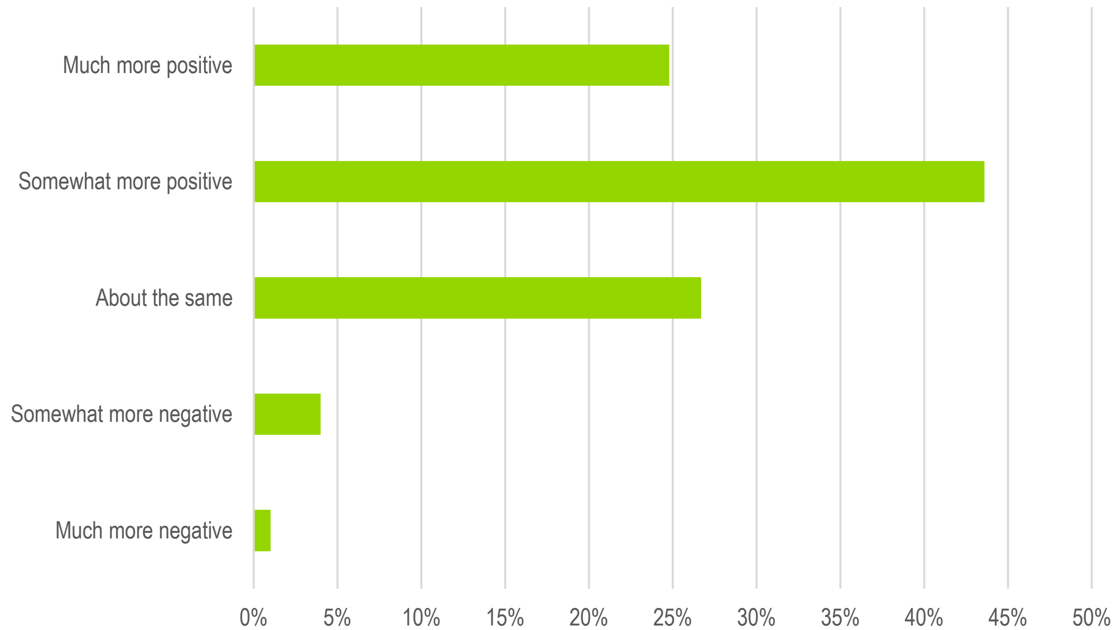
- Customers with overall high program satisfaction were more satisfied on average with every program element, but the difference was particularly noticeable on two program elements:
    - **The energy savings resulting from the new equipment**: highly satisfied customers gave an average rating of 9.1 vs. 5.4 among less satisfied customers.
    - **Program communications**: highly satisfied customers gave an average rating of 9.2 vs. 4.6 among less satisfied customers.
- Satisfaction with the **post-installation inspection** was very high with an average rating of 8.8, and customers who received a post-installation inspection[10] had statistically significant higher average satisfaction with the program overall and many of the individual program components. It appears that the post-installation inspection is a significant driver of overall program satisfaction.
    - Customers who received a post-installation inspection had an average overall satisfaction with the overall program of 9.3 vs. 7.8 for customers who did not receive an inspection.
    - Customers who received a post-installation inspection also had statistically significant higher average satisfaction with their installation contractor, the post-installation clean-up, the energy efficiency equipment installed, the quality of the light from new light fixtures, the energy savings resulting from new equipment, program communications, the amount of the rebate, and Duke Energy overall.

More than four out of five customers (84%) said they were very likely to participate in this program or a similar program in the future, rating their likelihood as an 8, 9, or 10 on a 10-point scale. These findings indicate both high program satisfaction and an opportunity to continue to market energy efficiency programs to previous participants to achieve deeper savings.

Participation in the SBES program generally served to improve customers' satisfaction with Duke Energy overall (Figure 6-3).

[10] SmartWatt is required to perform inspection visits on at least 20% of projects and all customer receive a follow up call after the project is complete.

Figure 6-3. Impact of SBES Participation on Attitude Toward Duke Energy (n=110)



Source: Navigant analysis

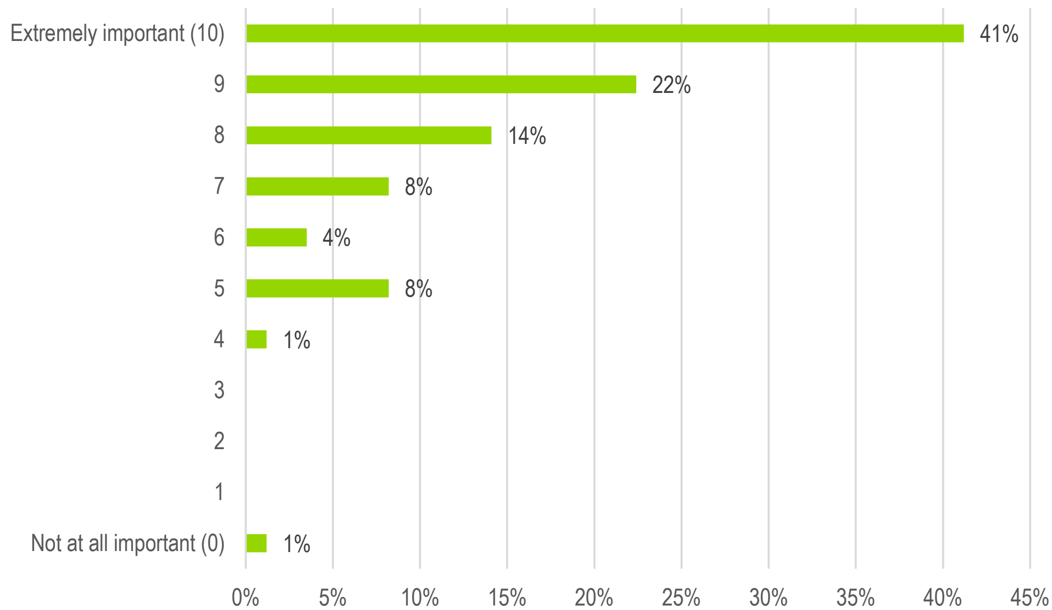
6.6.2 Implementation Contractor

As mentioned in the previous section, customers are highly satisfied with the services provided by the implementation contractor, SmartWatt Energy and that high satisfaction translates to high overall program satisfaction.

A large majority (89%) of customers said they knew who to contact if they had any questions or concerns about their project or any aspect of the program; of those, 75% identified a SmartWatt Energy employee as their helpful point of contact.

Overall, 86% of customers said that SmartWatt Energy helped them with their choice of energy-efficient measures. Of those customers, 78% said that the SmartWatt Energy's recommendation was very important in their decision to install energy-efficient equipment (8, 9, or 10), as shown in Figure 6-4.

Figure 6-4. Importance of SmartWatt Energy Recommendation (n=85)



Source: Navigant analysis

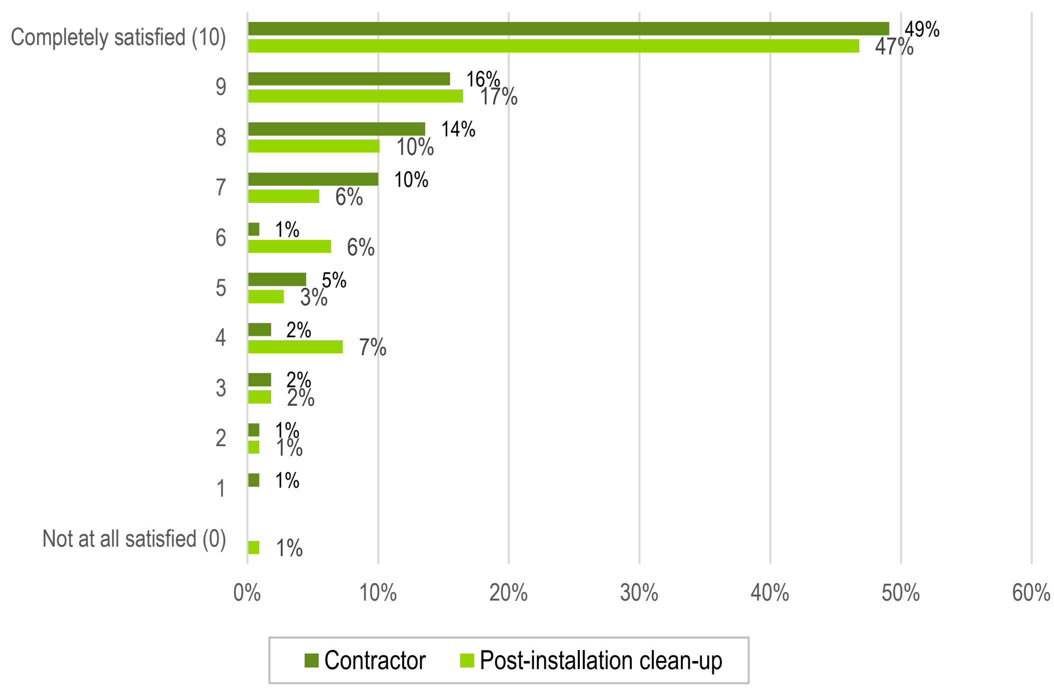
Customers are highly satisfied with the energy efficiency assessment conducted by SmartWatt Energy as well as the proposal prepared by SmartWatt Energy, with 83% rating their satisfaction as an 8 or higher for the assessment and 82% for the proposal. Nearly all (95%) said that the proposal was clear about the scope of work to be performed, and 98% said that the proposal was clear about their share of project costs.

Over half (53%) of customers received a post-installation inspection performed by SmartWatt Energy. Of those customers, 81% rated their satisfaction with the inspection as an 8 or higher.

6.6.3 Installation Contractors

Customer satisfaction with contractors is high. Figure 6-5 shows that 78 percent of survey respondents ranked their satisfaction with their contractor as an 8, 9, or 10, and 73 percent rated the contractor's post-installation clean-up as an 8, 9, or 10.

Figure 6-5: Customer Satisfaction with Contractor and Post-Installation Clean-up (n=110)



Source: Navigant analysis

6.6.4 Program Benefits

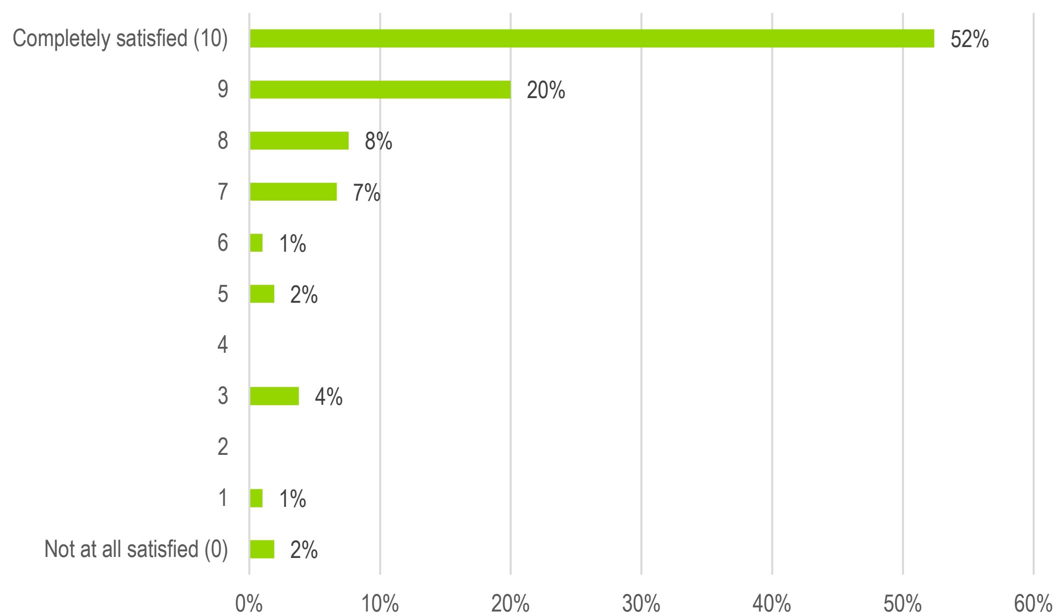
The majority of customers identified the energy savings and associated utility bill savings as the top benefits of participating in the SBES program. Better quality lighting and lower maintenance hassle were also significant benefits to many customers.

Another important survey finding was that 83 percent of customers stated that equipment offered through the program allowed them to upgrade all of the equipment they wanted at the time of the project, rather than piecing together the upgrades in multiple phases.

6.6.5 Upgraded Equipment

Customers are very satisfied with their new energy efficiency measures. Over three-quarters (83%) rated their satisfaction as an 8, 9, or 10 out of 10 (see Figure 6-6).

Figure 6-6: Participant Satisfaction with New Equipment (n=110)

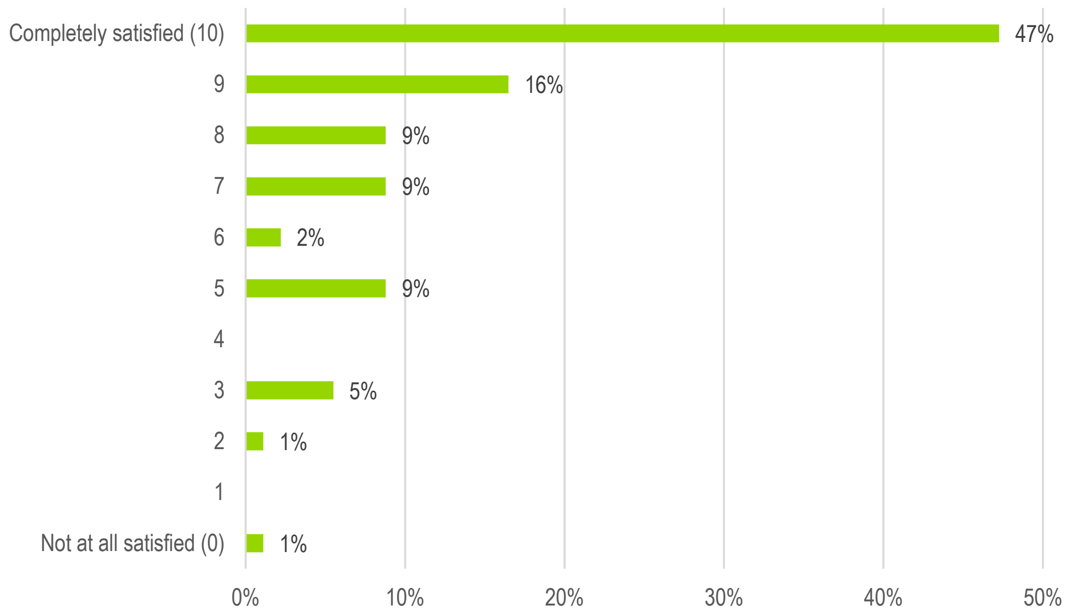


Source: Navigant analysis, totals subject to rounding

Lighting customers are very satisfied with the quality of the light produced by their new bulbs/fixtures, with 86% rating their satisfaction as an 8, 9, or 10.

Customer satisfaction with the energy savings resulting from their new equipment is slightly lower than satisfaction with the equipment itself. Nearly three-quarters (73%) rated their satisfaction as an 8, 9, or 10 out of 10, and the average rating was 8.3. This was the lowest-rated satisfaction metric in the customer survey, although still a relatively high level of satisfaction overall.

Figure 6-7: Participant Satisfaction with Energy Savings (n=110)

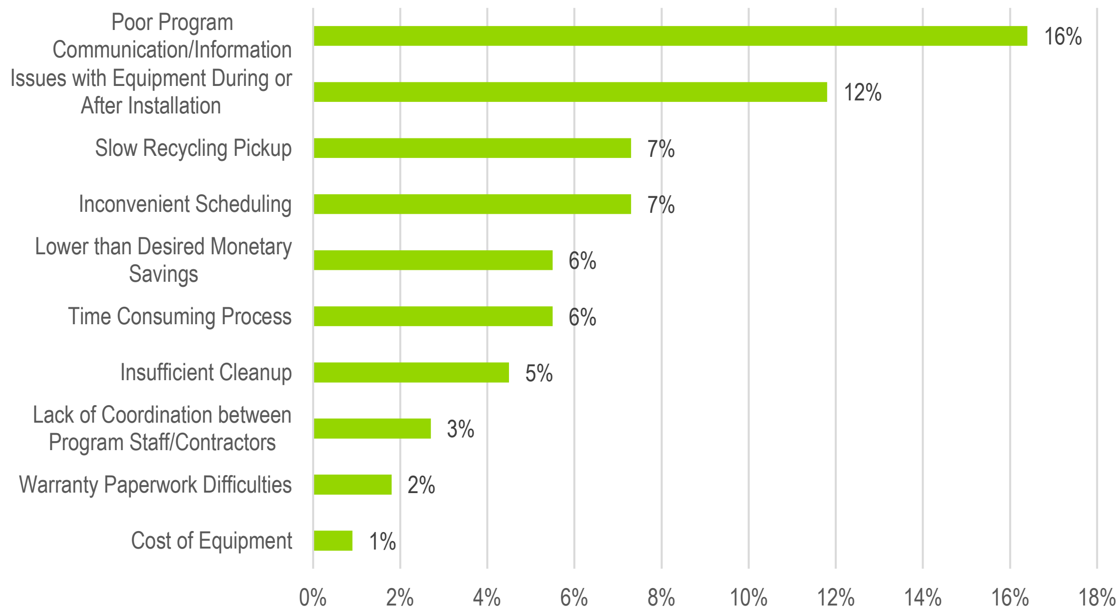


Source: Navigant analysis

6.6.6 Suggested Improvements

Overall program satisfaction is very high, but some customers had minor complaints or identified drawbacks of the program. The most common challenges (all mentioned by 16% of customers or less) are identified in Figure 6-8. Some customers felt that the program did not communicate clearly with them or had issues with the equipment during or after installation; other customers felt that the recycling pickup took too long or their energy savings expectations were not met. Note that many of the customer with complaints identified multiple issues (e.g., both a lack of communication *and* an equipment issue), and 67% of all customers did not mention *any* of the complaints shown in the figure below.

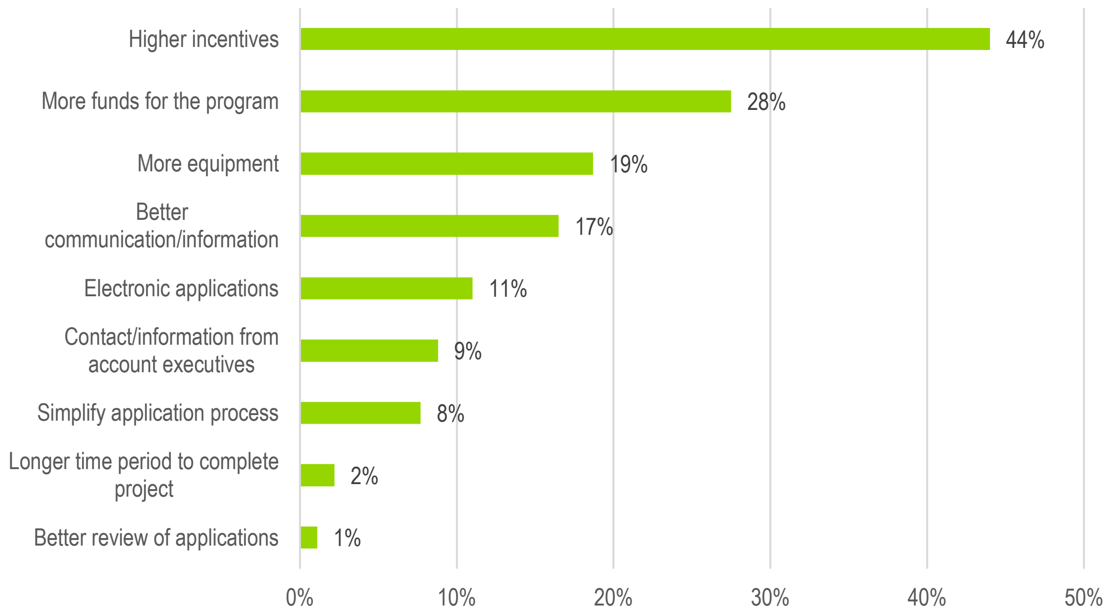
Figure 6-8. Program Challenges or Drawbacks (n=110)



Source: Navigant analysis

When asked how to improve the program, the most common responses were higher incentives and more funds for the program, followed by more equipment offered and better communication and program information, as shown in the following figure. Very few customers felt that the application process needed improvement or that longer time periods are necessary to complete projects.

Figure 6-9. Possible Program Improvements (n=110)



Source: Navigant analysis

7. SUMMARY FORM

Program Name

Completed EMV Fact Sheet

Description of program

Duke Energy's Small Business Energy Saver Program provides energy efficient equipment to eligible small business customer at up to an 80 percent discount. The program is delivered through an implementation contractor that coordinates all aspects of the program, from the initial audit, ordering equipment, coordinating installation, and invoicing.

The program consists of lighting and refrigeration measures.

- **Lighting measures:** LED lamps and fixtures, T8 fluorescent fixtures, occupancy sensors.
- **Refrigeration measures:** LED case lighting, EC motor upgrades, anti-sweat heater controls.
- **HVAC measures:** Programmable Wifi thermostats.

Date	August 29, 2018
Region(s)	Duke Energy Ohio
Evaluation Period	3/1/16 – 6/30/17
Annual net MWh Savings	27,688 MWh
Per Participant MWh Savings	30.36 MWh (across 912 total participants)
Coincident MW Impact	3.4 MW
Net-to-Gross Ratio	1.02
Process Evaluation	Annual
Previous Evaluation(s)	None

Evaluation Methodology

The evaluation team used engineering analysis, onsite field inspections, and time-of-use metering as the primary basis for estimating program impacts. Additionally, email surveys were conducted with participants to assess customer satisfaction and determine a net-to-gross ratio. Interviews were conducted with program and implementation team staff to understand program operational changes and enhancements.

Impact Evaluation Details

- **Onsite visits were conducted at 60 participant sites, while 20 of those sites were logged.** The evaluation team inspected program equipment to assess measure quantities and characteristics to compare with the program tracking database, and installed lighting loggers to verify hours of use and coincidence factors.
- **In-Service rates (ISRs) varied by equipment type.** The evaluation team found ISRs ranging from 0.95 for LED wall packs to 1.00for the majority of all other measures.
- **Participants achieved an average of 30.36 MWh of energy savings per year.** The program is accurately characterizing energy and demand impacts.

8. CONCLUSIONS AND RECOMMENDATIONS

The evaluation team performed extensive on-site work, email surveys, and analysis to determine gross and net verified savings. Overall conclusions and recommendations appear in the following sections.

8.1 Conclusions

Overall, the SBES Program performed very well in the DEO jurisdiction. The key to continued success is maintaining the strong foundation that the SBES program has built and continuing to monitor and improve customer issues as they arise.

- **Participants are overwhelmingly satisfied with the SBES Program, the implementation contractor, and Duke Energy.** A majority of customers plan to participate in Duke Energy programs in the future, and all participants surveyed reported a more positive or similar attitude towards Duke Energy. Customers are largely happy with all aspects of the SBES program, including the customer experience, the audit and installation process, and the upgraded equipment.
- The **energy savings realization rate is 1.04,** and is driven by several EM&V adjustments that roughly balanced out. The key adjustments the EM&V team made were the in-service rates and HVAC interactive effects. The **peak demand realization rate is lower at 0.74 (summer) and 0.83 (winter)** and is driven by HVAC interactive effects and coincidence factors.
- The evaluation effort estimated **free ridership for the SBES Program at 4 percent and spillover at 6 percent**, which drives an **NTG ratio of 1.02**. This indicates that the SBES Program is successfully reaching customers that would have not completed energy efficiency upgrades in the absence of the program. Spillover indicates that the program is showcasing the benefits of energy efficiency and driving customers to perform additional energy savings activities.

8.2 Recommendations

The evaluation team recommends a number of actions for improving the SBES Program, based on insights gained through the comprehensive evaluation effort for PY2016. These recommendations provide Duke Energy with a roadmap to fine-tune the SBES Program for continued success and include the following broad objectives:

Increasing Program Participation and Satisfaction

1. **Increase and improve program communications.** This is the most common challenge or drawback received from participants, with several customers noting specific communication issues regarding the responsibility for and timeline of recycling pickup. Additional education from both SmartWatt and Duke Energy account managers should help customers better understand the program participation process.
2. **Prioritize customer satisfaction training for installation contractors and customer follow-up services.** A minority of customers reported issues with installation and lighting equipment quality. Notably, overall satisfaction was higher for customers that received follow-up inspections from the implementation contractor than those that did not. There appears to be an opportunity to increase satisfaction by performing additional follow-up visits, although this must be balanced against increased cost. Additionally, this helps customers resolve equipment issues in a timely manner.

3. **Phase out T8 fluorescent lighting systems in favor of linear LED kits.** Linear LED lighting offers substantial savings above high-performance/reduced wattage T8 lamps and ballasts, which are increasingly perceived as outdated.

Improving Tracking Data and Reported Savings

4. **Track project facility types by using the same list of facility types specified in the Pennsylvania TRM.** This will reduce uncertainty in assigning facility types by the EM&V team based on SIC codes, and facilitate more direct application of HVAC interactive effects and coincidence factors.
5. **Track burnout lamps and fixtures during the initial audit.** It is likely that some burnouts were present and tolerated by customers, and may contribute to customers not realizing expected savings on their energy bills.
6. **Add connected load to occupancy sensor savings estimates.** Occupancy sensor savings were missing details on connected fixture load. This is a key input to the savings estimation, and should be recorded.

9. MEASURE-LEVEL INPUTS FOR DUKE ENERGY ANALYTICS

The SBES program estimates deemed savings on a per-fixture basis that takes into account specific operational characteristics. This approach differs from a more traditional prescriptive approach that applies deemed parameters by measure type and building type only.

For the lighting measures, the EM&V team applied HVAC interactive effects and coincident factors in the analysis that differed from those used by the IC; the values used are shown in Table 9-1 and Table 9-2. Note that for the PY2016 SBES evaluation the EM&V team applied the summer coincidence factors for both summer and winter peak demand reductions, with additional adjustments based on logger data for each of the corresponding peak periods.

Table 9-1. HVAC Interactive Effects[11]

Space Type	Energy HVAC Interactive Effect	Demand HVAC Interactive Effect
Air Conditioned/Cooled space	1.12	1.34
Freezer space	1.5	1.5
Medium-temperature refrigerated space	1.29	1.29
High-temperature refrigerated space	1.18	1.18
Uncooled space	1	1

Table 9-2. Coincidence Factors[12]

Facility Type	Annual Hours of Use	Summer Coincidence Factor
Auto Related	4,056	0.62
Daycare	2,590	0.62
Dusk-to-Dawn / Exterior Lighting	3,833	0
Education – School	1,632	0.31
Education – College/University	2,348	0.76
Grocery	4,660	0.87
Health/Medical – Clinic	3,213	0.73
Hospitals	5,182	0.8
Industrial Manufacturing – 1 Shift	2,857	0.57
Industrial Manufacturing – 2 Shift	4,730	0.57
Industrial Manufacturing – 3 Shift	6,631	0.57
Libraries	2,566	0.62
Lodging – Guest Rooms	914	0.09
Lodging – Common Spaces	7,884	0.9

[11] Pennsylvania Technical Reference Manual (TRM), 2015

[12] Pennsylvania Technical Reference Manual (TRM), 2015

Multi-Family (Common Areas) - High-rise & Low-rise	5,950	0.62
Nursing Home	4,160	0.62
Office	2,567	0.61
Parking Garages	6,552	0.62
Public Order and Safety	5,366	0.62
Public Assembly (one shift)	2,610	0.62
Public Services (nonfood)	3,425	0.62
Restaurant	3,613	0.65
Retail	2,829	0.73
Religious Worship/Church	1,810	0.62
Storage Conditioned/Unconditioned	3,420	0.62
Warehouse	2,316	0.54
24/7 Facilities or Spaces	8,760	1

Additionally, the Duke Energy DSMore table is embedded below for reference.

DSMore table
template -DEO SBES -

APPENDIX A. STATISTICS DETAIL

This appendix is intended to provide additional context around Navigant's sampling approach and impact findings for the PY2016 SBES evaluation for the DEO jurisdiction. Overall, Navigant believes that the evaluation results represents the program impacts in accordance with the evaluation approach and sample design. This is evidenced by the calculated statistical confidence and precision values, which were in line with expectations.

A.1 Sampling Approach

Navigant's methodology includes a double-ratio (nested) sampling approach. This approach is designed to efficiently utilize resources for primary data collection while minimizing sampling error. For the SBES program, Navigant chose a relatively large sample of sites to perform onsite verification activities, and a relatively smaller subsample of these sites for more detailed data collection with data loggers. The underlying assumption is that the larger verification sample represents the larger *population*, while the smaller metering sample represents the larger verification *sample*. This allows Navigant to perform high-rigor evaluation at lower cost for a given assumed sampling error.

For this evaluation, Navigant targeted 90/10 sampling and relative precision for the entire program. Sample sizes are ultimately driven by assumptions related to the variability of Navigant's verified savings compared to the Duke Energy deemed savings values. This is represented by the coefficient of variation, or CV. Less variation results in a lower CV value, which in turn results in lower sample sizes.

Based on previous evaluation work with the SBES program, Navigant designed a sample with 60 sites selected for verification, with a subsample of 20 of these sites for additional metering. Figure 9-1 illustrates the sample design and analysis plan.

Navigant will also note that the population split into four separate strata – large, medium, and small lighting, and one strata for refrigeration. The underlying assumption is that similar projects will tend to exhibit similar variations, so by grouping like projects (e.g. all refrigeration projects) we can further reduce sampling error and draw more meaningful conclusions from our onsite data collections efforts.

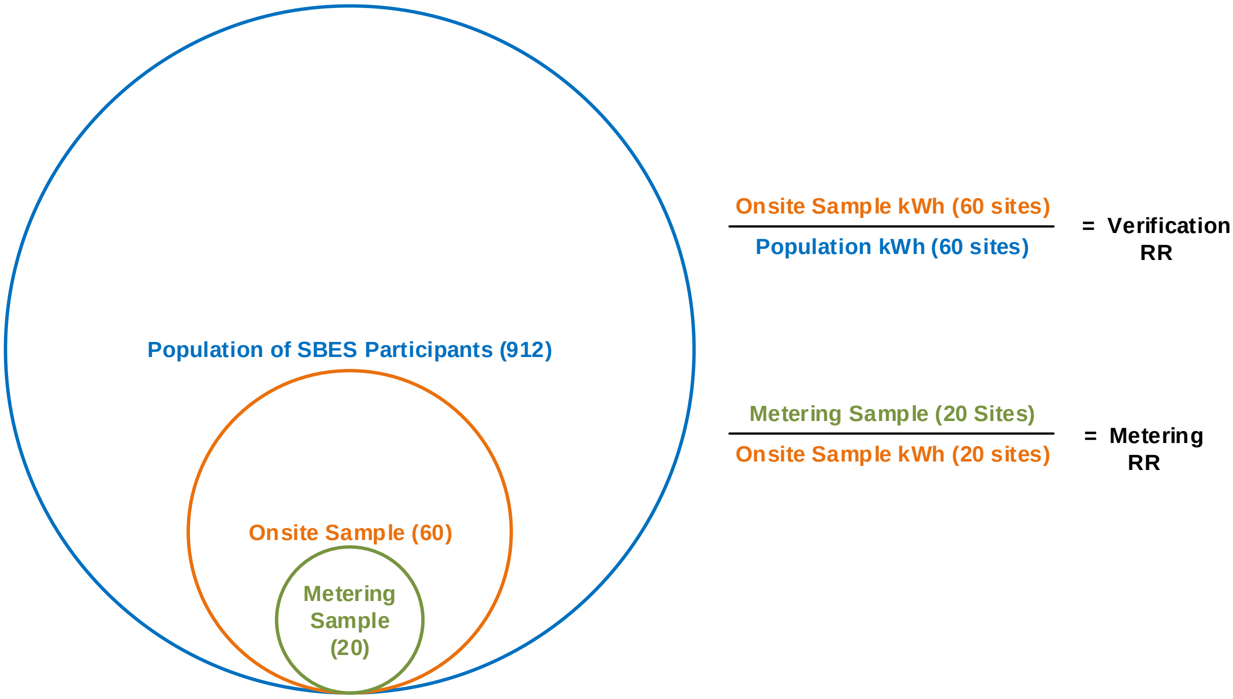


Figure 9-1. Illustration of Nested Sampling Concept

A.2 Analysis Approach

After performing the site visits, the next step is to analyze the measure-level data to develop project-level verification and metering estimates for each site. Because there are three sets of savings estimates, two ratios (hence double-ratio) are required to compare results.

1. The first ratio compares the onsite verification findings to the population for 60 sites. The onsite verification findings include all of Navigant's adjustments performed onsite, such as any adjustments due to in-service rate, HVAC interactive effects, wattage, or customer-reported hours of operation.
2. The second ratio compares the metering findings to the onsite findings for 20 sites. The only adjustment made here is due to hours of use adjustments (or for demand savings, the coincidence factor).

With these ratios, final program-level savings and realization rates are calculated. First, for each stratum, a total realization rate is calculated by multiplying the verification and metering realization rates together (ratios 1 and 2 outlined above). The total realization rate is then multiplied by the stratum deemed savings resulting in the verified savings. The verified savings for each of the four strata are then added together resulting in total program verified savings.

The last step of the analysis includes a statistical analysis to assess whether or not the precision targets were met. In some cases, if there is larger than expected variation between the claimed savings and the verified savings, it is possible that the precision target of 10% is not met. It is also possible that the “true” savings value will be outside of the confidence interval calculated from the statistics. This occurs on average 10% of the time at the 90% confidence level.

APPENDIX G - MYHER EVALUATION

REPORT

My Home Energy Report Program Evaluation

Submitted to Duke Energy Ohio

October 30, 2018

Principal Authors:
Candice Potter, Principal
Shannon Hees, Consultant
Tingting Xue, Project Analyst
Jim Herndon, Senior Vice President

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1 Executive Summary

1.1 Program Summary

This report describes process and impact findings for the Duke Energy Ohio My Home Energy Report (MyHER) offered to residential customers who live in single-metered, single family homes with thirteen months of usage history. MyHER relies on principles of behavioral science to encourage customer engagement with home energy management and energy efficiency. The program accomplishes this primarily by delivering a personalized report comparing each customer's energy use to that of a peer group of similar homes.[1] MyHER motivates customers to reduce their energy consumption by:

- Showing customers a comparison of their household electricity consumption to that of similar homes;
- Presenting a month-ahead forecast of electricity consumption disaggregated by end-use category;
- Suggesting tips for reducing energy use by changing customers' behavior or installing energy efficient equipment;
- Educating them about the energy savings benefits of Duke Energy's demand side management (DSM) programs; and
- Encouraging active management of their home's energy consumption.

1.2 Evaluation Objectives and High Level Findings

Nexant estimated the energy impacts associated with MyHER delivery for the period January 2017 through December 2017. This report also presents measurements of customer satisfaction and engagement for MyHER participants. The MyHER program is implemented as a randomized controlled trial (RCT). Customers are randomly assigned to either "treatment" or "control" groups for the purpose of measuring energy savings. Treatment customers are MyHER recipients (participants). The control group is a set of customers from whom the MyHER is intentionally withheld. The control group serves as the baseline against which MyHER impacts are measured. As Duke Energy customers become eligible for the MyHER program, Duke Energy randomly assigns them to one of these two groups.

The energy savings generated by the DEO MyHER program are presented in Table 1-1, showing that the evaluated impacts of the program are 209 kWh per household. These evaluated energy savings for the MyHER program are net of additional energy savings achieved through increased participation by the MyHER treatment group in other Duke Energy programs.

[1] Homes are grouped by characteristics such as location, size, vintage, and heating fuel. Energy use is compared on groups of similar homes.

Per Ohio Senate Bill (SB) 310, Duke Energy may claim energy efficiency program savings on either an evaluated or deemed basis. The deemed savings that Duke Energy will claim for MyHER is 256 kWh per home, also shown in Table 1-1. Additional information concerning the evaluation period is shown in Table 1-2.

Table 1-1: Deemed and Evaluated Energy Impacts per Participating Household

	Energy (kWh)	Confidence/Precision
Deemed Impacts (Claimed under SB 310)	256	N/A
Evaluated Impacts	209	90/13

*MyHER is an opt-out program. As such, all impacts are considered net impacts; Nexant also calculated the impacts of the MyHER program by removing savings achieved by MyHER participants via other Duke Energy Programs.

Table 1-2: Sample Period Start and End Dates

Evaluation Component	Start	End
Impact Evaluation Period	January 2017	December 2017
Customer Survey Period	May 2017	April 2018

1.3 Evaluation Recommendations

The Ohio MyHER program is found in this evaluation to realize 82% of its claimed impacts, reflecting a mix of mature and newer cohorts added to the program in recent years. Nexant recommends Duke Energy consider the potential for MyHER program's ongoing maturation as the utility undertakes program planning. Nexant's experience in other evaluations and with other Duke Energy jurisdictions indicates the effect of MyHER stimuli grow as a function of customers' duration of exposure to the program. The evaluation evidence points to a maturation effect that occurs after a couple of years of treatment.

Duke Energy undertakes substantial planning and coordination is required to deliver MyHER to approximately 300,000 customers in Ohio. Duke Energy has developed a production process with the MyHER implementation contractor (Tendril, Inc.) that allows Duke Energy to customize MyHER messages, tips, and promotions on the basis of customer information and exposure to Duke Energy's demand-side management programs. Tendril has implemented a number of improvements that has resulted in an improvement in product quality, as evidenced by improved performance in Duke Energy's quality checks that take place before each batch of reports is sent to participants. The process evaluation finds that MyHER is successful in achieving its goal of enhancing customer motivation, awareness, and attention to saving energy in certain areas probed by the customer surveys.

Nexant has the following specific recommendations for enhancing Duke Energy Ohio's MyHER program:

- **Continue the practice, adopted in September 2015, of simultaneous control and treatment assignment.** Assignment of new accounts to the MyHER treatment and control group should be limited to once or twice per year. **Continue to monitor engagement and evaluate the impacts of the Interactive Portal and increase participant awareness of Interactive.** The MyHER Interactive Portal appears to generate incremental savings above and beyond the standard MyHER paper edition. If Duke Energy continues to maintain the interactive portal as a supplement to paper or electronic MyHER reports, then incremental savings may be generated by this level of customer interaction and engagement. The process evaluation finds that current awareness of Interactive among Ohio MyHER participants is very low.
- **Continue to operate MyHER with an eye towards change management.** MyHER's implementer Tendril has made great strides in improving quality control performance since the prior evaluation. Effective change management and stable staffing have been notable contributors to these improvements and they should continue to be emphasized in MyHER program operations.
- **Prioritize and implement key product improvements to improve program processes.** The free-form text (FFT) module has been consistently mentioned by Duke Energy and Tendril staff as a resource intensive program feature that injects last-minute changes to the report generation process. Duke Energy and Tendril should develop and utilize the tools necessary to streamline the work associated with managing the content featured by this module in each MyHER report.

2 Introduction and Program Description

This section presents a brief description of the My Home Energy Report (MyHER) program as it operated in the DEO service territory from January 2017 through December 2017. This description is informed by document review, in-depth interviews with staff, and Nexant's understanding of program nuance developed through regular communication during the evaluation process.

2.1 Program Description

The MyHER program is a Duke Energy Ohio behavioral product for demand-side management (DSM) of energy consumption and generation capacity requirements. The MyHER presents a comparison of participants' energy use to a peer group of similar homes. It is sent by direct mail eight times a year, and 12 times a year by email to customers that have provided Duke Energy with their email address.[2] The MyHER provides customer-specific information that allows customers to compare their energy use for the month and over the past year to the consumption of similar homes as well as homes considered to be energy-efficient. Reports include seasonal and household-appropriate energy savings tips and information on energy efficiency programs offered by Duke Energy. Many tips include low cost suggestions such as behavioral changes. A new feature added to the report in 2017 presents a month-ahead forecast of energy usage disaggregated by end-use type. Duke contracts with Tendril Inc. for the management and delivery of its MyHER product.

Duke Energy also launched the MyHER Interactive Portal[3] in March 2015. MyHER Interactive seeks to engage customers in a responsive energy information and education dialogue. When customers enroll in the online portal they are given the opportunity to update and expand on information about their home and electricity consumption. Customers who have registered to use MyHER Interactive are also sent weekly energy management tips and conservation challenges via email. The general strategy of MyHER Interactive is to open communications between customers and the utility, as well as to explore new ways of engaging households in electricity consumption management.

Customers occupying single-family homes with an individual electric meter and at least thirteen months of electricity consumption history are eligible for MyHER in Ohio. The program is an opt out program: customers can notify Duke Energy if they no longer wish to receive a MyHER and will be subsequently removed from the program. Customers who receive both paper and email

[2] For clarity: MyHERs are only sent to customers randomly assigned to the treatment group. All of the customers in the treatment group receive paper MyHERs 8 times a year. Duke Energy has email contact information for some of the treatment customers – those email customers also receive email MyHERs 12 times a year. Therefore, the email customers receive both an email and paper MyHER 8 months of the year and only an email report 4 months of the year.

[3] We refer to the MyHER Interactive Portal simply as "Interactive" in the remainder of this report.

MyHERs may also opt out of the report format of their choice (i.e., elect to only receive MyHERs by email, or only receive them by U.S. Mail).

Duke Energy placed a portion of eligible customers into a control group to satisfy evaluation, measurement, and verification (EM&V) requirements. These control group customers are not eligible to participate in the MyHER program.

Duke Energy has several objectives for the MyHER program, including:

1. Generating cost effective energy savings;
2. Increasing customer awareness of household energy use, engagement with Duke Energy, and overall customer satisfaction with services provided by Duke Energy; and
3. Promoting other energy efficiency and demand response program options to residential customers.

2.2 Implementation

MyHER is implemented by Tendril Inc., a behavioral science and analytics contractor that prepares and distributes the MyHER reports according to a pre-determined annual calendar. Tendril also generates and disseminates the MyHER Interactive Portal reports, emails, energy savings tips, and energy savings challenges. Tendril and Duke Energy coordinate closely on the data transfer and preparation required to successfully manage the MyHER program, and they make adjustments as needed to provide custom tips and messages expected to reflect the characteristics of specific homes. A more detailed discussion of the roles and responsibilities of both organizations is provided in Section 4.

Eligibility

The single-family segment of the MyHER program targets residential customers living in single family, single meter, and non-commercial homes with at least thirteen months of electricity consumption history.[4] Approximately 308,000 DEO residential customers met those requirements as of December 2017 and are assigned to the MyHER treatment group. Accounts could still be excluded from the program for reasons such as the following: different mailing and service addresses and enrollment in payment plans based on income (although Equal Payment Plan customers are eligible). Eligibility criteria for the MyHER program have changed over time, and in some cases, customers were assigned to either treatment or control but later determined to be ineligible for the program. Nexant estimates that approximately 3.6% of assigned customers have been deemed ineligible for the program after having been assigned. Nexant addresses this topic by applying an intention-to-treat analysis (ITT); refer to Section 3.1.2.

2.3 Key Research Objectives

The section describes our key research objectives and associated evaluation activities.

[4] Duke Energy launched a multi-family MyHER program in other jurisdictions in December 2016. This report focuses solely on the single-family MyHER implementation in Ohio.

2.3.1 Impact Evaluation Objectives

The primary objective of the impact evaluation is to describe the impact of the program on energy consumption (kWh). Savings attributable to the program are measured across an average annual and monthly time period. The following research questions guided impact evaluation activities:

1. Is the process used to select customers into treatment and control groups unbiased?
2. What is the impact of MyHER on the uptake of other Duke Energy programs (downstream and upstream) in the market?
3. What net energy savings are attributable solely to MyHER reports after removing savings already claimed by other DEO energy efficiency programs?
4. What incremental savings are achieved by customers participating in the MyHER Interactive portal?

2.3.2 Process Evaluation Objectives

The program evaluation also seeks to identify improvements to the business processes of program delivery. Process evaluation activities focused on how the program is working and opportunities to make MyHER more effective. The following questions guided process data collection and evaluation activities:

1. Are there opportunities to make the program more efficient, more effective, or to increase participant engagement?
2. What components of the program are most effective and should be replicated or expanded?
3. What additional information, services, tips or other capabilities should MyHER consider?
4. Does MyHER participation increase customer awareness of their energy use and interest in saving energy?
5. To what extent does receiving MyHER increase customer engagement?
6. Do participants hold more favorable opinions of Duke Energy as a result of receiving the reports?
7. Do they express higher levels of stated intentions to save energy?
8. Are they more likely to say they will take advantage of Duke Energy's energy efficiency programs in the future?
9. What prevents households from acting upon information or tips provide by MyHER?
10. How can the program encourage additional action?

2.4 Organization of This Report

The remainder of this report contains the results of the impact analysis (Section 3); the results of the process evaluation activities, including the customer surveys (Section 4); and Nexant's conclusions and recommendations (Section 5).

3 Impact Evaluation

3.1 Methods

A key objective of the MyHER impact evaluation is to measure the change in electricity consumption (kWh) resulting from exposure to the normative comparisons and conservation messages presented in Duke Energy's My Home Energy Reports. The approach for estimating MyHER impacts is built into the program delivery strategy. Eligible accounts are randomly assigned to either a treatment (participant) group or a control group. The control group accounts are not exposed to MyHER in order to provide the baseline for estimating savings attributable to the Home Energy Reports. In this randomized controlled trial (RCT) design, the only explanation for the observed differences in energy consumption between the treatment and control group is exposure to MyHER.

The impact estimate is based on monthly billing data and program participation data provided by Duke Energy. The RCT delivery method of the program removes the need for a net-to-gross analysis as the billing analysis directly estimates the net impact of the program. After estimating the total change in energy consumption in treatment group homes, Nexant performed an "overlap analysis", which quantifies the savings associated with increased participation by treatment homes in other DEO energy efficiency offerings. These savings were claimed by other programs; therefore, they are subtracted from the MyHER impact estimates to eliminate double-counting.

3.1.1 Data Sources and Management

The MyHER impact evaluation relied on a large volume of participation and billing data from Duke Energy's data warehouse. Nexant provided a data request for the necessary information in January 2018. Key data elements include the following:

- **Participant List** – a table listing each of the homes assigned to the MyHER program since its inception in 2010. This table also indicated whether the account was in the treatment or control group and the date the home was assigned to either group. Duke Energy also provided a supplemental table of Acxiom demographic data for program participants.
- **Billing History** – a monthly consumption (kWh) history for each account in the treatment and control group. Records included all months since assignment as well as the pre-assignment usage history required for eligibility. This file also included the meter read date and the number of days in each billing cycle.
- **MyHER Report History** – a record of the approximate 'drop date' of each MyHER report sent to the treatment group accounts, the messaging included, and the recommended actions. This dataset also contained a supplemental table of treatment group accounts omitted from each MyHER mailing during the evaluation period, and the associated reason for omission.

- **Participation Tracking Data for Other Duke Energy Energy Efficiency Programs** – a table of the Duke DSM program participation of MyHER control and treatment group accounts. Key fields for analysis include the measure name, quantity, participation date, and net annual kWh and peak demand impacts per unit for each MyHER recipient and control group account participating in other DSM programs offered by Duke Energy.

In preparation for the impact analysis, Nexant combined and cleaned the participation and billing data provided by the MyHER program staff and then combined with the cleaned dataset from the Nexant's prior DEO MyHER impact evaluation.[5] The combined billing dataset includes 582,822 distinct accounts (the actual number varies by month.

Nexant removed the following accounts or data points from the analysis:

- 531 accounts that had a negative value for billed kWh;
- 2,656 records with 0 days in the billing cycle; and
- 233 records with unrealistically high usage: any month with greater than six times the 99th percentile value for daily kWh usage, or approximately 900 kWh per day.

Like most electric utilities, Duke Energy does not bill its customers for usage within a standard calendar month interval. Instead, billing cycles are a function of meter read dates that vary across accounts. Since the interval between meter reads vary by customer and by month, the evaluation team "calendarized" the usage data to reflect each calendar month, so that all accounts represent usage on a uniform basis. The calendarization process includes expanding usage data to daily usage, splitting the billing month's usage uniformly among the days between reads. The average daily usage for each calendar month is then calculated by taking the average of daily usage within the calendar month.

3.1.2 Intention to Treat

Duke Energy maintains a number of eligibility requirements for continued receipt of MyHER. Not all accounts assigned to treatment remained eligible and received MyHER over the study horizon. Several programmatic considerations can prevent a treatment group home from receiving MyHER in a given month. Common reasons for an account not being mailed include the following:

- **Mailing Address Issues** – mailing addresses are subjected to deliverability verification by the printer. If an account fails this check due to an invalid street name, PO Box or other issue, the home will not receive the MyHER.
- **Implausible Bill** – if a home's billed usage for the previous month is less than 150 kWh or greater than 10,000 kWh, Tendril does not mail the MyHER.

[5] Rather than re-requesting all of the data necessary for this evaluation (pretreatment and posttreatment usage data for all treatment and control customers), Nexant omitted any data that we already had from the first evaluation – the pretreatment data for cohorts included in our prior evaluation is still necessary for this current evaluation.

- **Insufficient Matching Households** – this filter is referred to as "Small Neighborhood" by Tendril and is a function of the clustering algorithm Tendril uses to produce the usage comparison. If a home can't be clustered with a sufficient number of other homes, it will not receive the MyHER.
- **No Bill Received** – if Tendril does not receive usage data for an account from Duke within the necessary time frame to print and mail, the home will not receive MyHER for the month.

Table 3-1 presents the shares for each of the above reasons that a MyHER was not mailed to customers for each month that MyHERs were sent in 2017. The prevailing reason that a MyHER report is not mailed is if Tendril does not receive a bill for that customer from Duke Energy. The most common reason for "no bill received" is account closure.

Table 3-1: Percentage Shares of Reasons for MyHER Reports Not Mailed by Month

Month	Mailing Address Issue (%)	Implausible Bill (%)	Insufficient Matching Households (%)	No Bill Received (%)	Total (%)	Total (Count)
17-Feb	0.35%	0.00%	0.22%	99.43%	100.00%	166,218
17-Mar	0.43%	0.00%	0.25%	99.32%	100.00%	150,804
17-May	0.00%	0.00%	0.21%	99.79%	100.00%	189,305
17-Jun	0.19%	0.00%	0.25%	99.56%	100.00%	157,990
17-Jul	0.23%	0.00%	0.24%	99.53%	100.00%	164,352
17-Aug	0.10%	0.00%	0.24%	99.65%	100.00%	164,771
17-Oct	0.13%	0.00%	0.28%	99.58%	100.00%	94,405
17-Nov	0.50%	0.00%	0.20%	99.30%	100.00%	113,174

The Nexant data cleaning steps listed in Section 3.1.1 do not impose these filters on the impact evaluation analysis dataset. This is necessary to preserve the RCT design because eligibility filters are not applied to the control group in the same manner as the treatment group. Instead, Nexant employed an "intention-to-treat" (ITT) analysis. In the ITT framework, the average energy savings per home *assigned* to the treatment is calculated via billing analysis. This impact estimate is then divided by the proportion of the treatment group homes analyzed that were active MyHER participants. The underlying assumption of this approach is all of the observed energy savings are being generated by the participating accounts.

Nexant relied on Duke Energy's monthly participation counts for the numerator of the proportion treated calculation. MyHER program staff calculates participation monthly according to the business rules and eligibility criteria in place at the time. The denominator of the proportion treated is the number of treatment group homes with billed kWh usage for the bill month. This calculation is presented by month in Table 3-2 for the study period. The average proportion of assigned accounts that were treated was 95.5% during the period January 2017 through December 2017.

Table 3-2: Calculation of Treatment Percentage by Bill Month

Month	Treatment Homes Analyzed	DEO Participant Count	% Treated
2017-1	332,394	315,609	95.0%
2017-2	330,762	315,609	95.4%
2017-3	329,165	310,562	94.3%
2017-4	326,941	309,450	94.7%
2017-5	324,962	309,450	95.2%
2017-6	322,204	305,009	94.7%
2017-7	319,165	306,838	96.1%
2017-8	316,674	302,121	95.4%
2017-9	314,127	302,222	96.2%
2017-10	311,970	302,222	96.9%
2017-11	309,990	297,336	95.9%
2017-12	307,548	296,616	96.4%
12-month Average Proportion			**95.5%**

The monthly participation counts shown in Table 3-2 were also used by Nexant to estimate the aggregate impacts of the MyHER. Per-home kWh savings estimates for each bill month are multiplied by the number of participating homes to arrive at the aggregate MWh impact achieved by the program.

3.1.3 Sampling Plan and Precision of Findings

The MyHER program was implemented as an RCT in which individuals were randomly assigned to a treatment (participant) group and a control group for the purpose of estimating changes in energy use because of the program. Nexant's analysis methodology relies on a census analysis of the homes in both groups so the resulting impact estimates are free of sampling error. However, there is inherent uncertainty associated with the impact estimates because random assignment produces a statistical chance that the control group consumption would not vary in perfect harmony with the treatment group, even in the absence of MyHER exposure. The uncertainty associated with random assignment is a function of the size of the treatment and control groups. As group size increases, the uncertainty introduced by randomization decreases, and the precision of the estimates improves.

Nexant's MyHER impact estimates are presented with both an absolute precision and relative precision. Absolute precision estimates are expressed in units of annual energy consumption (kWh) or as a percentage of annual consumption.

The two following statements about the MyHER Ohio impact analysis reflect absolute precision:

- MyHER saved an average of 209.4 kWh per home during the 12-month period January to December 2017, ± 45.7 kWh.
- Homes in the MyHER treatment group reduced electric consumption by an average of 1.67%, ± 0.32%.

In these examples, the uncertainty of the estimate, or margin of error (denoted by "±"), is presented in the same absolute terms as the impact estimate—that is, in terms of annual electricity consumption. Nexant also includes the relative precision of the findings. Relative precision expresses the margin of error as a percentage of the impact estimate itself. Consider the following example:

- The average treatment effect of MyHER during the 12-month period January to December 2017 is 209.4 kWh with a relative precision of ± 21.8%. In this case ± 21.8% is determined by dividing the absolute margin of error by the impact estimate: 45.7÷209.4 = 0.218 = 21.8%.

All of the precision estimates in this report are presented at the 90% confidence level and assume a two-tailed distribution.

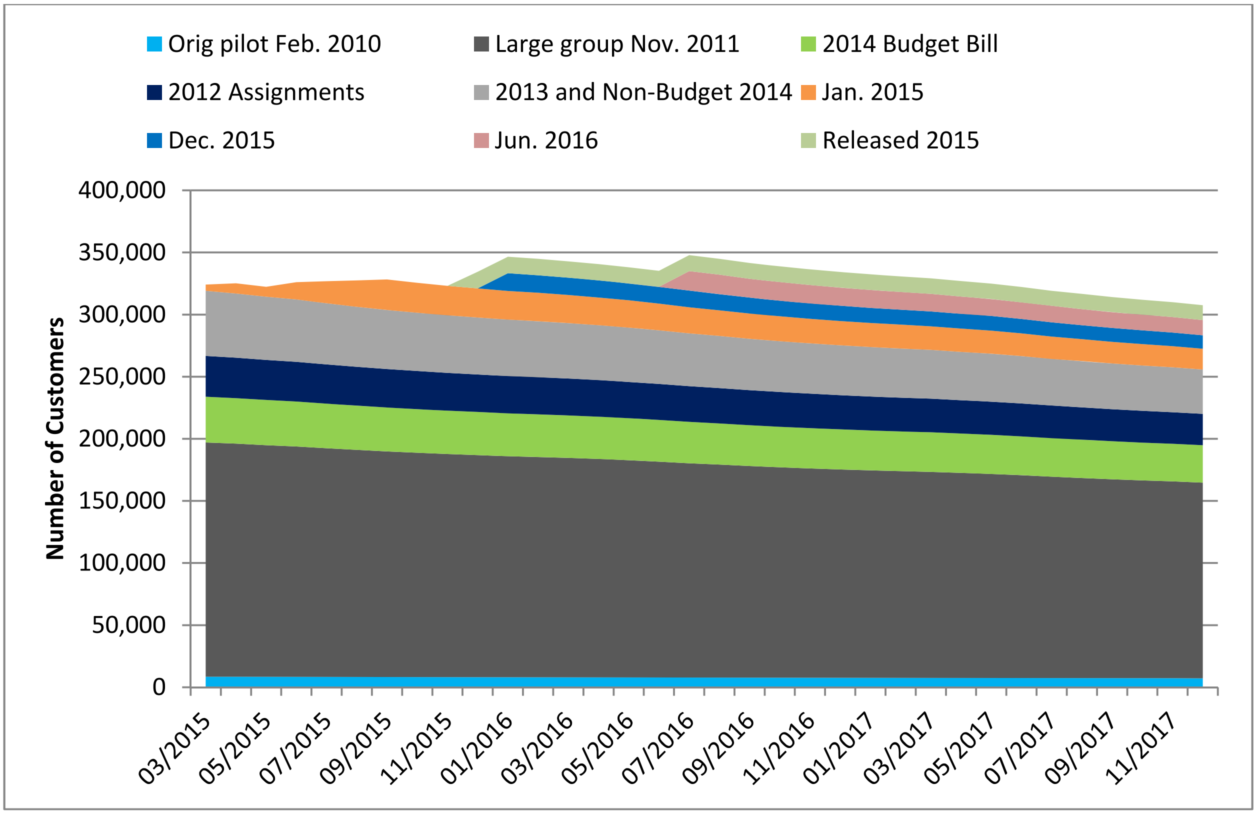
3.1.4 Assignment Cohorts and Equivalence Testing

The DEO MyHER program has been growing over time since its launch in 2010. Nexant mapped the DEO MyHER population into nine cohorts on a temporal basis, generally following the major periods when customers were assigned to treatment and control groups.

The original pilot cohort started the program in 2010 which was followed by a large expansion of customers in 2011. The program has continued to expand annually since 2012, in more modest increments relative to the 2011 expansion, as newer customers met the program's eligibility criteria. Figure 3-1 shows the timeline of program expansion by cohort since March 2013; the largest cohort from 2011 can be seen as the region in dark grey, while the cohorts that joined the program starting in 2012 are seen to be much smaller. In 2015, Duke Energy also released a small number of DEO customers into treatment (denoted "Released 2015" in Figure 3-1 from the control group of the original 2010 pilot cohort.[6]

[6] Duke Energy commissioned a review of the MyHER control groups in 2015 to assess whether or not there were any control groups that were larger than necessary for the purpose of EM&V. A relatively small release (approximately 13,000 customers) from the DEO jurisdiction was recommended by that review. Consequently, about 13,000 DEO control group customers from the original pilot cohort were randomly selected for release into treatment.

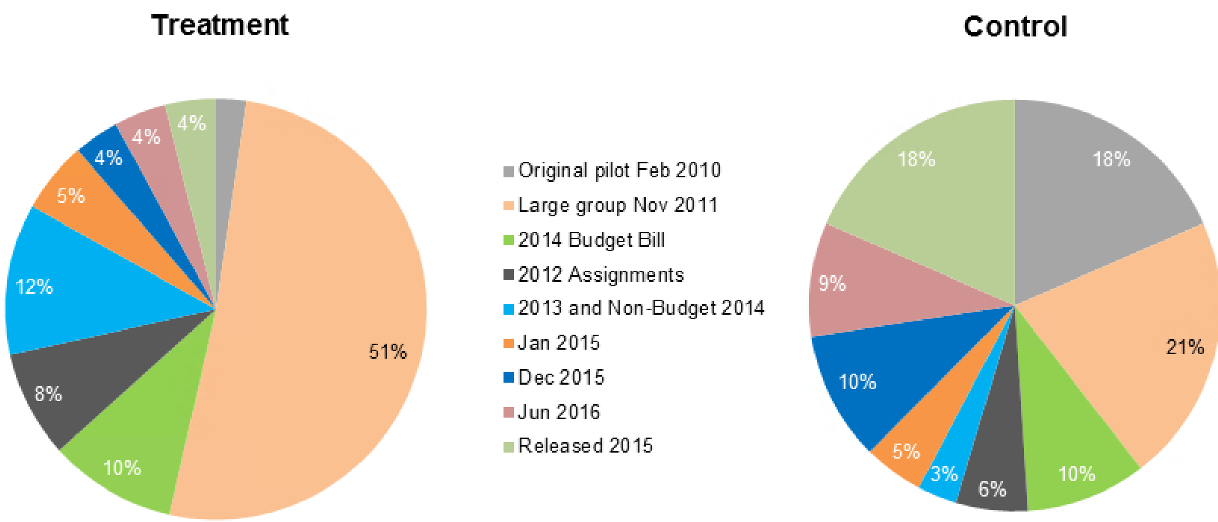
Figure 3-1: History of Cohort Assignments for DEO MyHER Program



After the 2014 cohort launches, customers were assigned to treatment and control on an alternating basis. Nexant has advised Duke Energy to maintain a simultaneous assignment protocol and to make assignments on an annual or biennial basis. Doing so will minimize any potential sources of bias that could occur due to a lack of simultaneous assignment to treatment and control.

Figure 3-2 indicates the composition of the DEO MyHER program as of the end of this evaluation period, December 2017 by cohort. The Original Pilot and Released cohorts share a control group, so those control customers are represented twice here for both cohorts.

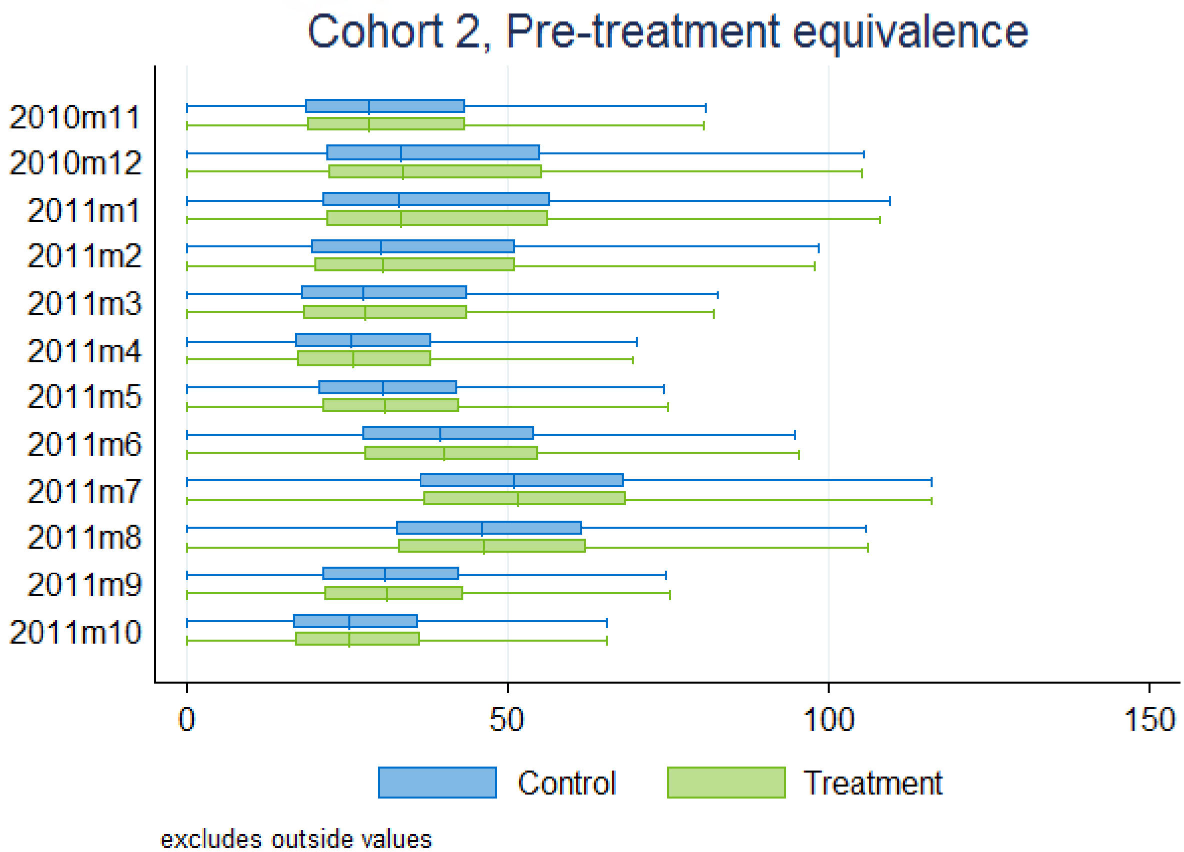
Figure 3-2: Comparison of Treatment and Control Group Composition by Cohort



Straightforward impact estimates are a fundamental property of the RCT design. Random assignment to treatment and control produces a situation in which the treatment and control groups are statistically identical on all dimensions prior to the onset of treatment; the only difference between the treatment and control groups is exposure to MyHER. The impact is therefore simply the difference in average electricity consumption between the two groups. The first step to assessing the impact of an experiment involving a RCT is to determine whether or not the randomization worked as planned.

Figure 3-3 is a box-and-whisker plot of the average pre-treatment consumption for the treatment and control groups of Cohort 2 (“Large Group Nov. 2011”), the largest treatment cohort of the DEO MyHER program. The figure depicts the distribution of monthly average consumption from November 2010 to October 2011, the time period prior to the launch of the cohort. This figure represents usage of all accounts assigned to treatment and control in this cohort. There are no apparent differences between the treatment and control groups, indicating a robust assignment process for these customers.

Figure 3-3: Difference in Average Pre-treatment Billed Consumption (kWh)



Nexant estimated MyHER impacts by cohort using a fixed-effects panel regression model. The assignments to treatment and control made for the January 2015 cohort (cohort 6) resulted in resulted in differences in consumption patterns between the treatment and control groups over this time period; reliable estimates for cohort 6 could not be obtained and therefore cohort 6 is excluded from the analysis. In the absence of a valid comparison group, Nexant has assumed impacts for cohort 6 are similar to the average of the other eight cohorts

Table 3-3 presents summary information for each of the eight cohorts included in Nexant's analysis, comparing the average annual kWh usage of each cohort's treatment and control group for the 12 months prior to the beginning of assignment. The pre-assignment usage is relatively balanced between groups for each of these cohorts, where the largest difference occurs in Cohort 5 (2013 and Non-budget billed 2014) which is the smallest cohort in terms of the number of both treatment and control customers.

Table 3-3: MyHER Cohort Summary Statistics

Cohort	Pre-period		# Homes		Annual kWh in Pre-period	
	Start	End	Control	Treatment	Control	Treatment
Original pilot Feb 2010	February 2009	January 2010	14,783	11,065	15,552	15,702
Large group Nov 2011	November 2010	October 2011	11,764	239,869	14,329	14,459
2014 Budget Bill	January 2013	December 2013	4,472	40,034	13,589	13,455
2012 Assignments	March 2011	February 2012	3,964	41,720	12,226	12,995
2013 and Non-Budget 2014	January 2012	December 2012	2,740	26,462	11,303	12,464
Dec 2015	December 2014	November 2015	4,946	14,430	13,230	13,000
Jun 2016	June 2015	May 2016	4,140	15,847	12,108	12,097
Released 2015	November 2014	October 2015	7,680	13,800	15,428	15,376

3.1.5 Regression Analysis

Separating the MyHER population into cohorts accounts for cohort maturation effects and improves statistical precision relative to differences among the cohorts. Nevertheless, there are still small underlying differences between the cohort treatment and control groups that need to be netted out via a difference-in-differences approach. Nexant applied a linear fixed effects regression (LFER) model to account for the month-to-month differences in electricity usage observed in the pre-treatment period between the treatment and control groups. The basic form of the LFER model is shown in Equation 3-1. Average daily electricity consumption for treatment and control group customers is modeled using an indicator variable for the billing period of the study, a treatment indicator variable, and a customer-specific intercept term:

Equation 3-1: Fixed Effects Model Specification

$$\mathrm{kWh}_{ity} = \mathrm{customer}_i * \beta_i + \sum_{t=1}^{12} \sum_{y=2009}^{2017} \mathrm{I}_{ty} * \beta_{ty} + \sum_{t=1}^{12} \sum_{y=2009}^{2017} \mathrm{I}_{ty} * \tau_{ty} * \mathrm{treatment}_{ity} + \varepsilon_{ity}$$

Table 3-4 provides additional information about the terms and coefficients in Equation 3-1.

Table 3-4: Fixed Effects Regression Model Definition of Terms

Variable	Definition
kWh_{ity}	Customer i's average daily energy usage in billing month t of year y
$customer_i$	An indicator variable that equals one for customer i and zero otherwise. This variable models each customer's average energy use separately.
β_i	The coefficient on the customer indicator variable. Equal to the mean daily energy use for each customer.
I_{ty}	An indicator variable equal to one for each monthly billing period t, year y and zero otherwise. This variable captures the effect of each billing period's deviation from the customer's average energy use over the entire time series under investigation.
β_{ty}	The coefficient on the billing period t, year y indicator variable.
$treatment_{ity}$	The treatment variable. Equal to one when the treatment is in effect for the treatment group. Zero otherwise. Always zero for the control group.
τ_{ty}	The estimated treatment effect in kWh per day per customer in billing month t of year y; the main parameter of interest.
ε_{ity}	The error term.

Nexant estimated the LFER model separately for each of the eight randomized cohorts included in the analysis (cohort 6 was omitted from estimation as explained above). Detailed regression outputs can be found in Appendix A. The model specification includes an interaction term between the treatment indicator variable and the indicator variable for the bill month term. This specification generates a separate estimate of the MyHER daily impact for each month.

Table 3-5 illustrates the calculation of monthly impact estimates from the regression model coefficients for homes assigned to treatment in the original MyHER pilot. The monthly savings shown in Table 3-5 are the unweighted point estimates for that cohort. Each month's average treatment effect is multiplied by an assumed number of days in the month equal to 365.25/12 = 30.4375.

Table 3-5: Impact Calculation Example – Cohort 1

Month	Daily Treatment Coefficient (τ)	Monthly Impact (kWh)
2017-1	-0.7178	-21.8
2017-2	-0.2914	-8.9
2017-3	-0.2484	-7.6
2017-4	0.0656	2.0
2017-5	-0.0725	-2.2
2017-6	-0.1831	-5.6
2017-7	-0.4354	-13.3
2017-8	-0.2551	-7.8
2017-9	-0.1807	-5.5
2017-10	0.0647	2.0
2017-11	-0.4067	-12.4
2017-12	-1.2004	-36.5
2017 Total		**-117.5**

Impact estimates from the eight cohorts were combined for each month using a weighted average where the weighting factor was the number of homes with billing data that had been assigned to the treatment group during a prior month (e.g., were in the post-treatment period). These estimates of the average MyHER impact per assigned home were then divided by the proportion of customers treated, as shown in Table 3-2, to estimate the average treatment effect per participating home.

3.1.6 Dual Participation Analysis

The regression model outputs and subsequent intention-to-treat adjustments discussed in Section 3.1.5 produce estimates of the total change in electricity consumption in homes exposed to MyHER. Some portion of the savings estimated by the regression is attributable to the propensity of MyHER treatment group homes to participate in other Duke Energy energy efficiency offerings at a greater rate than control group homes. The primary purpose of the dual participation analysis is to quantify annual electricity savings attributable to this incremental DSM participation and subtract it from the MyHER impact estimates. This downward adjustment prevents savings from being double-counted by both the MyHER program and the program where savings were originally claimed.

A secondary objective of the dual participation analysis is to better understand the increased DSM participation, or "uplift" triggered by inclusion of marketing messages within MyHER. The ability to serve as a marketing tool for other DSM initiatives is an important part of what makes MyHER attractive as Duke Energy assumes the role of a trusted energy advisor with its customer base.

Duke Energy EM&V staff provided Nexant with a dataset of non-MyHER program participation records for the MyHER treatment and control group homes dating back to January 2014. This dataset included nearly 350,000 records of efficient measure installations by the MyHER treatment and control group and formed the basis of Nexant's dual participation analysis.

Table 3-6 shows the distribution of participation and savings during the 12-month period January 2017 to December 2017 across Duke Energy's residential portfolio.

Table 3-6: Total 2017 EE Program Participation among MyHER Customers

Program Name	Number of Records	Net MWh/year	Net kW/year
DE Residential EE Products & Services[7]	21,049	7,224	1,087
DE Smart Saver Residential[8]	53,096	42,358	12,984
Elec Wtzn pay per kwh program	349	1,149	135
Residential Energy Assessments	3,751	13,057	1,642
Total	**78,245**	**63,788**	**15,848**

The MyHER dual participation analysis included the following steps:

- Match the data to the treatment and control homes by Account ID
- Assign each transaction to a bill month based on the participation date field in the tracking data
- Exclude any installations that occurred prior to the home being assigned to the treatment or control group
- Calculate the daily net energy savings for each efficiency measure
- Sum the daily net energy impact by Account ID for measures installed prior to each bill month
- Calculate the average savings per day for the treatment and control groups by bill month. This calculation is performed separately for each cohort
- Calculate the incremental daily energy saved from energy efficiency (treatment – control) and multiply by the average number of days per bill month (30.4375)
- Take a weighted average across cohorts of the incremental energy savings observed in the treatment group
- Subtract this value from the LFER estimates of treatment effect for each bill month

[7] The Residential EE Products and Services measures deliver energy efficiency through water end uses in the home, such as aerators, pipe wraps, and pool pumps.

[8] The Smart Saver Program measures include efficient light bulbs, thermostats, and attic insulation, in addition to others.

Table 3-7 shows the dual participation calculations, by bill month, for the homes assigned to the original MyHER pilot (cohort 1). Savings from energy efficiency measures climb steadily over time in both groups as additional efficient technologies are installed through Duke Energy's residential energy efficiency portfolio. The treatment group's impacts increase at a slightly greater rate, so the incremental energy savings subtracted from the MyHER treatment effect generally grows as a cohort's duration of exposure lengthens.

Table 3-7: Incremental Energy Efficiency Savings Calculation Example – Cohort 1

Month	Mean Daily kWh Impact (Control)	Mean Daily kWh Impact (Treatment)	Incremental Daily kWh from EE (Treatment – Control)	Uplift %	Incremental kWh Savings
2017-1	0.426	0.430	0.004	1.0%	0.136
2017-2	0.440	0.444	0.004	0.9%	0.126
2017-3	0.449	0.452	0.003	0.6%	0.088
2017-4	0.461	0.467	0.006	1.2%	0.170
2017-5	0.477	0.486	0.009	1.8%	0.265
2017-6	0.493	0.499	0.006	1.3%	0.191
2017-7	0.504	0.510	0.006	1.1%	0.173
2017-8	0.527	0.527	0.000	0.0%	-0.002
2017-9	0.550	0.545	-0.005	-0.9%	-0.144
2017-10	0.574	0.574	0.000	0.0%	0.003
2017-11	0.584	0.584	-0.001	-0.1%	-0.023
2017-12	0.587	0.589	0.002	0.3%	0.054
2017 Total					**1.04**

While the incremental participation rate of the treatment group in other EE programs is modest when considered in total, increased uptake of measures immediately following promotional messaging within MyHER mailers can be much more dramatic. Each MyHER issued has space for one product promotion message that is used to market other Duke Energy programs or initiatives. Duke Energy provided Nexant with records of the exact messages received by each home. Table 3-8 shows the number of homes that received each combination of messages for the MyHER cycles from this evaluation period.

Table 3-8: MyHER Promotional Messaging by Month

Source Month	Message 1 - Details	Message 2 - Details	Number of Homes
2017-2	Duke Energy Store - Bulbs	Prescraping dishes	292,448
2017-3	Budget Billing Program	Landscaping can lower energy bills by as much as 25 percent	92,732
2017-3	Demand Response	Landscaping can lower energy bills by as much as 25 percent	210,761
2017-5	Contractor Program - duke-energy.com/425	Get comfortable by using fans	269
2017-5	Upgrade insulation	Get comfortable by using fans	269,872
2017-5	Get a $300 rebate and a lower monthly bill when you invest in a quieter, more efficient pool pump	Get comfortable by using fans	11,732
2017-6	Enrolling in Duke Energy's GoGreen Ohio program costs as little as $2 more a month	Don't end up with a chilly home and a high electric bill by setting your thermostat too low	229,773
2017-6	Home Energy House Call	Don't end up with a chilly home and a high electric bill by setting your thermostat too low	67,546
2017-7	Duke Energy Store - Bulbs	Refrigerators and freezers work best when they are full, but not overstuffed	291,194
2017-7	Summer is a great time for fun in the sun, just be sure to be safe while you play!	Refrigerators and freezers work best when they are full, but not overstuffed	3,078
2017-8	Smart laundry habits can lower your energy costs and your water/sewer bills if you have them	Using home automation can lower your energy bills	288,426
2017-10	duke-energy.com/HeatShare	Preheating the oven for long periods wastes energy	289,645
2017-11	Weatherstrip your windows	Make sure all your registers are open and unblocked. If you have hot water heating, make sure your radiators are not covered or blocked by furniture. If you have baseboard heat, keep furniture and window coverings away from the heaters	139,325

3.2 Impact Findings

3.2.1 Per-Home kWh and Percent Impacts

Nexant estimates the average participating MyHER home saved 209.4 kWh of electricity from January 2017 to December 2017. This represents a 1.64% reduction in total electricity consumption, compared to the control group over the same period. These estimates reflect an upward adjustment to account for the intention-to-treat methodology and a downward adjustment to prevent double-counting of savings attributable to incremental participation of treatment groups in Duke Energy's energy efficiency programs.

Table 3-9 shows the impact estimates in each bill month for the average home assigned to treatment. The table also shows the subsequent adjustment to account for the fact that only a subset of homes assigned to treatment was actively participating in MyHER during the study period.

Table 3-9: MyHER Impact Estimates with ITT Adjustment, before EE Overlap Adjustment

Month	Treatment Homes Analyzed	DEO Participant Count	kWh impact in Assigned Homes	% Treated	kWh Impact in Treated Homes
2017-1	332,394	315,609	28.2	95.0%	29.7
2017-2	330,762	315,609	24.7	95.4%	25.9
2017-3	329,165	310,562	23.4	94.3%	24.8
2017-4	326,941	309,450	15.0	94.7%	15.8
2017-5	324,962	309,450	13.1	95.2%	13.8
2017-6	322,204	305,009	10.5	94.7%	11.1
2017-7	319,165	306,838	9.9	96.1%	10.2
2017-8	316,674	302,121	12.1	95.4%	12.7
2017-9	314,127	302,222	12.2	96.2%	12.7
2017-10	311,970	302,222	12.8	96.9%	13.3
2017-11	309,990	297,336	21.6	95.9%	22.5
2017-12	307,548	296,616	26.2	96.4%	27.2
2017 Total			**209.6**	**95.5%**	**219.6**

An adjustment factor of 10.2 kWh per home over the period January to December 2017 is applied to MyHER impact estimate estimates in Table 3-10 to arrive at the final net verified program impact per home. Section 3.2.6 provides additional detail on the calculation of the adjustment for overlapping participation in other Duke EE programs.

Table 3-10: MyHER Impact Estimates Net of EE Overlap

Time Period	kWh Savings in Treated Homes	Incremental kWh from EE Programs	Net MyHER Impact Estimate	Control Group Usage (kWh)	Percent Reduction
2017	219.6	-10.2	209.4	12,763	1.64%

In the state of Ohio, electric distribution utilities (EDUs), including DEO, are required to achieve a cumulative annual energy savings of more than 22% by 2027 per Ohio Senate Bill (SB) 310.[9] SB 310 also introduced new mechanisms that adjust how EDUs may estimate their energy savings achieved through demand side management programs. Specifically, SB 310 requires the Ohio Public Utilities Commission (PUC) to permit EDUs to account for energy-efficiency savings estimated on an “as-found” or a deemed basis. That is, an EDU may claim savings based on the baseline operating conditions found at the locations where the energy efficiency measure are implemented, or the EDU may claim a deemed savings estimate. The deemed annual savings estimate for the DEO MyHER program has been filed as 256 kWh per home. Duke Energy, per SB 310, will claim the deemed savings value of 256 kWh per home with the Ohio PUC for 2017.

3.2.2 Aggregate Impacts

The total impact of the MyHER program in the DEO service territory is calculated by multiplying the per-home impacts (adjusted for ITT and incremental EE participation) for each bill month by the number of participating homes. Over the 12-month period January to December 2017, MyHER participants conserved 64.2 GWh of electricity; or enough energy to power 5,032 homes for an entire year. The aggregate impacts presented in Table 3-11 are at the meter level so they do not reflect line losses which occur during transmission and distribution between the generator and end-use customer.

Table 3-11: MyHER Aggregate Impacts

Month	DEO Participant Count	kWh Net Impact	GWh Net Impact
2017-1	315,609	29.0	9.2
2017-2	315,609	25.2	7.9
2017-3	310,562	24.0	7.4
2017-4	309,450	14.9	4.6
2017-5	309,450	12.9	4.0
2017-6	305,009	10.2	3.1
2017-7	306,838	9.3	2.9
2017-8	302,121	11.8	3.6
2017-9	302,222	11.8	3.6
2017-10	302,222	12.4	3.8
2017-11	297,336	21.6	6.4
2017-12	296,616	26.2	7.8
2017 Total		**209.4**	**64.2**

[9] State of Ohio Substitute Senate Bill 310 Section 4928.662, sections (A) through (G), pages 30 and 31.

3.2.3 Precision of Findings

The margin of error of the per-home impact estimate is ± 45.7 kWh at the 90% confidence interval. Nexant clustered the variation of the LFER model by Account ID to produce a robust estimate of the standard error associated with treatment coefficients. The standard normal z-statistic for the 90% confidence level of 1.645 was then used to estimate the uncertainty associated with each cohort estimate. This uncertainty was then aggregated across cohorts to quantify the precision of the program-level impacts estimates (Table 3-12).

Table 3-12: 90% Confidence Intervals Associated with MyHER Impact Estimates

Parameter	Lower Bound (90%)	Point Estimate	Upper Bound (90%)
Evaluation Period Savings per Home (kWh)	163.7	209.4	255.1
Percent Reduction	1.35%	1.67%	1.99%
Aggregate Impact (GWh)	50.2	64.2	78.2

The absolute precision of the result is ± 0.32% and the relative precision of ± 21.8% at the 90% confidence level.

3.2.4 Impact Estimates by Cohort

The per-home impact estimates shown in Table 3-9 reflect a weighted average impact across the eight cohorts of MyHER customers analyzed. The impact estimates for the individual cohorts varied across the study period. Table 3-13 shows point estimates for each cohort for the period January to December 2017.

Table 3-13: Annual kWh Impact Estimates by Cohort

Month	Monthly Average Impact							
	Orig Pilot Feb. 2010	Large Group Nov. 2011	2014 Budget Bill	2012 Assignments	2013 and Non-budget 2014	Dec. 2015	Jun. 2015	Released 2015
2017-1	-21.85	-26.16	-25.96	-22.43	-53.56	-10.00	-26.41	-15.89
2017-2	-8.87	-25.71	-23.42	-16.04	-42.55	-9.82	-13.48	-14.62
2017-3	-7.56	-25.21	-18.81	-21.80	-34.61	-9.61	-14.99	-11.54
2017-4	2.00	-16.97	-8.14	-23.23	-16.64	-2.30	-12.53	-7.51
2017-5	-2.21	-15.84	-5.96	-11.16	-14.67	-4.73	-9.67	-12.53
2017-6	-5.57	-13.71	-9.59	1.46	-7.84	-8.07	-5.05	-15.70
2017-7	-13.25	-13.53	-9.98	11.04	-4.85	-15.91	-4.90	-18.55
2017-8	-7.77	-15.81	-5.57	-3.27	-9.50	-18.50	-0.69	-14.65
2017-9	-5.50	-14.78	-4.83	-20.66	-8.59	-9.77	0.23	-9.57
2017-10	1.97	-13.80	-10.89	-22.11	-10.80	-7.65	-7.87	-10.59
2017-11	-12.38	-20.78	-17.53	-31.33	-30.80	-7.46	-13.06	-21.32
2017-12	-36.54	-23.39	-21.27	-25.97	-47.83	-7.95	-18.98	-29.05
2017 Total	**-117.52**	**-225.67**	**-161.94**	**-185.51**	**-282.24**	**-111.77**	**-127.40**	**-181.51**

Cohorts 5 (2013 and 2014 Non-budget) shows the largest average impact during the study period, which is consistent with the previous evaluation. Table 3-14 shows the margin of error at the 90% confidence level for each cohort's annual impact estimate. The combined margin of error for the entire program is lower than the error for any single cohort because the combined program impact estimate is based on a larger pool of customers. Individual cohort margins of error are high for the small cohorts due to the sizes of these groups relative to the underlying variation in consumption among the treatment and control groups constituting each cohort.

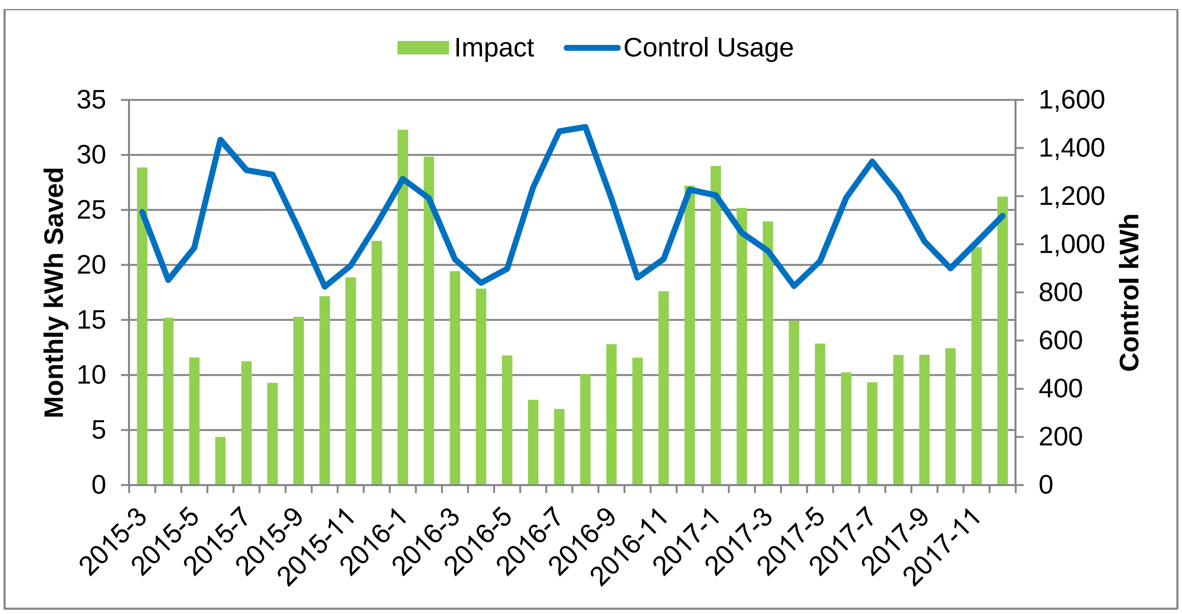
Table 3-14: 90% Confidence Intervals Associated with Cohort Savings Estimates

Cohort	Margin of Error in kWh at 90% Confidence Level		Lower Bound (kWh)	Point Estimate (kWh)	Upper Bound (kWh)
Original pilot Feb 2010	±	141	-259	-118	23
Large group Nov 2011	±	71	-297	-226	-154
2014 Budget Bill	±	86	-248	-162	-76
2012 Assignments	±	143	-329	-186	-42
2013 and Non-Budget 2014	±	149	-432	-282	-133
Dec 2015	±	73	-185	-112	-39
Jun 2016	±	81	-208	-127	-46
Released 2015	±	73	-255	-182	-108

3.2.5 Seasonal Trends

There is a clear seasonal pattern to the MyHER savings profile, with the largest impacts occurring during winter months and the smallest impacts occurring during summer months. The green series in Figure 3-4 shows the average estimated monthly treatment effect for the program in each bill month from March 2015 to December 2017. The blue series in Figure 3-4 shows the average control customer's load during the same period of time. Even though annual electricity consumption for DEO customers is clearly bimodal (with peaks in both the summer and winter), MyHER impacts are not: MyHER impacts peak in the winter and are at their lowest in the summer.

Figure 3-4: Average kWh Savings by Month



Based on the observed savings trends, MyHER is realizing the greatest impacts in the winter and shoulder months, with the lowest impacts in the summer months. Seasonal trends in MyHER average treatment effects likely reflect customers' differing abilities to respond by season. For example, customers' summer savings are lower than in winter, which is due to the fact the winter offers more opportunities to conserve energy relative to baseline demands for energy in each season. Winter demands can be mitigated by dressing more warmly, using more blankets in the home, or shutting off lights more often (due to fewer daylight hours in the winter). The summer impacts still occur but the conservation options available to customers are fewer.

3.2.6 Uplift in Other Duke Energy Programs

Section 3.1.6 outlined the methodology Nexant used to calculate the annual kWh savings attributable to increased participation in other DEO programs, a downward adjustment of 10.2 kWh per home, or 3.1 GWh in aggregate, for the 12-month period January 2017 to December 2017 as shown in Table 3-15.

Table 3-15: Monthly Adjustment for Overlapping Participation in Other EE Programs

Month	Incremental kWh from Other EE Programs
2017-1	0.67
2017-2	0.75
2017-3	0.85
2017-4	0.89
2017-5	0.90
2017-6	0.87
2017-7	0.91
2017-8	0.84
2017-9	0.87
2017-10	0.82
2017-11	0.89
2017-12	0.95
2017 Total	**10.2**

Although these additional savings must be subtracted from the MyHER effect to prevent double-counting, the MyHERs clearly played an important role in harvesting these savings.

Table 3-16 shows the average daily energy savings attributable to tracked energy efficiency measures as of December 2017 by cohort and calculates an uplift percentage. In nearly case the treatment group showed a higher propensity to adopt measures through Duke Energy programs than the control group. The exception is the newest cohort, cohort 8 (June 2016).

Nexant only counted savings for measures installed in the post-treatment period so the cohorts that have been assigned to MyHER for the longest period of time have accumulated the most savings.

Table 3-16: Uplift Percentage by Cohort

Cohort	Monthly Net kWh Savings from EE (Treatment Group)	Monthly Net kWh Savings from EE (Control Group)	Uplift Percentage
Original pilot Feb 2010	14.1	14.0	0.52%
Large group Nov 2011	13.8	13.1	5.75%
2014 Budget Bill	15.1	13.6	10.80%
2012 Assignments	13.6	12.6	7.84%
2013 and Non-Budget 2014	15.2	14.6	4.23%
Dec 2015	5.0	4.4	14.70%
Jun 2016	4.1	4.3	-4.77%
Released 2015	5.1	5.0	1.15%

3.2.7 Duration of Exposure

Home energy report evaluations in North America consistently find a trend of increasing savings with length of treatment. Since the prior evaluation, Nexant has estimated impacts for three new cohorts who make up 12% of the treatment population at the end of 2017. Figure 3-5 compares the overall results with the results of the average customer in the three newest cohorts, beginning in July 2016, once all three were introduced to the program. The older cohorts consistently realize higher impacts than their newer counterparts.

Figure 3-5: Comparison of Average Customer Savings to the Savings of the Newest Program Participants

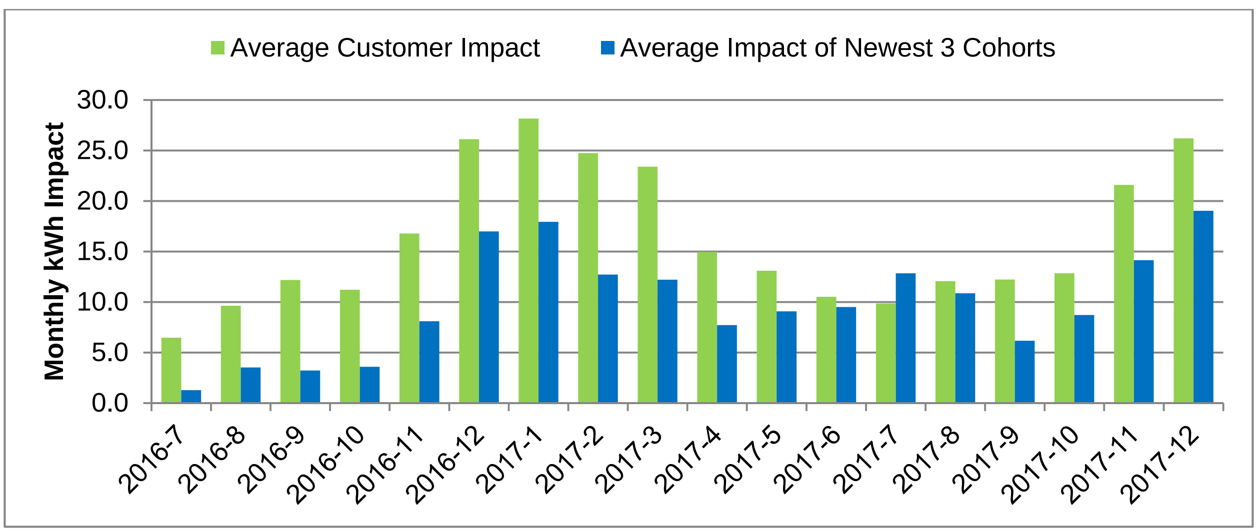
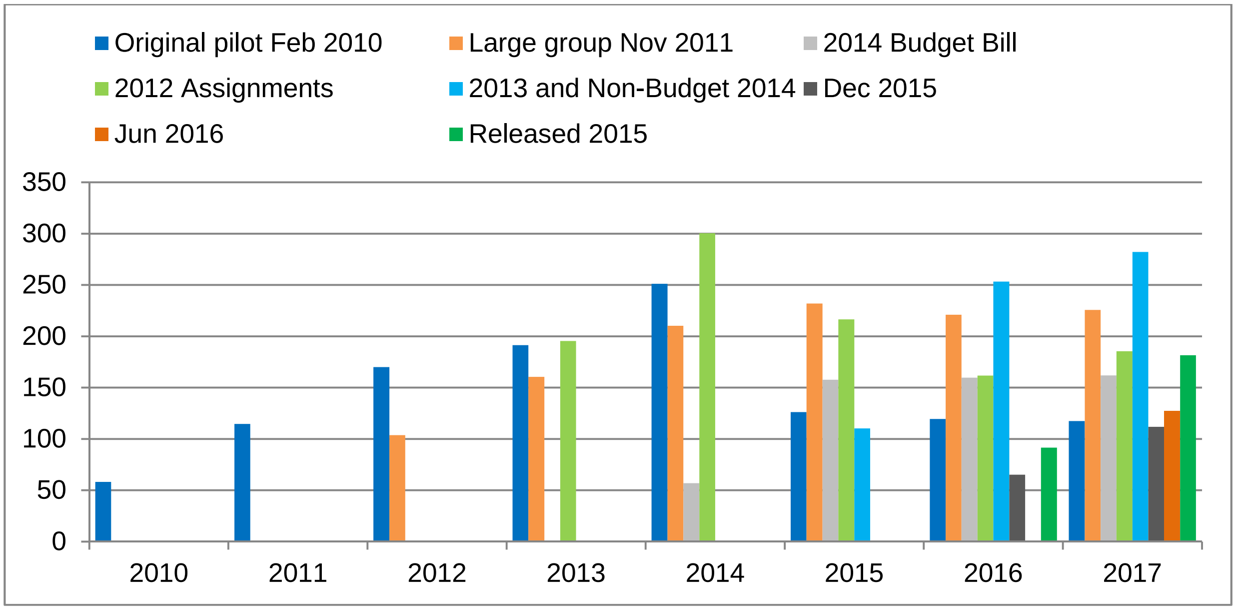


Figure 3-6 displays the annual savings by the number of years a cohort has been in the program. A general upward trend of savings occurs with longer exposure to treatment, however some exceptions are visible. The oldest cohort that has been in treatment since 2010 has shown a reduction in impacts after year 5 of treatment. It should be noted that there are few program implementations of home energy report programs with durations in excess of five years and there less information about what should be expected from implementations of that vintage. Additionally, with less than 8,000 treatment customers in this cohort, it is now the smallest DEO cohort. It is reasonable to expect the newer cohorts' impacts to increase with maturation of the cohorts, however the 2010 cohort's performance may be indicative of the existence of a point peak maturation after which mature impacts cannot be sustained.

Figure 3-6: Annual Savings by Duration of Exposure



3.3 MyHER Interactive Portal

Nexant also evaluated the incremental energy savings generated by Duke Energy's enhancement to the standard MyHER report. Duke Energy launched the MyHER Interactive Portal in March 2015. The portal offers additional means for customers to customize or update Duke Energy's data on their premises, demographics, and other characteristics that affect consumption and MyHER's classification of each customer.

The portal provides additional custom tips based on updated data provided by the customer. MyHER Interactive also sends weekly email challenges that seek to engage customers in active energy management, additional efficiency upgrades, and conservation behaviors. Nexant evaluated the impacts of the MyHER Interactive Portal using a matched comparison group because MyHER Interactive was not deployed as a randomized controlled trial (RCT).

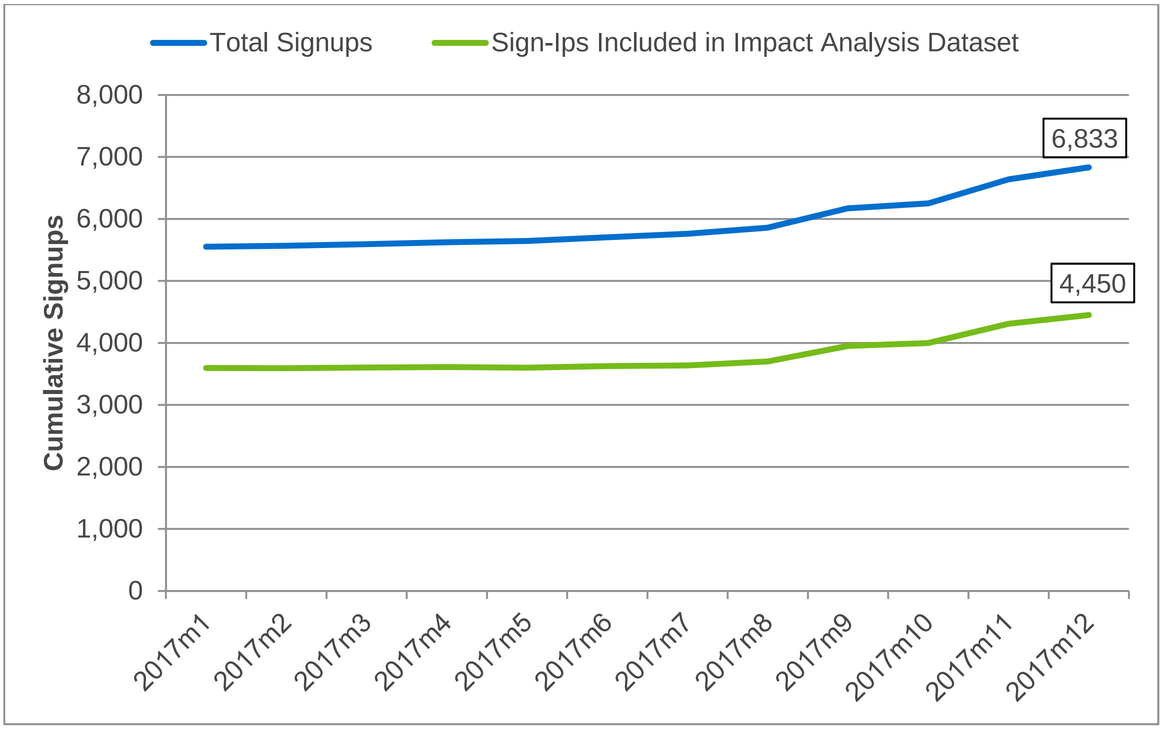
3.3.1 Estimation Procedures for MyHER Interactive

A matched comparison group is a standard approach for establishing a counterfactual baseline when there is no random assignment to treatment and control. The goal of matching estimators is to estimate impacts by matching treatment customers to similar customers that did not participate in the program. The key assumption to matched comparison approaches is that MyHER Interactive participants closely resemble non-participants, except for the fact that one of these two groups participated in the program while the other did not. When a strong comparison group is established, evaluators can reliably conclude that any differences observed after enrollment are due to program's stimulus. In using a matched comparison group to estimate energy savings due to exposure to MyHER Interactive, the same statistical modeling approach is used to estimate energy savings impacts as was used for estimating energy savings for the program overall (i.e., with linear fixed effects regression (LFER) estimation).

Duke Energy provided Nexant with MyHER participant enrollment information for the Interactive portal. A total of 6,833 MyHER treatment customers signed up to use the portal. Most enrollments occurred in late 2015 and mid-2016. Of the 6,833 Interactive users, 2,612 signed into the portal more than once, and 1,361 signed in more than twice between March 2015 and December 2017.

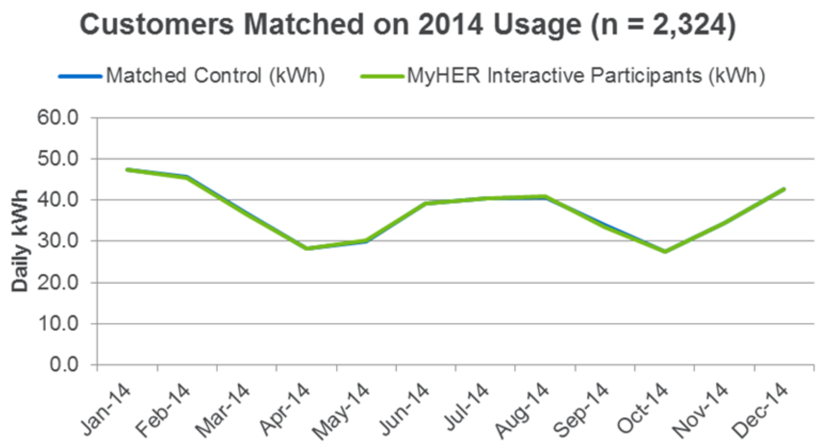
In order for the LFER regression model to generate monthly energy savings attributable to Interactive, the customer data that the regression model uses to make the estimates must use a year of exposure to MyHER reports prior to enrolling in Interactive. Around two-thirds, 4,450, of the Interactive users had sufficient data available for the LFER analysis before their Interactive enrollment. Figure 3-7 plots the number of customers signing up for MyHER Interactive in each month of the 12-month period January through December 2017 for both the entire group of 6,833 users and the 4,450 users that were used in the analysis.

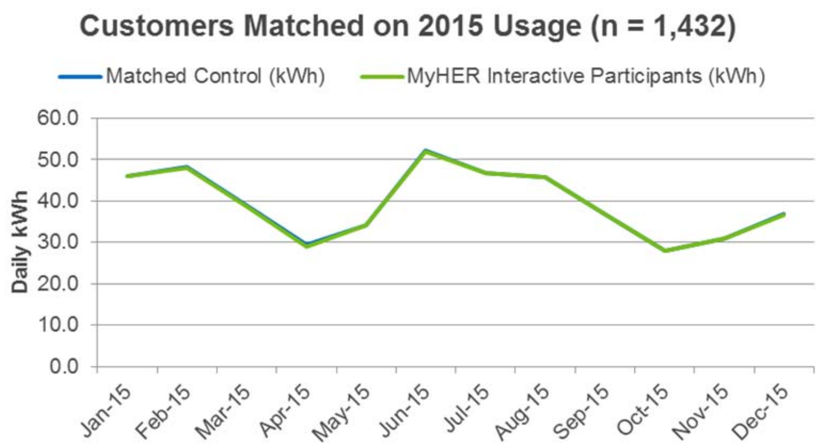
Figure 3-7: MyHER Interactive Portal Enrollment

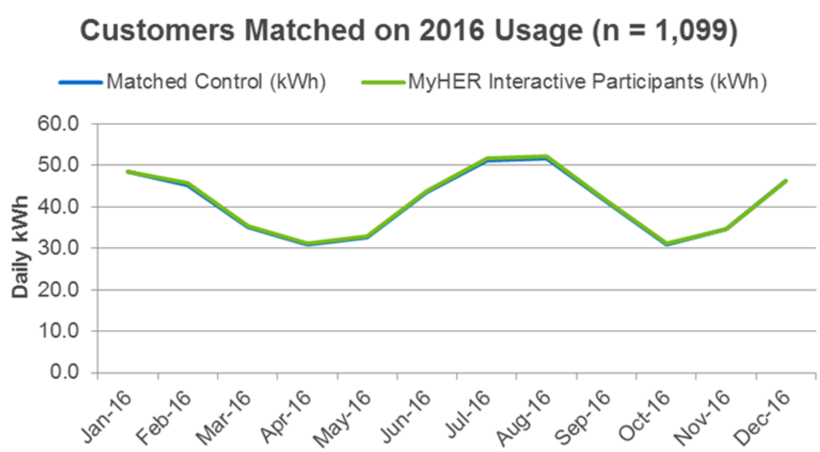


Many of the Interactive customers used in the estimation analysis were matched on their 2014 billing usage, but some customers who enrolled in Interactive at later points in time were matched on their 2015 or 2016 usage. Figure 3-8 presents the pre-treatment consumption for MyHER Interactive customers and a matched comparison group comprised of MyHER customers that have not enrolled in Interactive. The matching approach generates two groups with nearly identical consumption patterns over the time period prior to customers' enrollment in MyHER Interactive. On average, the difference in monthly usage between the matched control group and the Interactive treatment group is -0.2% for the 2014 match, -0.3% for the 2015 match, and 0.6% for the 2016 match. The fixed effects model specification Nexant applies controls for these pre-treatment differences, as discussed earlier in Section 3.1.5.

Figure 3-8: MyHER Interactive Portal Customers and Matched Comparison Group – 2014, 2015 and 2016 Pre-Interactive Enrollment Periods







3.3.2 Results and Precision

The average monthly impact across the 12-month period January 2017 to December 2017 was 17.3 kWh, representing the uplift in savings that MyHER Interactive produces over and above the savings produced by the paper MyHER, but this estimate is not statistically significant at the 90% level of confidence. On a month-to-month basis, energy impacts were statistically significant during the months of July, August, October, November, and December and range from 1.5% to 2.7%, or from 17 to 34 kWh on an absolute basis.

Figure 3-9 illustrates average monthly energy usage for the MyHER Interactive users (the blue line) and the same for the matched control group (the green line), along with the estimated impact and 90% confidence band (the orange lines and orange dashed lines) by month. Also shown as blue bars are counts of Interactive sign-ups.

Table 3-17 provides impact model results, along with the margin of error for estimated impacts. The column at the right side of the table shows asterisks for those months where the energy savings are statistically significant at the 90% level of confidence.

Figure 3-9: MyHER Interactive Portal Energy Impacts

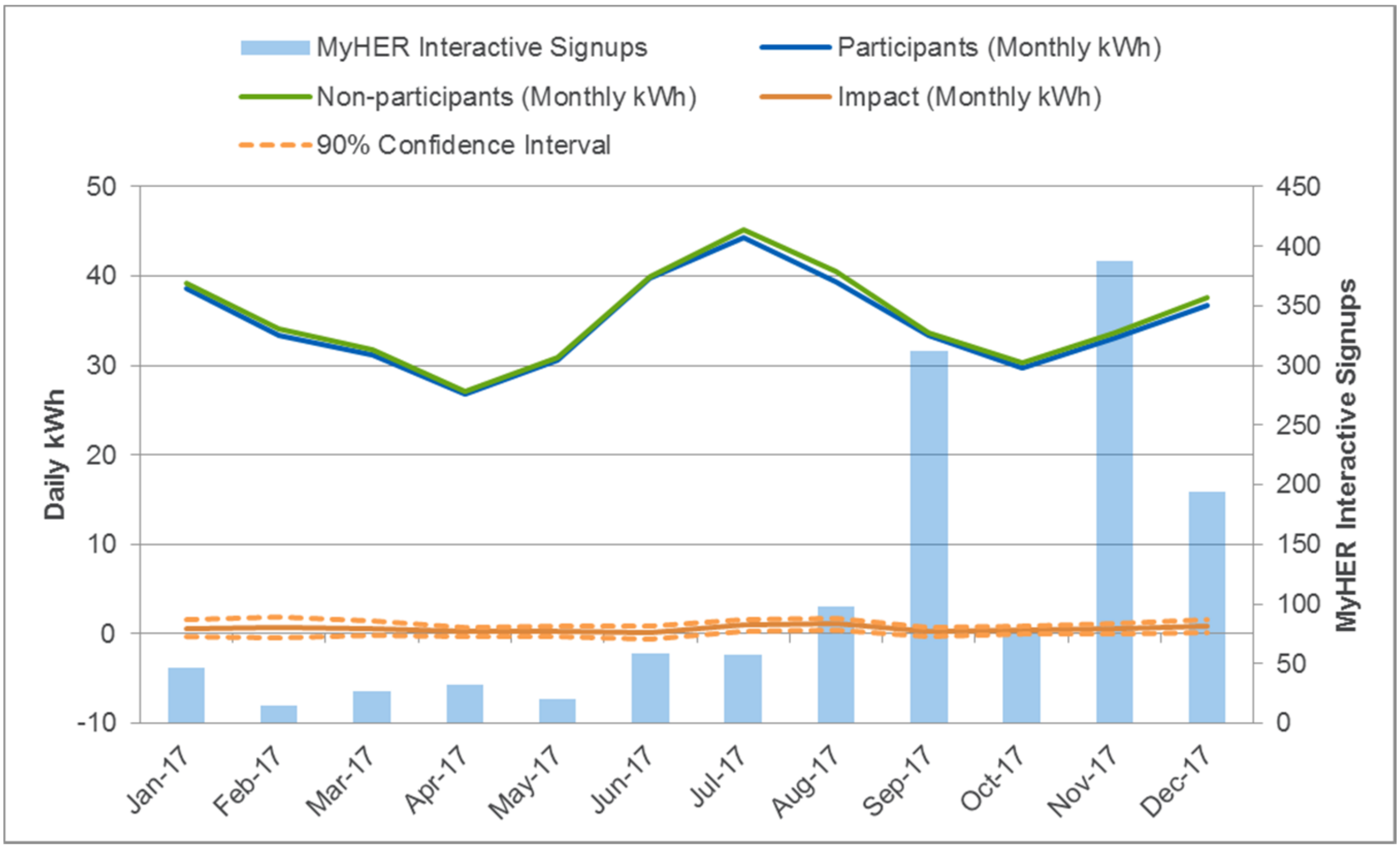


Table 3-17: MyHER Interactive Monthly Energy Savings

Month	Number of Participants	MyHER Interactive Sign-Ups	Non-participants (Monthly kWh)	Participants (Monthly kWh)	Impact (Monthly kWh)	90% Conf. Interval (Monthly kWh)		% Impact	
Jan-17	3,597	47	1,216	1,198	18	-11	48	1.5%	
Feb-17	3,594	15	957	936	20	-14	54	1.4%	
Mar-17	3,603	27	984	965	18	-7	43	2.7%	
Apr-17	3,611	32	813	805	8	-7	24	1.7%	
May-17	3,602	20	959	950	9	-9	26	1.5%	
Jun-17	3,628	59	1,197	1,193	4	-17	25	0.4%	
Jul-17	3,636	57	1,402	1,373	29	9	49	2.3%	*
Aug-17	3,701	98	1,256	1,222	34	15	53	2.5%	*
Sep-17	3,953	312	1,011	1,003	8	-8	23	0.8%	
Oct-17	3,998	79	938	923	14	0	28	1.6%	*
Nov-17	4,308	388	1,012	994	17	1	33	1.5%	*
Dec-17	4,450	194	1,167	1,141	27	4	50	2.7%	*
Average	**3,807**	**111**	**1,076**	**1,059**	**17**	**-268**	**303**	**1.6%**	

Nexant concludes that the MyHER Interactive portal succeeded in generating additional savings in 2017 during some of the summer and winter months.

3.4 Impact Conclusions and Recommendations

Nexant's impact evaluation shows that Duke Energy's MyHER program continues to trigger a reduction in electric consumption among homes exposed to the program messaging. MyHER programs demonstrate an apparent maturation effect, typically on the order of 1-2 years. If Duke Energy continues to consistently introduce new cohorts to the program, program management should generally expect the newest cohorts to underperform relative to the established cohorts. Currently, 12% of the program's participants should be considered as not fully mature.

Additionally, the findings from this evaluation suggest that savings of fully mature cohorts may eventually degrade over time – the oldest DEO cohorts delivered among the lowest impacts of the cohorts as estimated in this evaluation in its 7th year of activity.

Overall, the DEO program achieved 209.4 kWh in treatment homes in 2017, below the claimed value of 256 kWh per home, representing a realization rate of 82%. Due to MyHER Interactive's impact estimate not being statistically significant at the 90% level of confidence, Duke Energy will claim deemed impacts of 256 kWh per home to mirror base MyHER impacts.

Although MyHER is achieving its primary target of delivering cost-effective savings to the company, and its secondary goal of promoting other DEO initiatives, Nexant provides the following conclusions and recommendations for consideration:

- **Continue the practice, adopted in September 2015, of simultaneous control and treatment assignment.** Assignment of new accounts to the MyHER treatment and control group should be limited to once or twice per year.
- **Continue to monitor engagement and evaluate the impacts of the Interactive Portal.** The MyHER Interactive Portal appears to generate incremental savings above and beyond the standard MyHER paper edition during the summer months (which is the period of lowest energy savings for MyHER overall) and immediately following surges in portal usage. If Duke Energy continues to maintain the Interactive portal as a supplement to paper or electronic MyHER reports, then incremental savings may continue to be generated by this level of customer interaction and engagement. However, to date, annual energy savings over and above MyHER energy savings have not been found to be statistically significant.

4 Process Evaluation

This section presents the results of process evaluation activities including in-depth interviews with Duke Energy and implementation staff and a survey of control and treatment households.

4.1 Methods

Process evaluations support continuous program improvement by identifying opportunities to improve the effectiveness and efficiency of program operations and services. Process evaluations also identify successful program components that should be enhanced or replicated. Process evaluation activities for MyHER sought to document program operational processes and to understand the experience of those receiving MyHER mailings. The customer survey focused on investigating the recall and influence of MyHER messages among recipients, the extent to which MyHER affects customer engagement and satisfaction with Duke Energy, and subsequent actions taken by participants to reduce household energy consumption. A survey of control group households provided a point of comparison for estimating the effect of MyHER on behavior and attitudes of treatment households.

4.1.1 Data Collection and Sampling Plan

The process evaluation included two primary data collection activities: in-depth interviews with program management and implementation staff, and surveys with a sample of households selected to receive MyHER reports as well as a sample of control group households.

Nexant deployed the household surveys using a mixed-mode survey measurement protocol, the activities associated with which are summarized in Table 4-1. In this protocol, customers were contacted by letter on Duke Energy stationery (to assure recipients of the validity of the survey) asking them to go online and complete the survey. The letter contained a two-dollar bill as a cost-effective measure to maximize the survey completion rates. The letter also included a personalized URL for the online survey that points the recipient to a unique location on the internet at which they were able to complete the survey. Customers for whom email addresses were available also received an email inviting them to take the survey online, which also included the same personalized URL that appeared in the letter leading to the survey website at the location where they could complete it. After three weeks, customers who did not respond to the web survey received another letter, this time containing a paper copy of the survey and a return postage-paid envelope asking them to complete the survey by mail. Survey recipients also had the option of calling Nexant at a toll-free telephone number to complete the survey by telephone.

Table 4-1: Summary of Process Evaluation Activities

Population	Approach	Population	Sample		Confidence/Precision	
			Expected	Actual	Expected	Actual
Program management and implementation	In-depth interviews	~10	2-5	3	Not Applicable	Not Applicable
Treatment group households	Mixed-mode; mail, web, and phone	~323,000	189	223	90/06	90/06
Control group households	Mixed-mode; mail, web, and phone	~100,000	189	249	90/06	90/06

4.1.1.1 Interviews

Nexant conducted interviews with key contacts at Duke Energy and at Tendril. The interviews built upon information obtained during 2015 evaluations of the Duke Energy Indiana and Ohio MyHER programs, in addition to more recent evaluations of the Duke Energy MyHER program in other jurisdictions. The interviews were designed to allow the evaluation team to understand any developments or enhancements in program delivery in 2017. A central objective of the interviews was to understand program operations and the main activities required to develop and distribute the MyHER reports to DEO customers.

4.1.1.2 Household Surveys

Both treatment and control groups were surveyed. For the treatment households, the survey included questions about the experience of the reports themselves as well as questions to assess engagement and understanding of household energy use; awareness of Duke Energy efficiency program offers; and satisfaction with the services Duke Energy provides to help households manage their energy use. The control group survey excluded questions about the information and utility of the MyHER reports, but included identical questions on the other aspects to facilitate comparison with the treatment group.

Nexant analyzed the survey results to identify differences between treatment and control group households on the following:

- Reported levels of stated intention for future action;
- Levels of awareness of and interest in household energy use;
- The level of behavioral action or equipment-based upgrades;
- Satisfaction with Duke Energy service and efficiency options; and
- Inclination to seek information on managing household energy use from Duke Energy.

This survey approach is consistent with the RCT design of the program and supports both the impact and process evaluation activities by providing additional insight into potential program effects.

Survey Disposition

We mailed 555 letters to randomly selected residential customers in both the treatment and control groups, respectively. The survey was completed by 223 treatment households and 249 control households, representing a treatment group response rate of 40% and a control group response rate of 45%. More than half, 64% of the treatment group and 61% of the control group, of the surveys were completed online. Table 4-2 outlines the treatment and control group survey dispositions.

Table 4-2: Survey Disposition

Mode	Treatment		Control	
	Count	Percent	Count	Percent
Completes by Mode				
Web-based Survey	142	64%	152	61%
Mail/Paper Survey	81	36%	97	39%
Inbound Phone Survey	0	0%	0	0%
Total Completes	**223**	**100%**	**249**	**100%**

4.2 Findings

This section presents the findings from in-depth interviews with staff and implementation contractors and the results of the customer surveys.

4.2.1 Program Processes and Operations

As in other Duke Energy jurisdictions, MyHER at DEO is managed primarily through a core team of three Duke Energy staff members: a Manager of Behavioral Programs with oversight of residential behavioral programs, a Program Manager in charge of the day-to-day operations of the MyHER program, and a Data Analyst responsible for the substantial data tracking and cleaning tasks and program reporting that occur at Duke Energy to support the contracted implementation team.

At Tendril, Duke Energy's contracted program implementer, MyHER is supported by a team of people including an Operations Manager, a Home Energy Report Product Manager, an Engineering Manager, a dedicated Operations Engineer, a Quality Control Engineer, an "Ask-the-Expert" technical writer, and an Account Manager responsible for ensuring that the Duke Energy MyHER products meet expectations for quality, timing, and customer satisfaction. Tendril staff track the number of reports sent, the quality of the reports, and the timing of when reports are mailed. Tendril's key performance indicators (KPIs) include in-home dates for each batch as well as the percentage of treatment customers treated.

As MyHER is Duke Energy's flagship behavioral energy efficiency program, its primary goals are to achieve energy savings, increase customer satisfaction, and cross-promote enrollment into Duke Energy energy efficiency and demand response programs. Staff at both organizations described continuous, close coordination to ensure that the data behind the MyHER comparisons are accurate, the tips provided to specific households are appropriate, and that

MyHERs are delivered within the relatively short timeframe between bills.

Program operations are conducted with a customer-focused orientation where the commitment to producing a high-quality product is a demanding process that must be executed consistently each month of the year.

4.2.1.1 MyHER Production

During the period of time under study by this evaluation, MyHERs were mailed out to DEO customers on paper through the U.S. Mail service about eight times a year, where the mailing gaps generally occurred in January, April, September, and December. During the eight U.S. Mail treatment months, the reports are generated twice per week, a cadence that is designed to facilitate meeting a key performance indicator: that MyHER arrive at the customers' homes near the mid-point of their billing cycle so as to make the information presentment as useful and timely as possible. Additionally, any customer that has provided Duke Energy with their email address also receives their report by email, and in fact, MyHER reports are generated and emailed to those customers monthly, 12 times a year, while they continue to receive paper reports 8 times a year.[10]

The production process for any given treatment month begins as soon as meter reads for the first billing cycle are processed by Duke Energy's meter data management system. After processing, billing data is uploaded each afternoon, five times a week, to Tendril. Once the data has been received, production proceeds according to the following process: Tendril runs report production and conducts quality control checks. Then a flat file containing all the data from the reports in addition to drafts of every report (in PDF format) are sent to Duke Energy for an independent quality control check. Upon approval, Tendril then sends the PDFs to the printhouse, and the printhouse generates a final proof for Duke Energy approval. Finally, after the proof is approved, the printhouse prints and mails all the reports, and commences the process of reporting the printing and mailing to Duke Energy.

This production chain moves quickly: once Tendril generates a batch of reports, the time elapsed until transfer to the printhouse is generally 2-3 business days when all processes are completed according to plan. If any quality control problems emerge, that elapsed time can double, which, has at times (however, not in the past 12 months) resulted in the batch's cancellation and merge with the next batch. Considering that the printhouse has one week to

[10] Duke Energy will cease delivery of paper MyHER reports, and only send email reports, if the customer requests them to do so.

complete the mailing, and Standard Rate postage can take another week to deliver, making the mid-cycle in-home delivery goal takes dedicated effort to achieve.

Prior MyHER process evaluations in other Duke Energy jurisdictions where MyHER is also implemented found that this fast-moving process has seen improvements over time through the adoption of various changes: by moving from once-a-week mailings to twice-a-week and increasing the speed with which the data transfer process from Duke Energy to Tendril can be completed each business day. The program also shifted the responsibility for determining which treatment customers are (still) eligible to receive a MyHER each month from Tendril to Duke Energy. Those changes continue to deliver improvements in the number of problems found during report batch quality control checks. Additionally, Tendril has implemented a number of backoffice process enhancements in the past year, such as migrating their computational platform to Amazon Web Services (AWS), providing a pre-promotion (i.e., draft) platform to enable Duke Energy staff to review draft PDF reports prior to promoting or finalizing them, and converting their email HER reports to Hypertext Markup Language (HTML) format which provides greater responsiveness and flexibility to Tendril operational staff.

4.2.1.2 Quality Control

Embedded in the early days of this production cycle is a quality control process that is undertaken to ensure that the reports contain accurate information and are of high quality production. Duke Energy analyzes a dataset containing all of the information presented in the reports for each production cycle. This data is checked for essentially anything that could be erroneous, ranging from verifying that all the customers receiving reports are eligible to receive them, that no control customers are getting reports, that the reported electricity usage is correct, that no customers who have opted-out are getting reports, and that no one has gotten more than one report a month. Duke Energy also checks for unexpected cluster assignment changes, presentment of messaging and tips and overall print quality.

In the past, these checks have proven to be crucial as they occasionally revealed significant production problems, which were subsequently reviewed in Tendril's governance sessions with Duke Energy. This visibility typically resulted in issue resolution on a going-forward basis, however, sometimes the same issues have been reported to re-emerge a year or two later.

Both Duke Energy and Tendril staff report that the incidence of significant production problems has been dramatically reduced; issues that surfaced during this evaluation period were small in scope, affecting 10-200 reports, for example, rather than entire batches of reports. Data transfers (in both directions, from Duke Energy to Tendril, and vice versa) have achieved greater predictability in terms of timing of delivery in the past year as well.

These improvements are likely a function of the continuation of Duke Energy and Tendril's collaborative activities for program success. Duke Energy and Tendril staff join for weekly status meetings, monthly operations meetings, and quarterly governance meetings. These meetings provide a venue for shared brainstorming and roadmapping activities and the ongoing maintenance of a product request list for Tendril. Tendril has additionally commissioned an internal HER Improvement Team with the mandate to make consistent progress on the product request list.

Duke Energy and Tendril staff have recognized in prior evaluations of Duke Energy's MyHER program in other jurisdictions, as well as this one, that production problems, when they occur, usually occur following changes to the report or report cycle process. However, our interviewees also recognized that a strength of Tendril lies in their willingness to dive deep into details and processes to solve problems that may only affect a relatively few customers, and to go the extra mile to help address problems that in fact originate on the Duke Energy side. Interviews for this evaluation additionally reveal that the Tendril operations team has stabilized in terms of staffing, and that Tendril has added a quality control engineer to program staff. Tendril has also implemented a "Batch 0" strategy where the first batch of reports following any changes to the report is produced not for distribution, but only for quality control purposes, which is reviewed

prior to the production of any live batches of reports. This procedural innovation allows Tendril to support Duke Energy's interest in fine-tuning any new features or changes to reports and to facilitate early detection of unexpected problems. Generally, both Duke Energy and Tendril staff spoke highly of the collaborative partnership shared by Duke Energy and Tendril in running the MyHER program and of the open lines of communication that exist and function very well at all levels of program and corporate management.

Prior evaluations of MyHER revealed that some program processes could benefit from improved quality control performance. Improved quality control in these areas can reduce the risk associated with running a program with processes that too often fail quality control checks. Such issues present timing risks (reports may not be sent out on time), customer service risk (reports may be sent out with problems if problems someday are missed), and risk to the overall success of the program (if the QC process is overburdened with detecting too many problems, it can become an overly-leveraged component of program operations). Interviews for this evaluation revealed significant improvement in the past year in terms of frequency and significance of issues detected by Duke Energy's quality control processes. This has been attributed to greater staff stability at Tendril as well as a greater attention to risk management with respect to implementing and managing simultaneous program initiatives (i.e., not implementing too many changes or enhancements at the same time).

4.2.1.3 MyHER Components

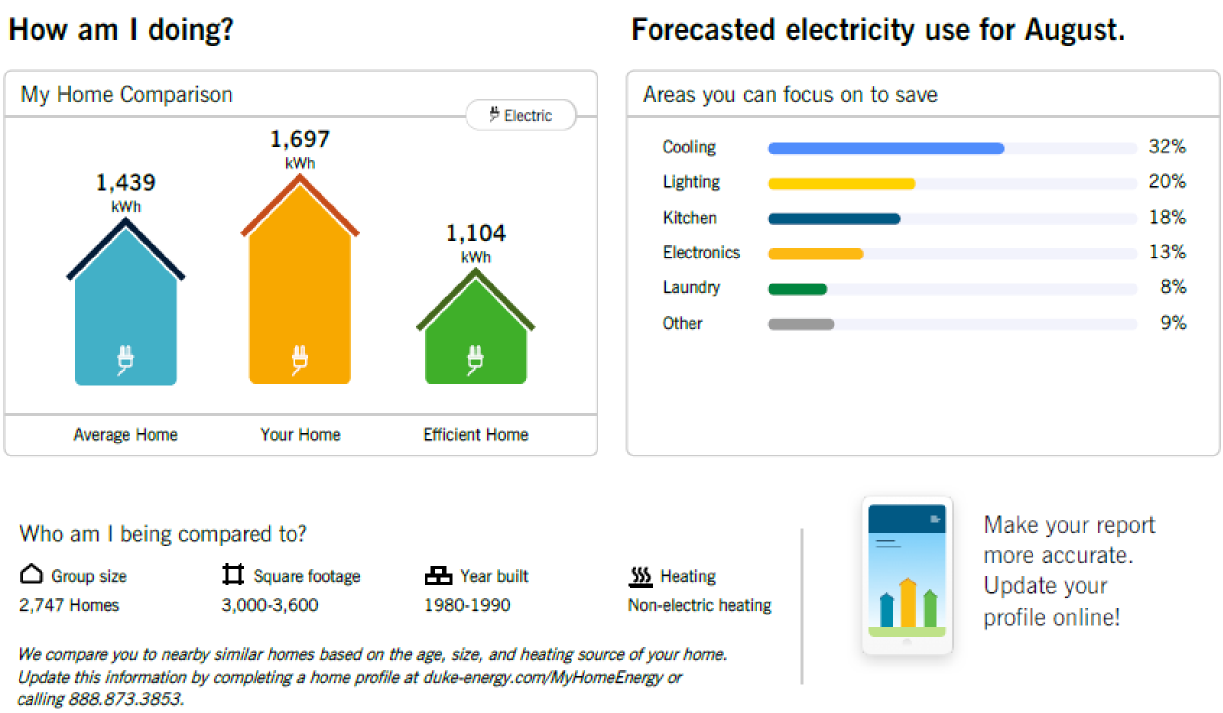
MyHER reports include several key elements that are customized each month: bar charts, tips, a trend chart, and messages. Duke Energy and Tendril implemented a general refresh of the MyHER report template in 2017, designed to improve readability and to keep the presentation fresh in the eyes of recipients. Graphics were updated and images were added to some modules (described below) that were previously text-only. A new module (also described below) was added that presents usage disaggregated by end use type.

The front page includes two bar chart graphics. The first chart is a vertical bar chart (stylized in the shape of homes) comparing the subject home to the average and most efficient homes for an assigned cluster or "neighborhood" of similar homes. Previously, in Duke Energy jurisdictions with the earliest MyHER program implementations, these graphs were labeled with dollars, but this occasionally caused confusion among recipients if the dollar amount didn't exactly match their recall of a recent bill. In March 2013, Duke Energy shifted to using kWh as the unit of measurement for the bar charts; Duke Energy conducted customer focus groups in an effort to understand the level of confusion this shift might cause and found that customers reported not paying attention to unit of measurement: they were simply absorbing the shape and directionality of the bar charts (Figure 4-1).

An infographic beneath the bar charts provides the size of the group of comparison homes, the assumed heating type, the approximate square footage, and the approximate age of the similar homes to which the customer's home is being compared. According to MyHER staff, a common reason for customer phone calls relating to MyHERs is simply the customer's desire to correct assumed information about a given home. For example, the MyHER could indicate that Duke Energy assumes a home has electric heat when it does not, or has assigned a home to the wrong size category. Any corrections provided in this manner are considered highly reliable and are not changed based on subsequent uploads of third party data.

To the right of the vertical bar chart is a horizontal bar chart that illustrates Tendril's forecast for subject home's electricity usage in the next month, disaggregated by end use type. This chart is intended to provide actionable insights to each customer as to where they might direct their energy savings efforts to make the greatest impact in their energy usage in the month ahead.

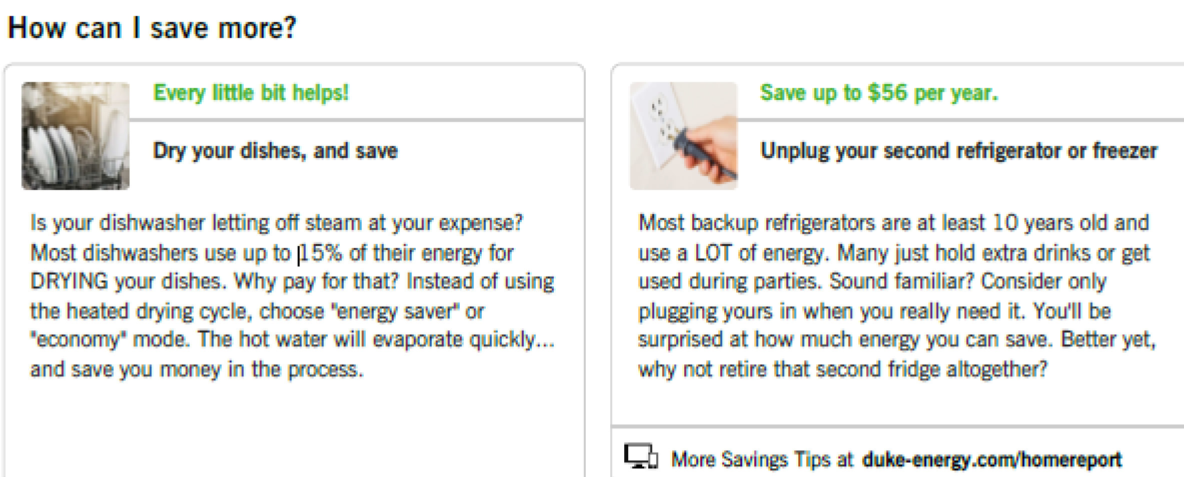
Figure 4-1: MyHER Electricity Usage Comparison and Forecasted Energy Use Bar Charts



In addition to the comparison graph, each MyHER includes a set of customized action tips under the heading “How can I save more?” (Figure 4-2).These tips are designed to provide information relevant to homes with similar characteristics, as presented in the box accompanying the comparison graph. These tips often are presented with monetary values (appropriately scaled to each customer receiving the tip) that estimate the bill savings that the customer might expect to realize by implementing the action tip.

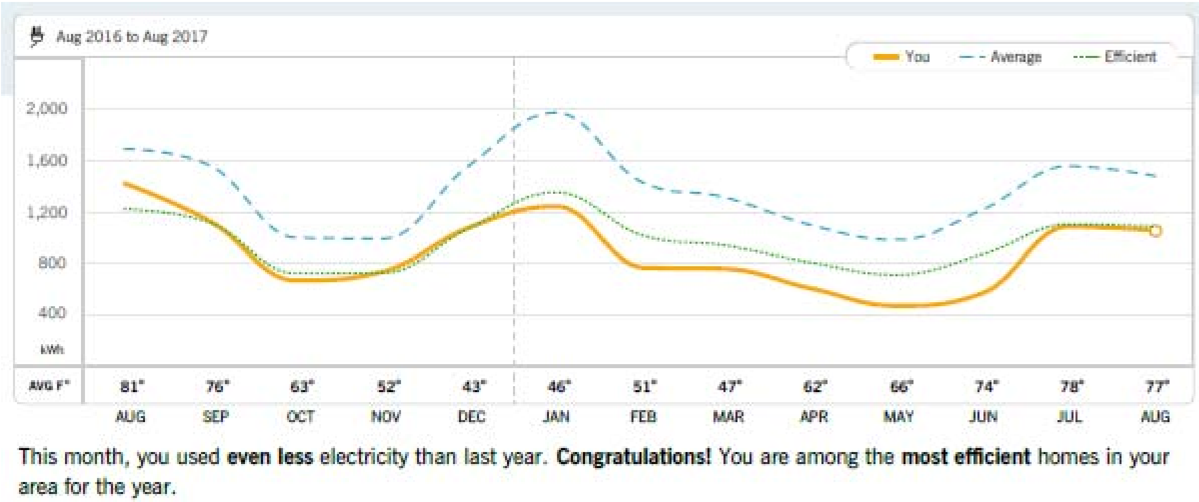
The Duke Energy MyHER program has a large library of action tips, currently numbering between 80 and 90. Half of them were initially developed internally at Duke Energy, and Tendril’s “Ask the Expert” technical writer has continued to add to them over time. The large library has enabled the program to avoid any repeats to customers over lengthy periods of time (up to three years). Tip freshness is also managed with display rules that ensure that a diversity of tip types (both in the value of the tip and the area of the household they apply to) is shown. Duke Energy validates the monetary values estimated by Tendril for each tip action for reasonableness. Duke Energy and Tendril have identified an opportunity for improvement with action tips in developing additional targeting algorithms for tip display. For example, more sophisticated targeting could be developed that cross-references age of home with relevancy for certain actions (e.g., only display a tip to install new windows to customers with older homes).

Figure 4-2: MyHER Tips on Saving Money and Energy



The back page of the MyHER reports contains a trend chart that displays how the recipient’s home compares to the average and efficient home in energy usage over a year (Figure 4-3). This trend chart can help customers identify certain months where their usage increased relative to the efficient or average home—helping them focus on the equipment and activities most likely to affect their usage. For example, if a home tracks the average home until mid-winter and then spikes well above, that could indicate the heating equipment should be checked.

Figure 4-3: MyHER 12 Month Trend Chart



The back page of the MyHER report also includes space for Duke Energy to include seasonal and programmatic messaging, referred to by program staff as free-form text (FFT), that reflects Duke Energy-specific communication objectives. Ensuring that FFT messages are relevant and do not conflict with the actions or tips provided on the front page, requires ongoing coordination and monitoring. Broad targeting efforts taking advantage of seasonal relevance, program eligibility, presence of end uses such as pools, are used to cross-promote Duke Energy programs. Customer participation databases are cross checked each month to ensure that customers only receive information about programs they have not already participated in; if a customer is found to have participated in the program being promoted in a given month, that customer will receive an alternate, typically more generic, message. Occasionally the action text on the front page will be disabled to accommodate FFT messaging.

FFT messages are developed by the MyHER team in cooperation with Duke Energy's marketing and communications group. Duke Energy staff strive to develop messages that are clever, relevant, and upbeat—some recognize events on the calendar (such as Earth Day) while others provide specific program promotional information or promote general home upgrades (even for measures outside of current programs).

Program contacts confirmed that establishing the FFT calendar early in the program year and stabilizing the messages to avoid late changes continues to be challenging, if not impossible. The calendar can be difficult to manage because of periodic changes to Duke Energy program promotions and incentive levels. An interviewee at Tendril noted that while they try to get this text solidified 30 days ahead of the mailing date in the calendar, last minute changes are not uncommon. In addition to developing the messages included in each MyHER, the program team must also ensure that the messages conform to expectations established to protect the customer experience. Due to the inherent flux associated with FFT messaging, this feature of MyHER is relatively resource-intensive given a revision-review-approval process with numerous stakeholders at Duke Energy. As such, this area of MyHER is ripe for process improvement. Duke Energy has requested and prioritized a FFT preview tool from Tendril, that will allow for faster and more accurate rendering of FFT messaging for all Duke Energy stakeholders to review simultaneously. The implementation of such a tool is expected to streamline the FFT process significantly, which as it currently stands, often injects last-minute changes into the production process.

Finally, the back page of the reports also provides contact information for the MyHER program at Duke Energy. Customers occasionally contact Duke Energy with questions or concerns about MyHERs and, rarely, to opt-out. Duke Energy's efforts to maintain a high-quality MyHER customer experience is reflected by the high value that is placed on program participant satisfaction and as such, it is closely monitored. Only 1% of MyHER customers contact Duke Energy annually and less than 1% of MyHER treatment customers contact Duke Energy to opt-out.[11] The rigorous quality control efforts described earlier have kept most quality-related issues from ever reaching customers.

4.2.1.4 MyHER Interactive

MyHER Interactive, the web portal component of the MyHER program, was available to MyHER customers throughout this evaluation period. Interactive provides a variety of online content for MyHER recipients to engage with. Customers can:

- Review MyHER data from the prior month;
- Fill out a home profile for more accurate load disaggregation in the reports;
- View a forecast of disaggregated loads for the upcoming month and year ahead;
- Implement a savings plan, using specific energy-saving actions, and then see how the plan will affect their usage over a 3-month horizon;
- Post questions about saving energy to "Ask an expert" area; and
- Customers who have registered to use MyHER Interactive also receive a weekly "Challenge" via email.

Enrollment in MyHER Interactive is still relatively low. The most successful enrollment generators are email campaigns, sweepstakes, and cross-promotion with the High Bill Alerts program. Envelope messaging has also been used, but is less successful. Email campaigns are a very successful enrollment generator because they can use personalized uniform resource locator PURLs (to enable clicking through to Interactive screen where the customers' account number is auto-populated in the registration process). Two program initiatives in 2017 resulted in Interactive enrollment surges: the introduction of the new report template and the expansion of email report delivery to all customers that have provided Duke Energy with their email address.

Few quality control or process issues pertaining to Interactive were reported in our interviews, however, it should be noted that there is currently no mechanism by which Duke Energy can

[11] For example, 1,730 customers, or 0.43% of the DEO MyHER treatment customer population opted out.

use or check the quality of data presented on Interactive in a systematic or bulk fashion. All checks are made on an individual customer basis.

An opportunity exists to improve the profile questionnaire on MyHER Interactive. Duke Energy reports that a large majority of Interactive users have completed their profiles. With further tuning of the questionnaire, the quality of the new load disaggregation feature of the reports can be improved. An improved questionnaire can also support more accurate and personalized savings advice as part of the Ask-the-Expert program feature.

4.2.1.5 Other MyHER Plans to Further Improve Program Operations

Looking forward, Duke Energy and Tendril are also contemplating other program enhancements that are anticipated to further improve program performance and the customer experience with the program:

- Developing new content specific to shoulder month email MyHERs; and
- Self-comparisons of energy usage (as opposed to “neighborhood” comparisons).

4.2.2 Customer Surveys

The customer surveys included a section of questions focused specifically on the experience of and satisfaction with the information provided in MyHERs, and the awareness of MyHER Interactive—these questions were asked only of households in the treatment group. Both treatment and control households answered the remaining questions, which focused on assessing:

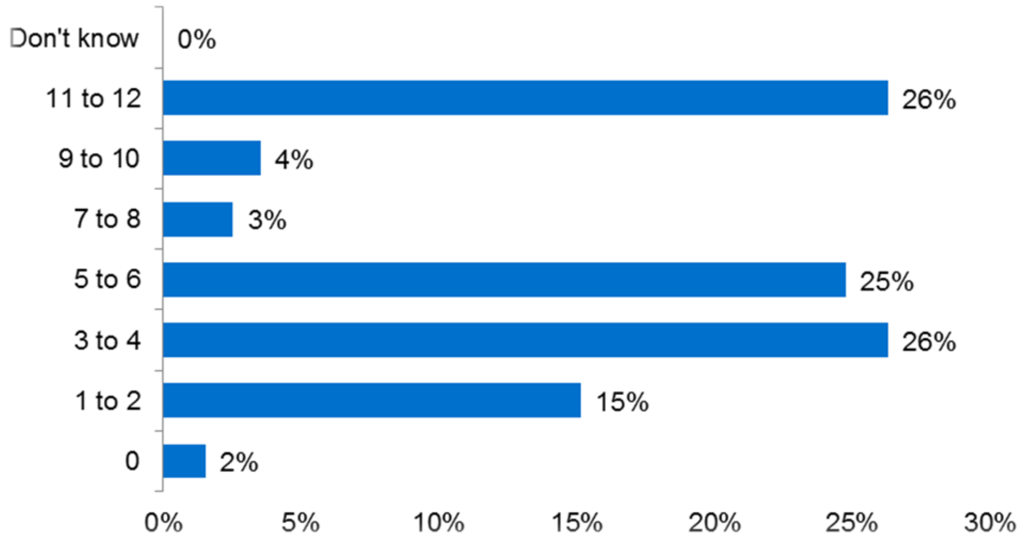
- Awareness of Duke Energy efficiency program offers;
- Satisfaction with the services Duke provides to help households manage their energy use;
- Levels of awareness of and interest in household energy use; motivations and perceived importance; and
- Reported behavioral or equipment-based upgrades.

4.2.2.1 Treatment Households: Experience and Satisfaction with MyHER

A large majority of treatment household respondents, 94%, (200 of 213) recalled receiving at least one of the MyHER reports.

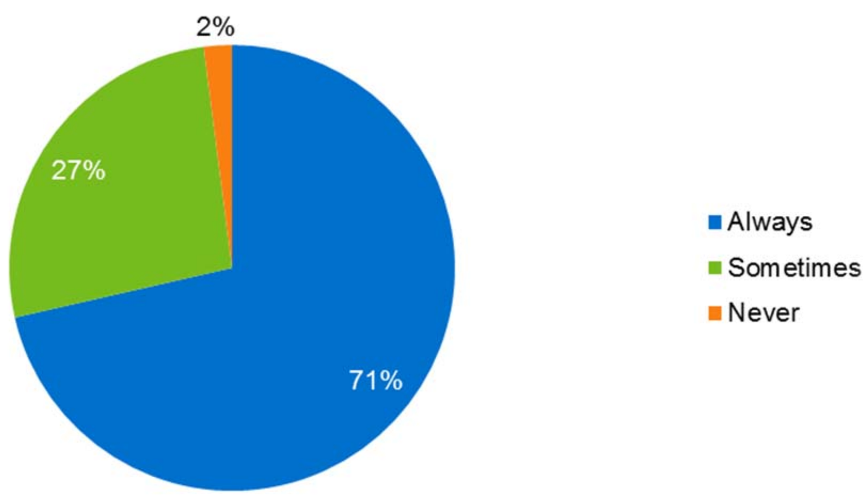
The survey asked those that could recall receiving at least one MyHER report if they could recall how many individual reports they had received “in the past 12 months” (Figure 4-4). The survey launched in May 2018, which means that most recipients would have received 8 MyHERs in the year since June 2017. Twenty-six percent (52 of 198) responded that they received 11 to 12 home energy reports in the past 12 months. The scattered distribution of responses related to recall is consistent with the difficulty of recalling an exact number of reports, however the question is valuable for grounding respondents in the experience of receiving a MyHER before asking them more specific questions about the document.

Figure 4-4: Reported Number of MyHERs Received "In the past 12 months" (n=198)



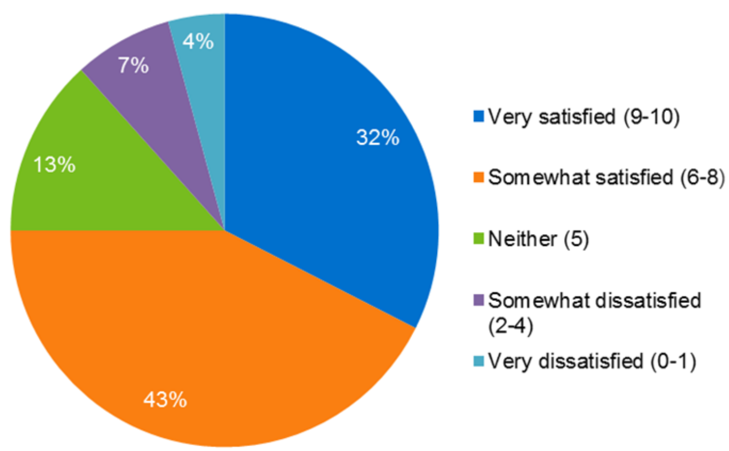
Survey respondents indicated high interest in the MyHER reports. As shown in Figure 4-5, when asked how often they read the reports, 98% of respondents indicated they "always" or "sometimes" read the reports. Four respondents (2%) indicated they do not read the reports.

Figure 4-5: How Often Customers Report Reading the MyHER (n=196)



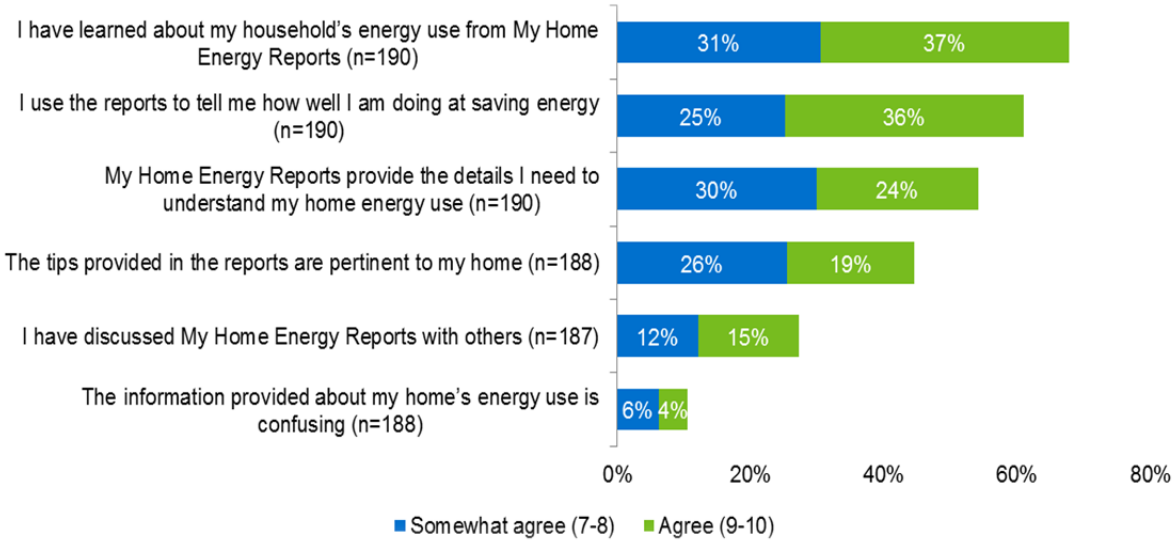
Seventy-five percent (141 of the 188 respondents that provided a rating) reported being “somewhat” or “very” satisfied with the information contained in the reports (Figure 4-6). The survey asked a further question to the respondents of why they said so: one hundred and four of the satisfied respondents provided reasons. Among customers who gave the highest satisfaction ratings, the most common comments on the MyHERs described the reports’ ability to engage the customer and provide greater awareness. The customers who reported being somewhat satisfied most often simply described the reports as “helpful.”

Figure 4-6: Satisfaction with the Information in MyHER Reports (n=188)



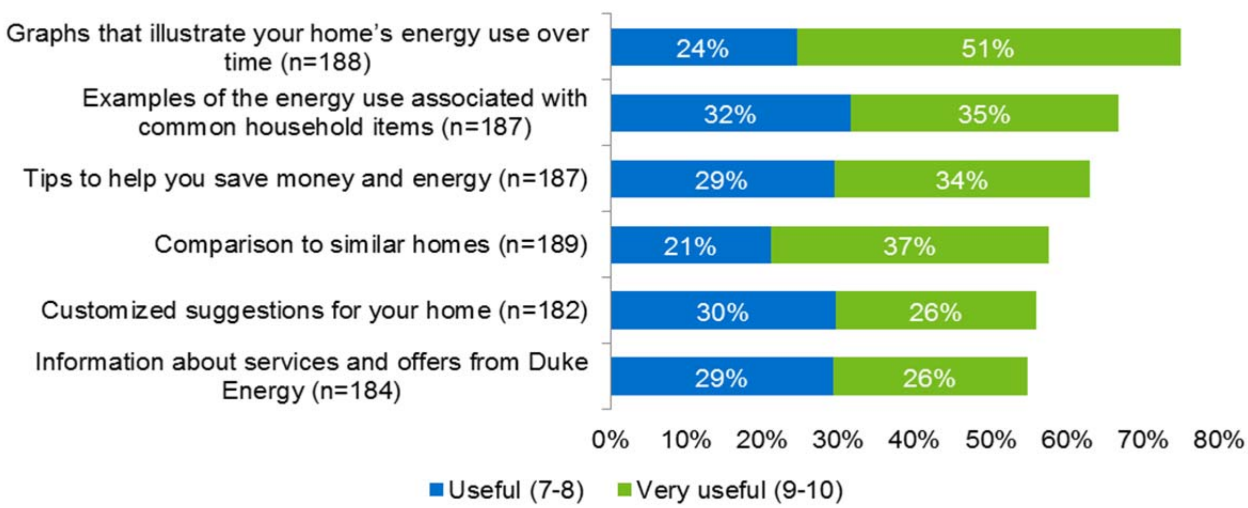
When asked to rate their agreement with a series of statements about MyHERs on a scale of 0 to 10, recipients largely agreed that the reports helped them understand their home’s energy use, with 68% of respondents rating their agreement a seven or higher on a 0-10 point scale, and that they use the report to gauge how successful they are at saving energy (61% rating a seven or higher). More than half (54%) agreed that the reports provided the details they needed to understand their home’s energy usage. Respondents provided weaker agreement to statements about the applicability of the tips provided and whether or not they discuss the reports with others. A relatively small percentage (11%) agreed with the statement that the information provided is confusing (Figure 4-7).

Figure 4-7: Level of Agreement with Statements about MyHER (0-10 Scale)



The results shown in Figure 4-8 illustrate that 75% of respondents in treatment group rated the time series graphs of home energy consumption a seven or higher on a 0-10 point scale of usefulness, indicating that a large majority of treatment households find this feature to be useful, followed by 67% of respondents rating examples of the energy use associated with common household items as useful and 63% of tips to help save money and energy as useful. Information about services and offers from Duke Energy was rated as useful by 55% of respondents.

Figure 4-8: Rating Usefulness of Key HER Features (0-10 Scale)



The survey provided an open-ended question to elicit suggestions about potential improvements to MyHER among those that had reported reading at least one report. Only 35% (79 of 223) offered suggestions, including six who offered only appreciative comments. Among those offering suggestions for improvement, the most common request, mentioned by 27 of the 73 with suggestions, reflected a desire for more specific information or details about their home and specific actions they should take. Some of these requests reflected interest in understanding at a more granular level how their home uses energy and energy consumption information related to appliances:

- *"Be more specific as to why gas or electric usage is higher than compared houses"*
- *"Give comparisons of energy usage, e.g., washing dishes by hand vs using dishwasher"*
- *"Identify estimates of which equipment is using how much energy"*
- *"My average bill runs pretty close to the most efficient homes except for cooling months. More information on possible reasons would be helpful"*
- *"Give example/list of what appliances use the most energy. ie. fridg, computer, etc"*

Other comments centered on other suggestions (such as providing free energy assessment, etc.), disbelief in the relevance of comparison homes, and a few respondents that simply did not see value in the reports. Responses coded as recommending production changes focus on changing the delivery method of MyHER reports as follows:

- *" I wish I had real-time visibility into my energy consumption via the web site or an app"*
- *"I believe you may have already started doing this but if not, these reports should be emailed instead of mailed"*

Nexant categorized these suggestions on the general basis of their content; the results are presented in Table 4-3.

Table 4-3: Distribution Suggestions for Improvement (Multiple Responses Allowed)

Suggestion	Count	Percent of Respondents Mentioning (n=79)	Percent of Total Mentions (n=86)
Provide more specific information or details	27	34%	31%
Other suggestions (such as providing free energy assessment, free light bulbs, etc.)	19	24%	22%
Don't believe comparison/accuracy	17	22%	20%
Address unique home/circumstances	9	11%	10%
Appreciate the Home Energy Report	6	8%	7%
Don't see value/dislike	4	5%	5%
Expressed frustration	2	3%	2%
Change production (mail, paper, format)	2	3%	2%

Treatment households were also asked questions that focused on the awareness and use of MyHER Interactive, revealing low awareness of the online Interactive platform:

- Only 26% of treatment customers are aware of MyHER Interactive; and
- Among aware customers, 83% reported that they had not signed up to use MyHER Interactive.

4.2.2.2 Comparing Treatment and Control Responses

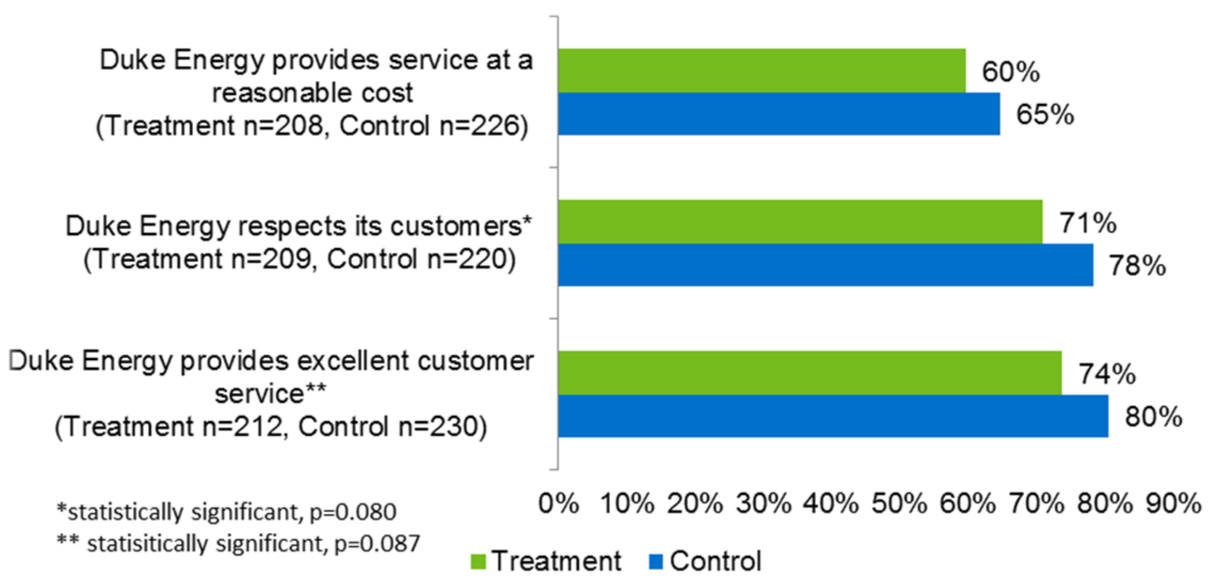
This section presents the results of survey questions asked of both treatment and control households and compares the response patterns provided. Statistically significant differences between treatment and control households are noted.

Duke Energy Customer Satisfaction

Both treatment and control groups' overall satisfaction with Duke Energy are high. Sixty-nine percent of treatment customers and 72% of control customers are satisfied or very satisfied with Duke Energy as their electric supplier (rated eight or higher on a 0-10 point scale); the difference is not statistically significant at the 90% level of confidence.

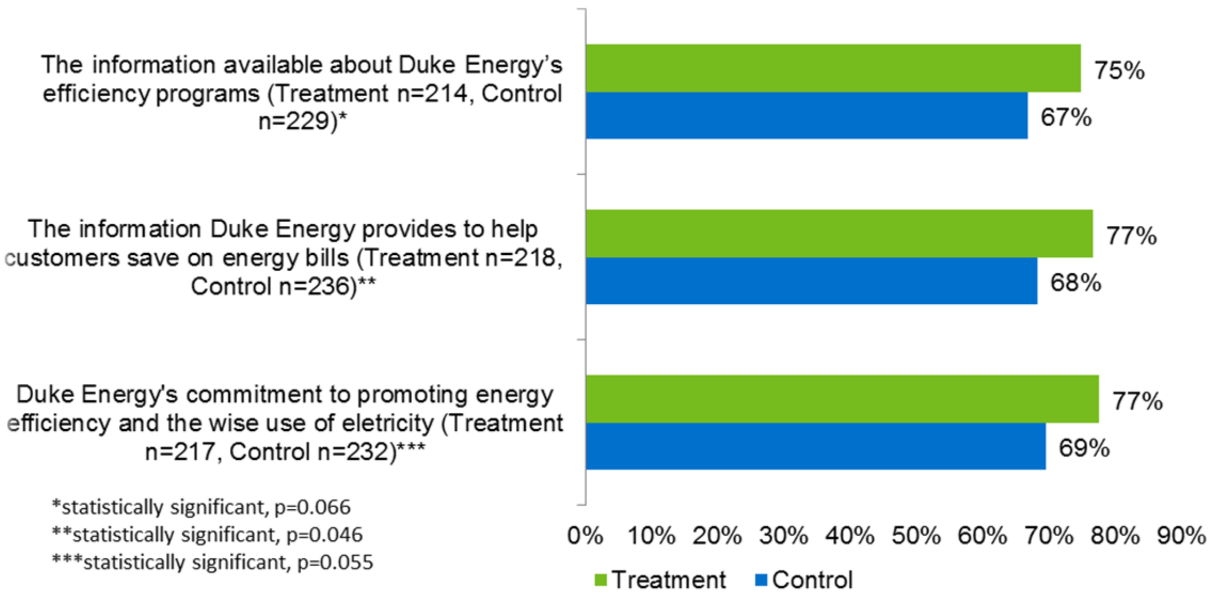
Control households rated Duke Energy significantly higher on respecting its customers and providing excellent customer service than treatment households. The control group also rated Duke Energy higher on providing service at a reasonable cost, but the difference between the control and treatment groups are not statistically significant (Figure 4-9). These outcomes of an inverse relationship between the MyHER treatment and satisfaction with Duke Energy are not directionally in line with the intended effect of the program. It is reasonable to conclude that the survey findings do not support the hypothesis that MyHERs are currently leading to an uplift in satisfaction in Ohio.

Figure 4-9: Satisfaction with Various Aspects of Customer Service



On the other hand, treatment group responses indicate significantly higher levels of satisfaction with certain aspects of Duke Energy energy efficiency efforts than the control group (Figure 4-10). The differences between treatment and control customers with respect to satisfaction with the information available about Duke Energy's efficiency programs, the information Duke Energy provides to help customers save on energy bills, and Duke Energy's commitment to promoting energy efficiency and the wise use of electricity are statistically significant.

Figure 4-10: Portion Satisfied with Each Communication Element



Engagement with Duke Energy's Website

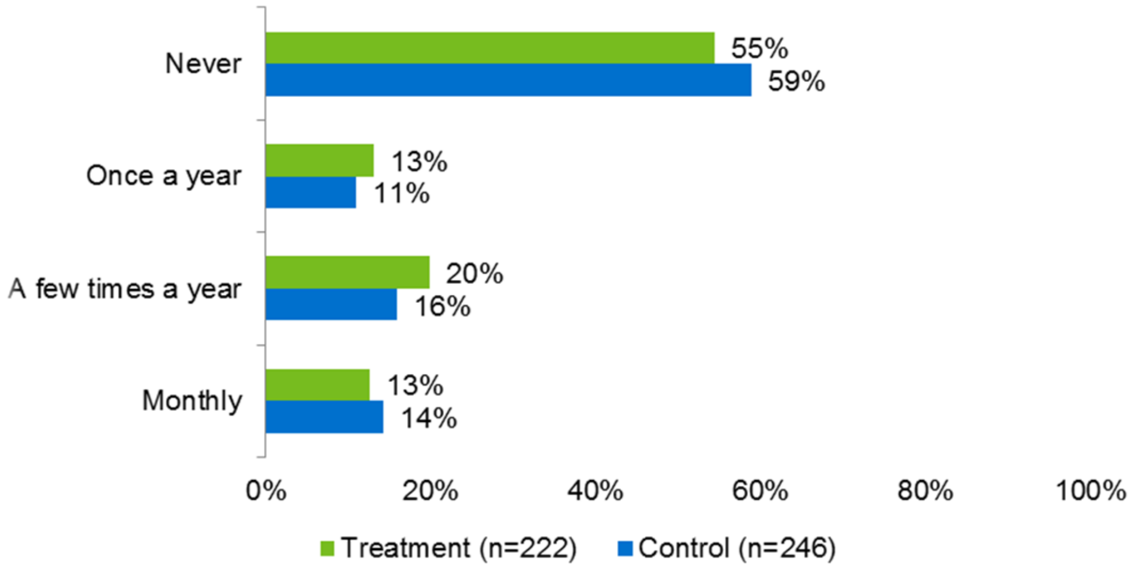
Both groups answered several questions about their use of the Duke Energy website, a proxy for overall engagement with information provided by the utility on energy efficiency and household energy use. Table 4-4 shows that 38% of the treatment group and 42% of the control group reported they had never logged in to their Duke Energy account. Among those that had logged in, the most commonly reported purpose was to pay their bill.

Table 4-4: Use of Duke Energy Online Account

Online Account Activity	Treatment Group (n=223)	Control Group (n=249)
Never logged in	38%	42%
Pay my bill	39%	39%
Look for energy efficiency opportunities or ideas	16%	15%

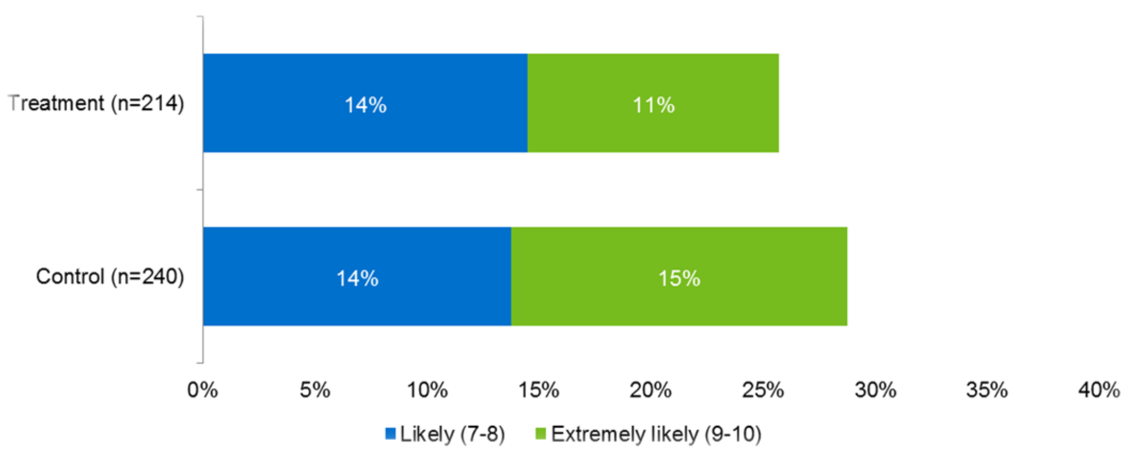
Treatment group households were more likely to report that they accessed the Duke Energy website to search for *other* information (for example, information about rebate programs, or how to make their home more energy efficient), but the difference is not statistically significant. Relatively small percentages of both groups report regular usage of the website for purposes other than bill payment, as shown in Figure 4-11.

Figure 4-11: Frequency Accessing the Duke Energy Website to Search for Other Information



Twenty-nine percent of control group and 26% of treatment group customers reported they would be likely to check the Duke Energy website for information before purchasing major household equipment. The portion of respondents rating their likelihood a “7” or higher on an 11-point scale of likelihood is plotted in Figure 4-12.

Figure 4-12: Portion Likely to Check Duke Energy Website prior to Purchasing Major Home Equipment

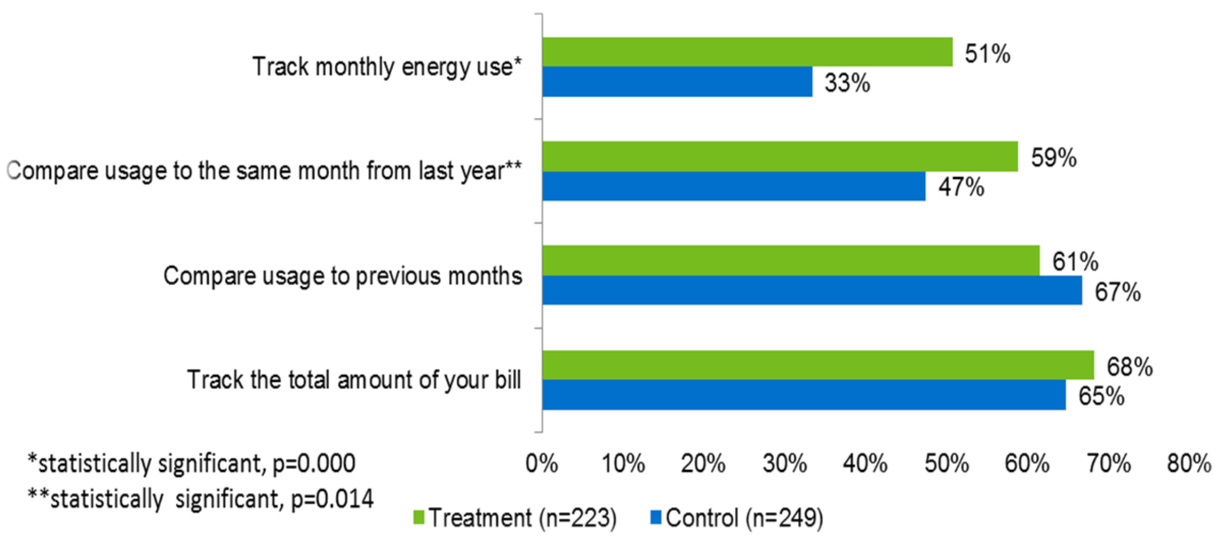


Reported Energy Saving Behaviors

Treatment and control customers track information (bills and usage) related to their household's energy usage in the following ways (Figure 4-13):

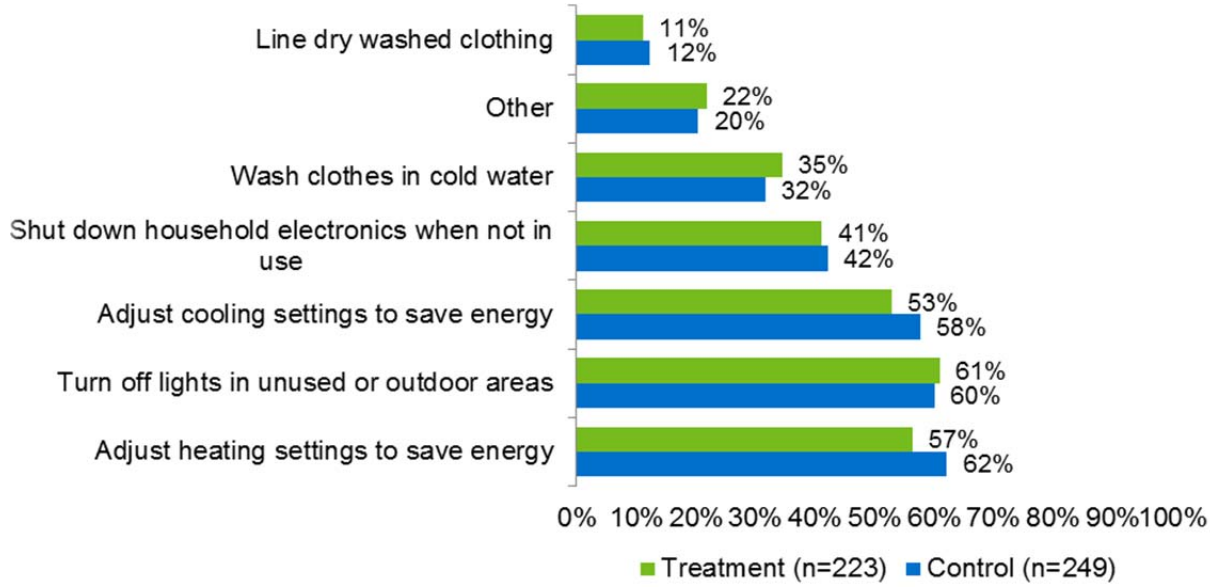
- Fifty-one percent of the treatment customers and 33% of the control customers reported tracking energy usage on a monthly basis. The difference is statistically significant at the 90% level of confidence.
- Fifty-nine percent of the treatment group and 47% of the control group compared usage to the same month from the prior year. The difference is statistically significant.
- More than sixty percent of respondents compare usage to prior months and track the total amount of their bill, but neither of the differences in responses here between treatment and control groups are statistically significant at the 90% level of confidence.

Figure 4-13: "Which of the Following Do you Do with Regard to Your Household's Energy Use?"



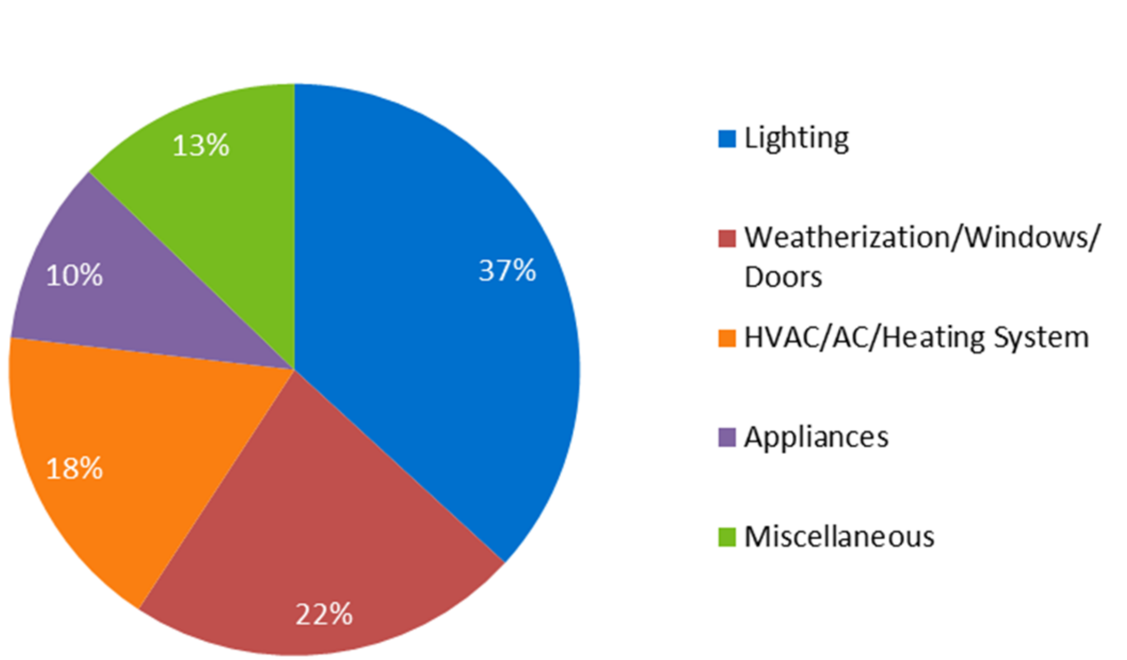
Both groups reported similar levels of energy saving behaviors, as shown in Figure 4-14. The treatment group was slightly more likely to wash clothes in cold water, report other energy savings behaviors, and turn off lights in unused or outdoor areas. Control customers were slightly more likely to line dry washed clothing, shut down household electronics when not in use, and adjust cooling and heating settings to save energy. None of the differences are statistically significant.

Figure 4-14: Reported Energy Saving Behaviors



One hundred and seventeen respondents (treatment and control customers in total) reported other energy savings actions as free-form text. Nexant categorized these actions and the results are shown in Figure 4-15. The most commonly reported action, mentioned by 46 respondents, pertains to lighting, such as switching to LED bulbs and using motion sensors, etc.

Figure 4-15: Distribution of Other Energy Savings Behaviors



Equipment Purchases: Past and Future Intention

Respondents were provided with a list of potential energy efficiency improvements to their home that homeowners rarely implement and asked if they had already done or intended to do each one. The treatment group has a significantly higher percentage of customers reported having already contacted a HVAC contractor for an estimate than the control customers did. The treatment group also has a higher percentage of customers reported having installed energy efficient kitchen appliances, install energy efficient heating/cooling system, and install energy efficient water heater than the customers in control group did (Table 4-5). However, those differences are not statistically significant at the 90% level of confidence.

Table 4-5: Portion Indicating they had "Already Done" Each Upgrade

Upgrade	Control	Treatment
Install energy-efficient kitchen appliances (Treatment n=207, Control n=225)	58%	63%
Install energy-efficient heating/cooling system (Treatment n=208, Control n=227)	55%	60%
Install energy-efficient water heater (Treatment n=202, Control n=225)	54%	60%
Caulk or weatherstrip (windows or doors) (Treatment n=215, Control n=231)	54%	51%
Replace windows or doors (Treatment n=214, Control n=240)	53%	45%
Add insulation to attic, walls, or floors (Treatment n=210, Control n=232)	35%	33%
Contact a HVAC contractor for an estimate (Treatment n=208, Control n=230)*	15%	23%
Request a home energy audit (Treatment n=209, Control n=233)	8%	7%

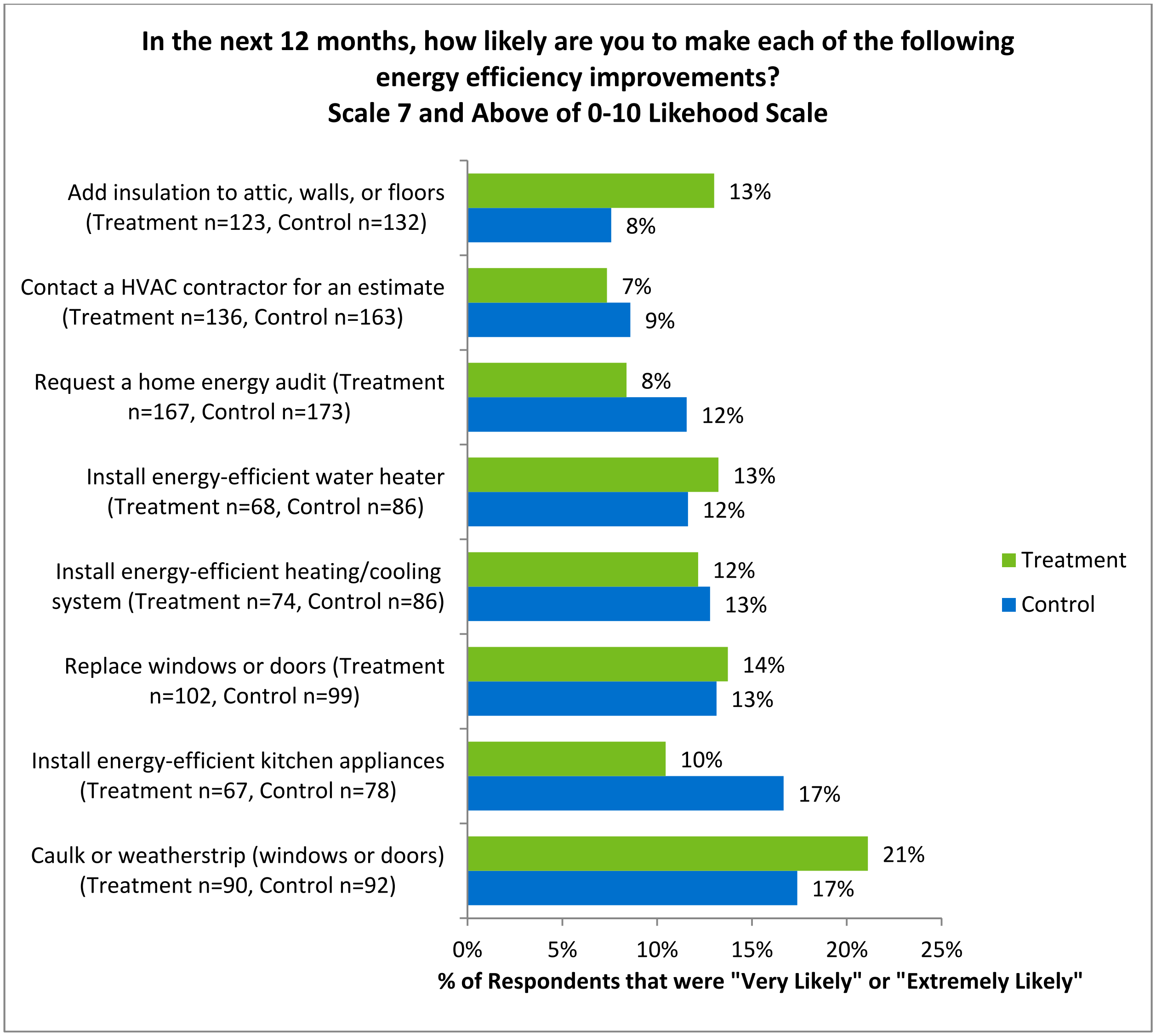
*Statistically significant, p=0.036

The treatment group reports higher likelihoods of completing the following actions in the next 12 months, caulking or weatherstripping windows or doors, replacing windows or doors, installing an energy efficient water heater, and adding insulation to attic, walls, or floors than the control group reports.

Perhaps unsurprisingly, the most commonly reported likely upgrade for both groups is the one homeowners can complete without help from a professional; caulking windows and doors. The control group reported they are more likely to install energy-efficient heating/cooling system, to install energy efficient kitchen appliances, to request a home energy audit and to contact a HVAC contractor for an estimate than the treatment group.

The results are presented in Figure 4-16 where a customer is considered to be "likely" to pursue an improvement if they gave a likelihood score of 7 or higher for that improvement. However, none of the differences between treatment and control groups are statistically significant.

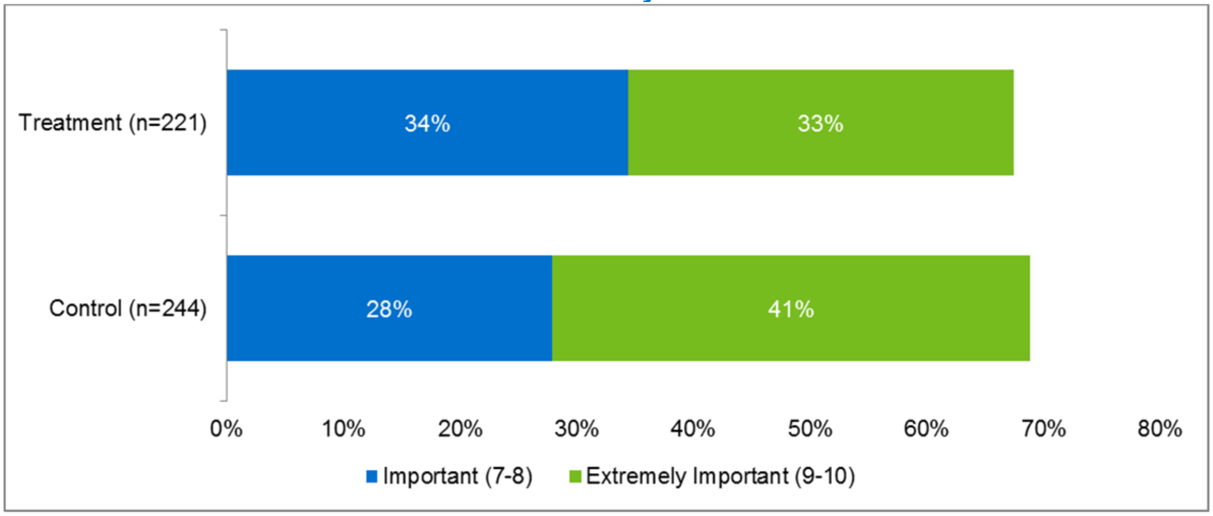
Figure 4-16: Likelihood of Completing Upgrades in the Next 12 Months



Customer Motivation and Awareness

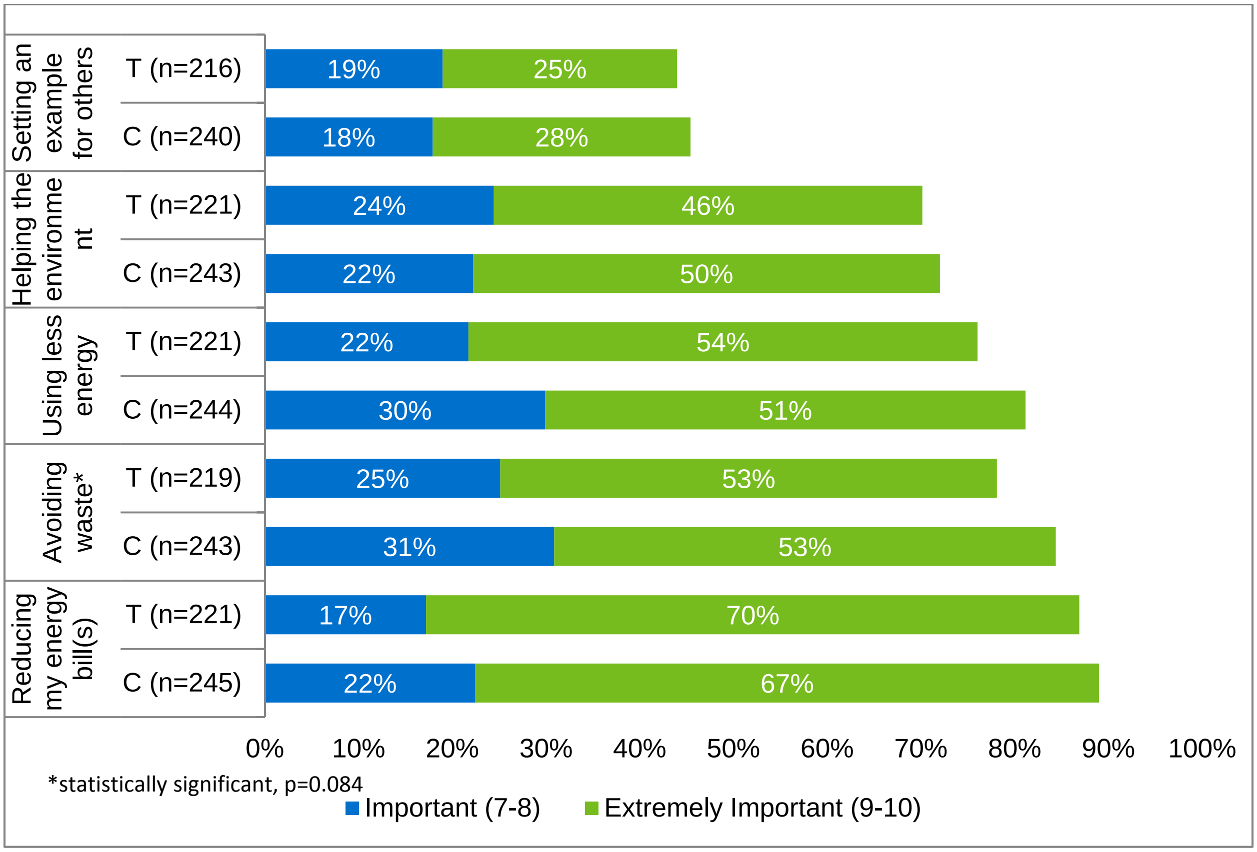
The control group and treatment groups report similar levels motivation for saving energy. Sixty-nine percent of control customers indicated that knowing they are using energy wisely is important or very important, compared to 67% of treatment customers. This difference is not statistically significant (Figure 4-17).

Figure 4-17: "How Important Is It for You to Know if Your Household is Using Energy Wisely?"



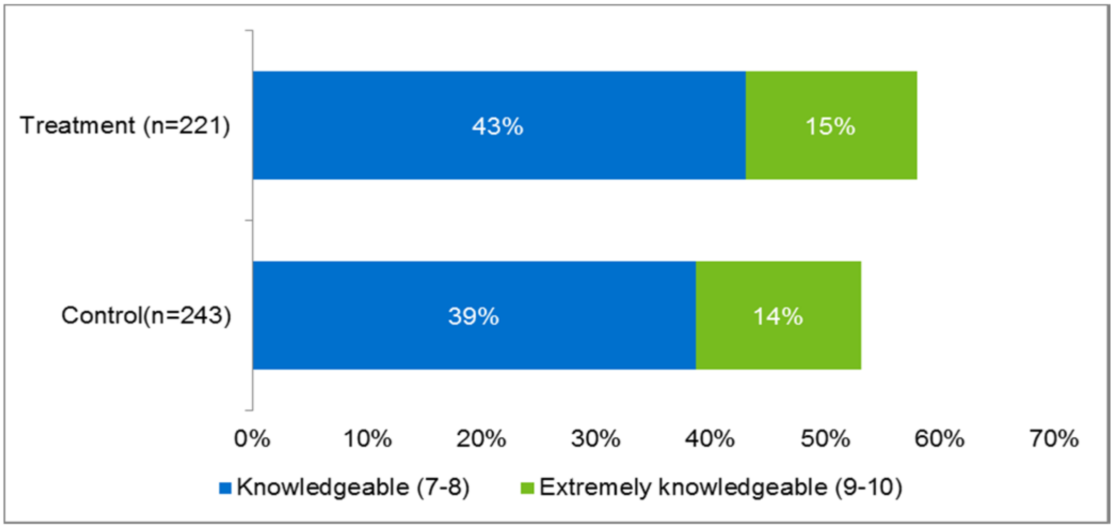
Customers were asked to rate, on a scale of 0 to 10, the importance of various reasons for why they might try to reduce their home's energy use. The strongest motivation for both groups is saving money on their energy bills, where 87% of treatment respondents and 89% of control respondents reported that saving money on their energy bills was "very important". Eighty-four percent of control respondents indicated that "avoiding waste" was very important to them, while 78% of treatment customers said as much; the difference between control and treatment groups is statistically significant at the 90% confidence level. Seventy-six percent of treatment customers and 81% of control customers reported that "using energy less" was "very important". Seventy percent of treatment customers and 72% of control customers reported that "helping environment" was "very important". Those differences between treatment and control group are not statistically significant. Figure 4-18 contains the frequency of responses to this question, shown as a percentage for both the treatment and control group.

Figure 4-18: "Please Indicate How Important Each Statement Is to You"



As indicated by Figure 4-19, among treatment customers, 58% rated themselves above a seven on a 0-10 point scale of knowledability of ways to save energy, while 53% of control group customers rated themselves this way. The difference is not statistically significant at the 90% level of confidence.

Figure 4-19: "How Would You Rate Your Knowledge of the Different Ways You Can Save Energy in Your Home?"



Earlier, we presented the portion of treatment households that found each HER feature useful (Figure 4-7). A similar question was asked of control group respondents, somewhat rephrased, to ask them how useful they might expect each feature to be. Table 4-6 presents the portion rating each item a "7" or higher on an 11-point scale. The treatment group rated the usefulness of graphs that illustrate home' energy use over time significantly higher than the control group. The control group rated the tips to help save money and energy significantly higher than the treatment group.

Table 4-6: Usefulness or Hypothetical Usefulness of HER Features Treatment and Control

HER Feature	Control Group	Treatment Group
Graphs that illustrate home energy use over time**	66% (n=236)	75% (n=188)
Tips to help save money and energy*	71% (n=237)	63% (n=187)
Examples of the energy use associated with common household items	62% (n=236)	67% (n=187)
Comparison to similar homes	56% (n=231)	58% (n=189)
Information about services and offers from Duke Energy	61% (n=233)	55% (n=184)
Customized suggestions for your home	57% (n=231)	56% (n=182)

* Statistically significant, p=0.073
**Statistically significant, p=0.047

Evidence of MyHER Effects

As noted above, while formal statistical testing found a number of differences among treatment and control group households for individual questions, the Nexant team sought to understand if the overall pattern of survey responses differed among treatment and control households. To do this, we categorized each survey question by topic area and then counted any survey item in which the treatment households provided a more positive response than the control households.

Table 4-7 presents the categories, the count of questions in each category for which the treatment group provided a more favorable response than the control group, and the number of questions in each category. A response is considered “favorable” if the treatment group gave a response that is consistent with the program objectives of MyHER.

Table 4-7: Survey Response Pattern Index

Question Category	Count of Questions where T>C	Number of Questions in Topic Area	Portion of Questions where T>C
Duke Energy’s Public Stance on Energy Efficiency	3	3	100%
Customer Engagement with Duke Energy Website	4	5	80%
Customers’ Reported Energy-saving Behaviors	2	7	29%
Customers’ Past & Future Equipment Purchases	6	16	38%
Customer Motivation, Engagement & Awareness of Energy Efficiency	4	11	36%
Customer Satisfaction with Duke Energy	0	4	0%
Total	**19**	**46**	**41%**

Nexant’s approach consists of the following logical elements:

- Assume the number of positive responses between treatment and control customers will be equal if MyHER lacks influence;
- Count the total number of topics and questions asked of both groups – there are six topic areas and 46 questions;
- Note any item for which the treatment group outperformed the control group – the treatment group outperformed the control group in 19 questions, or 41% of the total questions;
- Since this value is less than 50% we cannot conclude that that MyHER had wide-ranging enhancing effects across all the various engagement and attitudinal areas probed by the survey.
- However, two specific survey areas show particularly consistent MyHER uplift: in DEO customer engagement with the Duke Energy website in addition to satisfaction with Duke Energy’s stance on energy efficiency. In these two cases 7 out of 8 questions show more favorable responses for the treatment group;
- Considering these two areas, calculate the probability that the difference in response patterns is due to chance, rather than an underlying difference in populations – 3% (p-value = 0.031). Since this probability is less than 10%, we reject the null hypothesis (that the number of positive responses should be equal for treatment and control customers) at the 95% level of confidence.

Because this analysis compares the response patterns between the treatment and control groups, if the MyHER program did not influence customers, one would expect the treatment group to "score higher" on roughly half of the questions. In other words, if the MyHER is not influencing treatment group customers, there is a 50/50 chance that they will "outperform" the control group as many times as not. For a more detailed description of the index framework, see Appendix F.

We call out the survey area covering general customer satisfaction with Duke Energy as an area of particular note: treatment customers reported lower satisfaction scores than control customers for all four general satisfaction questions. Nexant recommends that the MyHER program staff coordinate with any internal customer satisfaction data collection efforts to cross-reference these findings with any learnings on DEO customer satisfaction. The lower satisfaction scores for DEO treatment customers may indicate an opportunity for new messaging or content in Ohio.

Respondent Demographics

Nearly all respondents—98% of treatment group customers and 96% of control group customers—own their residence. More than half of households surveyed have two or fewer residents, but about 25% of treatment households and 22% of control households have four or more residents. There are no statistically significant differences in the distribution of age of homes assigned to the treatment and control groups (Figure 4-20) (chi-squared test).

Figure 4-20: "In What Year Was Your Home Built?"

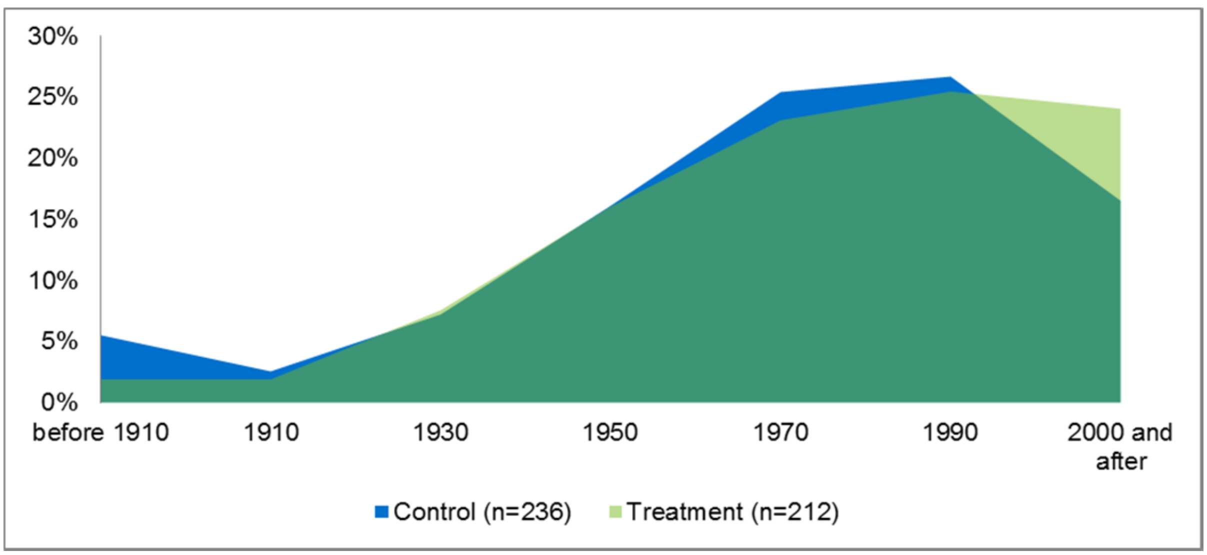
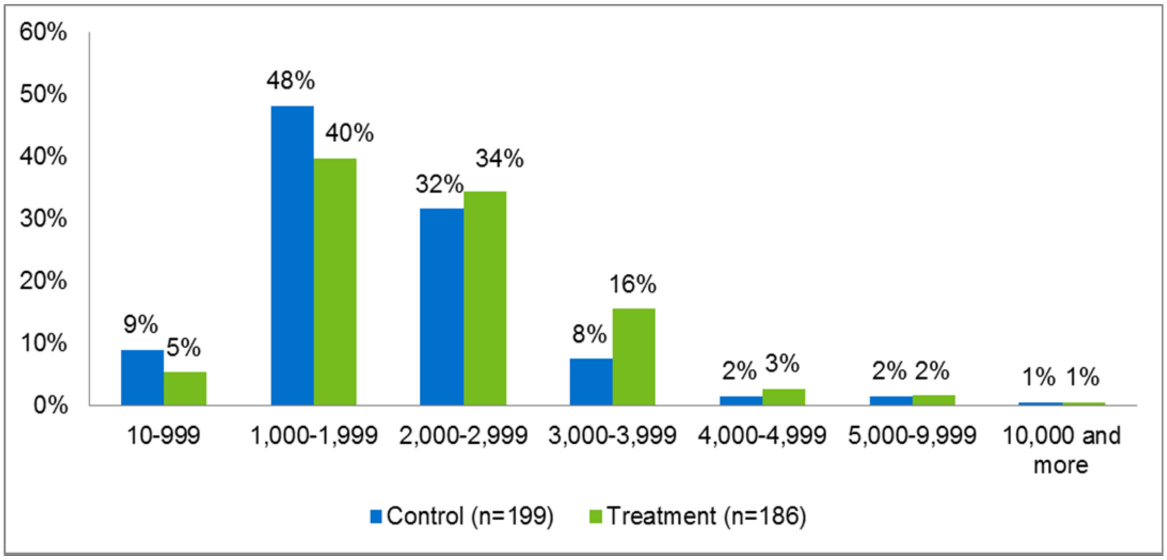


Figure 4-21 shows distribution of home square footage is similar between control and treatment households. The average square footage above ground is 2,041 for control households and 2,187 for treatment households.

Figure 4-21: How many square feet is above ground living space?



Respondent samples are relatively close to those reported by the U.S. Census American Community Survey (ACS) for Ohio. The lowest age category (25-34) is often underrepresented when sampling based on residence in single family homes, given that many members of that population are in apartments, dormitories, or living with other family members. This common underrepresentation is true in this survey study, as well. The average age is 60 for control group respondents and 58 for treatment group respondents (see Table 4-8).

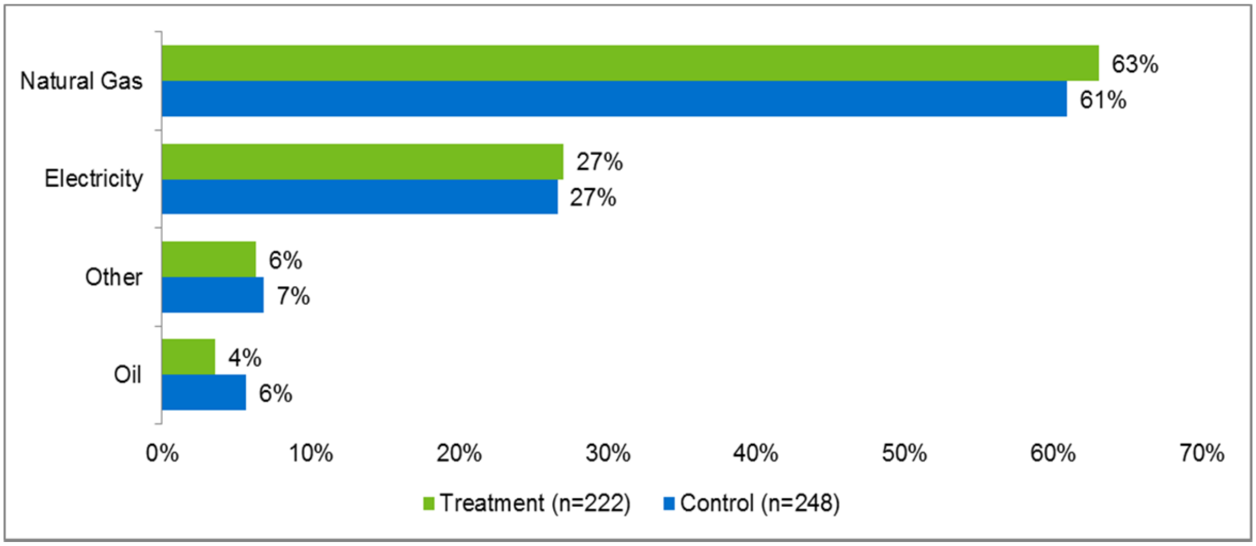
Table 4-8: Respondent Age Relative to American Community Survey_Ohio

Age	Treatment Group (n=201)	Control Group (n=235)	2016 American Community Survey_Ohio[12]
25-34	2%	5%	13%
35-44	15%	13%	12%
45-54	24%	18%	13%
55-64	28%	23%	14%
65 and over	30%	40%	16%

Figure 4-22 shows the primary heating fuel type used in control and treatment customers' households. The majority of treatment (63%) and control (61%) customers use natural gas in their households for heating. Twenty-seven percent of treatment customers and control customers, respectively, use electricity for heating.

[12] American Community Survey (ACS) is the Census Bureau's Population Estimates Program that produces and disseminates the official estimates of the population for the nation, states, counties, cities and towns and estimates of housing units for states and counties.
https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_16_SPL_K200104&prodType=table

Figure 4-22: Primary Heating Fuel in Households



4.3 Summary of Process Evaluation Findings

In-depth interviews with MyHER implementation staff reveal that the DEO MyHER program has benefited from a number of enhancements to the program and improvements in process and program management. Electronic MyHERs are now sent via email to all treatment customers that have provided Duke Energy with an email address. This enhancement means that report production is now a year-round process since the email reports are sent on a monthly basis for each month of the year. The MyHER report template was also refreshed to increase visual appeal and value to the customer. The new template includes the addition of a module that presents energy usage disaggregated by end-use category, on a looking-forward basis for the month ahead. Also, the template update included the addition of images to the free-form text (FFT) module of the reports. Both of these program enhancements (email MyHERs and the template redesign) resulted in surges of enrollment (and usage) of the MyHER Interactive online portal. MyHER Interactive also added the “Challenges” feature, which are messages that are emailed to Interactive users on a weekly basis.

From the backoffice perspective, Tendril, Duke Energy’s MyHER program provider, implemented a number of process improvements. Tendril migrated their computational platform to Amazon Web Services (AWS), significantly reducing the time required to process data and generate batches of reports, and developed a pre-production platform to enable Duke Energy to review PDF drafts of MyHERs prior to promotion into production, which realized process efficiencies for Tendril. Tendril also transitioned email MyHER production to Hypertext Markup Language (HTML) format to provide greater flexibility in Tendril’s production processes.

Duke Energy and Tendril continue to collaborate for success through joint weekly status meetings, monthly operations meetings, and quarterly governance meetings. Working together, monthly key performance indicators (KPIs) such as in-home dates and percentage of treated customers treated are monitored. These meetings provide the venue for brainstorming and roadmapping activities as well as monitoring and prioritizing Duke Energy's MyHER product request list. Since the prior evaluation, Tendril has improved their performance in product quality, which is rigorously monitored by Duke Energy staff. These improvements have been attributed to a stable operations team at Tendril which has also expanded to include a quality control engineer. Additionally, Tendril has implemented an internal HER Improvement team and has also adopted a "Batch 0" strategy to implement significant changes to the MyHER reports on a test batch of data prior to producing a live batch to be mailed to customers. Batch 0 reports are tested for quality by both Tendril and Duke Energy and have allowed unexpected problems to be surfaced early and also to allow Duke Energy to fine tune the newly implemented changes. Improved product quality has resulted in fewer problems turning up in the quality control process, and when they do appear, they affect small numbers of reports (10-200). In addition, exchanges of data/reports and information between Duke Energy and Tendril has achieved greater process predictability for everyone involved. All staff that were interviewed for this evaluation stated that the successful launch of the template redesign was a big accomplishment for the program team in 2017.

Opportunities for further program improvements to the MyHER program do exist. The free-form text (FFT) module of the report is currently a resource-intensive, multi-stakeholder component with an unwieldy revision-review-approval process. Monthly revisions to the planned messages are unavoidable due to the flexible and responsive nature of FFT messages. This process currently injects last-minute changes into the MyHER production process. A "preview tool" that will allow for streamlined editing and review for multiple Duke Energy stakeholders will be a valuable product improvement for MyHER. Duke Energy and Tendril should prioritize development of this program enhancement. Other areas that were noted for potential improvement include improving the MyHER Interactive profile questionnaire and to implement more sophisticated targeting in the action tips module of the reports.

A survey of DEO treatment and control customers shows that, among treatment group households:

- 94% recalled receiving at least one MyHER and 98% of those indicated that they "always" or "sometimes" read the reports.
- 75% reported being "very" or "somewhat" satisfied with the information provided by MyHERs.
- Only 26% of MyHER recipients are aware of MyHER Interactive, and only 18% of the aware recipients report that they have signed up to use it.
- Sixty-eight of respondents give strong agreement ratings to the statement "I have learned about my household's energy use from My Home Energy Reports". Very few (11%) strongly agree with the idea that the energy usage information presented by the reports is confusing.
- The most useful features of the reports, as rated by treatment customer respondents, are the graphs that illustrate the home's energy usage over time. The least useful-rated feature is information about services and offers from Duke Energy.

- Most (65%) respondents had no feedback or suggestions to improve the program. Those that made suggestions most frequently requested more specific or detailed information in their MyHERs.

In comparing responses of treatment and control group respondents, there were a number of areas where treatment customers provided responses that more favorably reflected increased awareness, engagement, or attitudes towards energy savings opportunities and actions relative to control customers:

- Treatment group respondents reported higher levels of satisfaction with the information Duke Energy makes available about energy efficiency programs, with the information Duke Energy provides to help customers save on energy bills, and with Duke Energy's commitment to promoting energy efficiency and the wise use of electricity, the differences are statistically significant at the 90% level of confidence;
- MyHER provides a measurable uplift in customer engagement with Duke Energy's website; and
- Treatment group respondents state taking significantly more actions to track and monitor their energy usage than do control customers.

An index designed to account for overall survey-wide differences in response patterns does not find a more positive response pattern for treatment customers in simple frequencies across the entire survey. Notably, DEO treatment customers fared particularly poorly in the area of general satisfaction with Duke Energy: treatment customers reported lower satisfaction scores than control customers for all four general satisfaction questions. Nexant recommends that the MyHER program staff coordinate with any internal customer satisfaction data collection efforts to cross-reference these findings with any learnings on DEO customer satisfaction. The lower satisfaction scores for DEO treatment customers may indicate an opportunity for new messaging or content in Ohio.

On the other hand, two other survey areas show particularly consistent MyHER uplift in DEO customer engagement with the Duke Energy website in addition to satisfaction with Duke Energy's stance on energy efficiency. In these two cases 7 out of 8 questions show more favorable responses for the treatment group. Using standard statistical techniques (specifically, the non-parametric sign test), Nexant calculates the probability of randomly obtaining this result is 3% and is not likely due to chance. We conclude that exposure to MyHER is positively affecting customer attitudes pertaining to perception of Duke Energy's public stance on energy efficiency and customers' engagement with Duke Energy website.

5 Conclusions and Recommendations

Nexant found that the MyHER program is an effective channel for increasing customer engagement with energy efficiency and demand side management. The RCT program design facilitates reliable estimates of program energy savings. Further, the energy savings generated by the program are corroborated by survey findings of respondent engagement and focus on the importance of saving energy. As a valuable secondary benefit, Nexant found the MyHER is a useful tool for enhancing Duke Energy customer engagement and increases uptake in other Duke Energy efficiency programs. The MyHER program has achieved full deployment among Duke Energy Ohio customers and Nexant recommends that Duke Energy continue to focus on program processes and operations to further increase the efficiency of program delivery.

Duke Energy launched the MyHER Interactive Portal in March 2015. The portal offers additional means for customers to customize or update Duke Energy's data on their premises, demographics, and other characteristics that affect consumption and the classification of each customer. The portal also provides additional custom tips based on updated data provided by the customer. MyHER Interactive also sends email challenges that seek to engage customer in active energy management, additional efficiency upgrades, and conservation behavior. Nexant evaluated the impacts of the MyHER Interactive Portal using a matched comparison group because the MyHER Interactive Portal was not deployed as a randomized controlled trial (RCT).

5.1 Impact Findings

Nexant estimates that the MyHER program saved a total of 64.2 GWh in Ohio during the period January to December 2017. The confidence and relative precision of the estimate is 90% and 21.8%, respectively. This impact estimate accounts for the fact that MyHER increases uptake of other DEO programs; 10.2 kWh has been subtracted from the average household program impact to account for the MyHER uplift in other programs. Without such a correction, those savings (10.2, kWh per household per year) would be double counted by Duke Energy.

All Ohio EDUs, including DEO, are required to achieve a cumulative annual energy savings of more than 22% by 2027 per Ohio Senate Bill (SB) 310[13]. SB 310 also introduced new mechanisms that adjust how EDUs may estimate their energy savings achieved through demand side management programs. Specifically, SB 310 requires the Ohio PUC to permit EDUs to account for energy-efficiency savings estimated on an either an "as-found" or on a deemed basis. The deemed annual savings estimate for the DEO MyHER program has been filed as 256 kWh per home. Duke Energy, per SB 310, will claim the deemed savings value of 256 kWh per home with the Ohio PUC for 2017.

[13] State of Ohio Substitute Senate Bill 310 Section 4928.662, sections (A) through (G), pages 30 and 31.

For this evaluation period, the MyHER Interactive Portal savings estimates indicate the portal generates 1-4% incremental savings above and beyond the standard MyHER treatment, which is statistically significant in the summer months and in the winter months immediately following surges in portal usage, as measured by portal logins. Across the period January through December 2017, the incremental savings are 1% but are not statistically significant at the 90% level of confidence. Since MyHER Interactive Portal customers volunteered to participate in the portal product, their savings may not represent the expected savings if all customers were assigned to the portal product by default.

5.2 Process Findings

The DEO MyHER program is Duke Energy's most mature behavioral program in terms of delivered energy savings. The large volume of data required to generate MyHER and support the program delivery schedule is the primary driver of program activities and focus. Duke Energy and its implementation contractor, Tendril, are successfully managing this process and providing DEO customers valuable information for managing home energy consumption.

The DEO MyHER program has benefited from a number of process and product management improvements. Careful change management and a stable operations team at Tendril have been key enablers of maintaining a production process that consistently meets MyHER quality control standards.

MyHER participants have been found in this evaluation's customer surveys to display higher levels or incidence of certain energy savings behaviors, opinions, attitudes, and engagement with energy efficiency. MyHER's strengths, in the DEO jurisdiction, are positively affecting customer's perception of Duke Energy's public stance on energy efficiency, customer engagement with the Duke Energy website, and customers' monitoring and tracking household energy consumption. These strengths indicate success in the key program goals of cross-promotion of energy efficiency and demand response programs and increasing customer satisfaction.

5.3 Program Recommendations

- **Continue the practice, adopted in September 2015, of simultaneous control and treatment assignment.** Assignment of new accounts to the MyHER treatment and control group should be limited to once or twice per year.
- **Continue to monitor engagement and evaluate the impacts of the Interactive Portal and increase participant awareness of Interactive.** The MyHER Interactive Portal appears to generate incremental savings above and beyond the standard MyHER paper edition. If Duke Energy continues to maintain the interactive portal as a supplement to paper or electronic MyHER reports, then incremental savings may be generated by this level of customer interaction and engagement. The process evaluation finds that current awareness of Interactive among Ohio MyHER participants is very low.

- **Continue to operate MyHER with an eye towards change management**. MyHER's implementer Tendril has made great strides in improving quality control performance since the prior evaluation. Effective change management and stable staffing have been notable contributors to these improvements and they should continue to be emphasized in MyHER program operations.
- **Prioritize and implement key product improvements to improve program processes**. The free-form text (FFT) module has been consistently mentioned by Duke Energy and Tendril staff as a resource intensive program feature that injects last-minute changes to the report generation process. Duke Energy and Tendril should develop and utilize the tools necessary to streamline the work associated with managing the content featured by this module in each MyHER report.

Appendix A Summary Form

MyHER Ohio

Completed EMV Fact Sheet

Description of program

Duke Energy offers the My Home Energy Report (MyHER) to residential customers. MyHER relies on principles of behavioral science to encourage customer engagement with home energy management and energy efficiency. The program accomplishes this primarily by delivering a personalized report comparing each customer's energy use to a peer group of similar homes.

Date	August 27, 2018
Region(s)	Ohio
Evaluation Period	January 2017 – December 2017
Annual kWh Savings	64,226,457 kWh
Per Participant kWh Savings	209.4 kWh/home
Coincident kW Impact	0.032 kW/home
Net-to-Gross Ratio	Not Applicable
Process Evaluation	Yes
Previous Evaluation(s)	2016 – Nexant 2013 – TecMarket Works

Evaluation Methodology

Impact Evaluation Activities

- *Eligible accounts are randomly assigned to either a treatment (participant) group or a control group. The control group accounts are not exposed to MyHER in order to provide the baseline for estimating savings attributable to the Home Energy Reports. In this randomized controlled trial (RCT) design, the only explanation for the observed differences in energy consumption between the treatment and control group is exposure to MyHER*.
- *The impact estimate is based on monthly billing data and program participation data provided by Duke Energy.*
- *The RCT delivery method of the program removes the need for a net-to-gross analysis as the billing analysis directly estimates the net impact of the program.*

Impact Evaluation Findings

- *Realization rate = 82% for energy impacts; 209.4 kWh per home*
- *Cohort treatment group receiving report for at least two years showed savings of 219.3 kWh/home*

Process Evaluation Activities

- *223 surveys of treatment customers, 249 surveys for control group customers and staff interviews.*

Process Evaluation Findings

- *Increase awareness of the Interactive Portal; Develop efficient production tools to streamline processes to manage the free-form text report module.*

Appendix B Measure Impact Results

Table B-1: DSMore Measure Impact Results

Measure Category	Prod Code	State	Gross Energy Savings (kWh)	Gross Summer Coincident Demand (kW)	Gross Winter Coincident Demand (kW)	Net to Gross Ratio	Net Energy Savings (kWh)	Net Summer Coincident Demand (kW)	Net Winter Coincident Demand (kW)	Measure Life
OH_ My Home Energy Report	HECR	OH	256	0.0654	N/A	100%	256	0.0654	N/A	1

Appendix C Survey Instruments

C.1 Treatment Households

Q1. First, we'd like to ask you about your overall opinion of Duke Energy. Please rate how satisfied you are with Duke Energy as your electric supplier.

Not at all Satisfied										Completely Satisfied
0	1	2	3	4	5	6	7	8	9	10

Q2. We would also like to know how satisfied you are with several aspects of communication from Duke Energy. Please rate your overall satisfaction with each of the following.

	Very Satisfied	Somewhat Satisfied	Neither	Somewhat Dissatisfied	Very Dissatisfied
The information available about Duke Energy's efficiency programs.	☐	☐	☐	☐	☐
Duke Energy's commitment to promoting energy efficiency and the wise use of electricity.	☐	☐	☐	☐	☐
The information Duke Energy provides to help customers save on energy bills.	☐	☐	☐	☐	☐

Q3. When you log in to your Duke Energy account, which of the following have you done? Check all that apply.

- ☐ I have never logged in
- ☐ Pay my bill
- ☐ Review energy consumption graphs
- ☐ Look for energy efficiency opportunities or ideas
- ☐ None of the above

Q4. How often do you access the Duke Energy website to search for other information (for example: information about rebate programs, or how to make your home more energy efficient)? Select only one.

- ☐ Monthly
- ☐ A few times a year
- ☐ Once a year
- ☐ Never

Q5. If you needed to replace major home equipment or were considering improvements to your home's energy performance today, how likely would you be to check the Duke Energy website for information about energy efficient solutions or incentives?

Not at all Likely										Extremely Likely
0	1	2	3	4	5	6	7	8	9	10

Q6. Over the past 12 months, have you taken any actions to reduce your household energy use?

- ☐ Yes
- ☐ No – **Skip to Q8**

Q7. What actions have you taken? Check all that apply.

- ☐ Adjust heating settings to save energy
- ☐ Adjust cooling settings to save energy
- ☐ Wash clothes in cold water
- ☐ Shut down household electronics when not in use
- ☐ Turn off lights in unused or outdoor areas
- ☐ Line dry washed clothing
- ☐ Other, please specify: ______________________________
- ☐ Other, please specify: ______________________________

Q8a. Have you **already** made any of the following energy efficiency improvements in your home?

Q8b. **For the items you selected "No" on in 8a**, how likely are you to make those energy efficiency improvements **in the next 12 months**?

	Yes	No	Don't Know	Not at all Likely 0	1	2	3	4	5	6	7	8	9	Extremely Likely 10	Don't Know
Install energy-efficient kitchen appliances	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻
Install energy-efficient heating/cooling system	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻
Install energy-efficient water heater	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻
Replace windows or doors	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻
Caulk or weatherstrip (windows or doors)	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻
Add insulation to attic, walls, or floors	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻
Contact a HVAC contractor for an estimate	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻
Request a home energy audit	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻	◻

Q9. How important is it for you to know if your household is using energy wisely?

Not at all Important										Extremely Important
0	1	2	3	4	5	6	7	8	9	10

Q10. Which of the following do you do with regard to your household's energy use? Check all that apply.

- ◻ Track monthly energy use
- ◻ Track the total amount of your bill
- ◻ Compare usage to previous months
- ◻ Compare usage to the same month from last year
- ◻ None of the above

Q11. How would you rate your knowledge of the different ways you can save energy in your home?

Not at all Knowledgeable										Extremely Knowledgeable
0	1	2	3	4	5	6	7	8	9	10

Q12. Duke Energy sends a personalized report called *My Home Energy Report* to a select group of homes. These documents are mailed in a standard envelope every few months and provide customers with information on how their home's electric energy usage compares with similar homes. Have you seen one of these reports?

◻ Yes ◻ No – **Skip to Q20**

Q13. About how many *My Home Energy Reports* have you received in the past 12 months? __ **If zero, skip to Q20**

Q14. How often do you read the *My Home Energy Reports*?

◻ Always ◻ Sometimes ◻ Never – **Skip to Q20**

Q15. Please indicate how much you agree or disagree with the following statements about *My Home Energy Reports*. Scale: 0 = Strongly Disagree; 10 = Strongly Agree

	Strongly Disagree										Strongly Agree
I have learned about my household's energy use from *My Home Energy Reports*.	0	1	2	3	4	5	6	7	8	9	10
I use the reports to tell me how well I am doing at saving energy.	0	1	2	3	4	5	6	7	8	9	10
The tips provided in the reports are pertinent to my home.	0	1	2	3	4	5	6	7	8	9	10
My Home Energy Reports provide the details I need to understand my home's energy use.	0	1	2	3	4	5	6	7	8	9	10
I have discussed *My Home Energy Reports* with others.	0	1	2	3	4	5	6	7	8	9	10
The information provided about my home's energy use is confusing.	0	1	2	3	4	5	6	7	8	9	10

Q16. How could Duke Energy make *My Home Energy Reports* more useful for your household? Please provide any suggestions you may have to improve the reports.

____

____

____

Q17. Below is a list of *My Home Energy Report* features. Please rate how useful each feature is to you. Scale: 0 = Not at all Useful; 10 = Extremely Useful

	Not at all Useful										Extremely Useful
Comparison to similar homes	0	1	2	3	4	5	6	7	8	9	10
Tips to help you save money and energy	0	1	2	3	4	5	6	7	8	9	10
Examples of the energy use associated with common household items	0	1	2	3	4	5	6	7	8	9	10
Customized suggestions for your home	0	1	2	3	4	5	6	7	8	9	10
Graphs that illustrate your home's energy use over time	0	1	2	3	4	5	6	7	8	9	10
Information about services and offers from Duke Energy	0	1	2	3	4	5	6	7	8	9	10

Q18. Please rate your satisfaction with the information in the *My Home Energy Reports* you've received. Scale: 0 = Not at all Satisfied; 10 = Completely Satisfied

Not at all Satisfied										Completely Satisfied
0	1	2	3	4	5	6	7	8	9	10

Q18a. Why do you say that? ______________________________

____

Q19. Before today, were you aware that you can go online to *My Home Energy Interactive* to access more features, above and beyond those found in the *My Home Energy Report*, that provide more ways to save energy?

☐ Yes ☐ No – **Skip to Q20**

Q19a. Have you signed up to use *My Home Energy Interactive*?

☐ Yes ☐ No – **Skip to Q20**

Q19b. Please rate how useful *My Home Energy Interactive* is to you for saving energy.
Scale: 0 = Not at all Useful; 10 = Extremely Useful

Not at all Useful										Extremely Useful
0	1	2	3	4	5	6	7	8	9	10

Q20. The statements below provide reasons why households might try to reduce their home's energy use. Please indicate how important each statement is to you. Scale: 0 = Not at all Important; 10 = Extremely Important

	Not at all Important										Extremely Important
Reducing my energy bill(s)	0	1	2	3	4	5	6	7	8	9	10
Using less energy	0	1	2	3	4	5	6	7	8	9	10
Helping the environment	0	1	2	3	4	5	6	7	8	9	10
Setting an example for others	0	1	2	3	4	5	6	7	8	9	10
Avoiding waste	0	1	2	3	4	5	6	7	8	9	10

Q21. Please indicate your level of agreement with each of the following statements:

	Strongly Disagree	Somewhat Disagree	Neither	Somewhat Agree	Strongly Agree
Duke Energy provides excellent customer service	☐	☐	☐	☐	☐
Duke Energy respects its customers	☐	☐	☐	☐	☐
Duke Energy provides service at a reasonable cost	☐	☐	☐	☐	☐

Q22. Before today, were you aware that you could order free or discounted lighting products through the Duke Energy website?

☐ Yes ☐ No – **Skip to Q23**

Q22a. How many **free** light bulbs have you ordered through the Duke Energy website this year? ________

Q22b. How many **discounted** light bulbs have you ordered through the Duke Energy website this year? ________

Q23. Do you own or rent this residence? ☐ Own ☐ Rent

Q24. Including yourself, how many people live in your home? __________

Q25. In what year was your home built? __________

Q26. How many square feet is the above-ground living space? __________

Q27. What is your primary heating fuel? ☐ Electricity ☐ Natural Gas ☐ Oil ☐ Other

Q28. In what year were you born? __________

C.2 Control Households

Q1. First, we'd like to ask you about your overall opinion of Duke Energy. Please rate how satisfied you are with Duke Energy as your electric supplier.

Not at all Satisfied										Completely Satisfied
0	1	2	3	4	5	6	7	8	9	10

Q2. We would also like to know how satisfied you are with several aspects of communication from Duke Energy. Please rate your overall satisfaction with each of the following.

	Very Satisfied	Somewhat Satisfied	Neither	Somewhat Dissatisfied	Very Dissatisfied
The information available about Duke Energy's efficiency programs.	☐	☐	☐	☐	☐
Duke Energy's commitment to promoting energy efficiency and the wise use of electricity.	☐	☐	☐	☐	☐
The information Duke Energy provides to help customers save on energy bills.	☐	☐	☐	☐	☐

Q3. When you log in to your Duke Energy account, which of the following have you done? Check all that apply.

- ☐ I have never logged in
- ☐ Pay my bill
- ☐ Review energy consumption graphs
- ☐ Look for energy efficiency opportunities or ideas
- ☐ None of the above

Q4. How often do you access the Duke Energy website to search for other information (for example: information about rebate programs, or how to make your home more energy efficient)? Select only one.

- ☐ Monthly
- ☐ A few times a year
- ☐ Once a year
- ☐ Never

Q5. If you needed to replace major home equipment or were considering improvements to your home's energy performance today, how likely would you be to check the Duke Energy website for information about energy efficient solutions or incentives?

Not at all Likely										Extremely Likely
0	1	2	3	4	5	6	7	8	9	10

Q6. Over the past 12 months, have you taken any actions to reduce your household energy use?

- ☐ Yes
- ☐ No – **Skip to Q8**

Q7. What actions have you taken? Check all that apply.

- ☐ Adjust heating settings to save energy
- ☐ Adjust cooling settings to save energy
- ☐ Wash clothes in cold water
- ☐ Shut down household electronics when not in use
- ☐ Turn off lights in unused or outdoor areas
- ☐ Line dry washed clothing
- ☐ Other, please specify: ____
- ☐ Other, please specify: ____

Q8a. Have you **already** made any of the following energy efficiency improvements in your home?

Q8b. **For the items you selected "No" on in 8a**, how likely are you to make those energy efficiency improvements **in the next 12 months?**

	Yes	No	Don't know	0 Not at all likely	1	2	3	4	5	6	7	8	9	10 Extremely likely	Don't know
Install energy-efficient kitchen appliances	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Install energy-efficient heating/cooling system	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Install energy-efficient water heater	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Replace windows or doors	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Caulk or weatherstrip (windows or doors)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Add insulation to attic, walls, or floors	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Contact a HVAC contractor for an estimate	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Request a home energy audit	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Q9. How important is it for you to know if your household is using energy wisely?

Not at all Important										Extremely Important
0	1	2	3	4	5	6	7	8	9	10

Q10. Which of the following do you do with regard to your household's energy use? Check all that apply.

- ☐ Track monthly energy use
- ☐ Track the total amount of your bill
- ☐ Compare usage to previous months
- ☐ Compare usage to the same month from last year
- ☐ None of the above

Q11. How would you rate your knowledge of the different ways you can save energy in your home?

Not at all Knowledgeable										Extremely Knowledgeable
0	1	2	3	4	5	6	7	8	9	10

Q12. Thinking about the information you have about your home's energy use, please rate how useful each of the following items would be for your household. Scale: 0 = Not at all Useful; 10 = Extremely Useful

	Not at all Useful										Extremely Useful
Your home's energy use compared to that of similar homes	0	1	2	3	4	5	6	7	8	9	10
Tips to help you save money and energy	0	1	2	3	4	5	6	7	8	9	10
Examples of the energy use associated with common household items	0	1	2	3	4	5	6	7	8	9	10
Customized suggestions for your home	0	1	2	3	4	5	6	7	8	9	10
Graphs that illustrate your home's energy use over time	0	1	2	3	4	5	6	7	8	9	10
Information about services and offers from Duke Energy	0	1	2	3	4	5	6	7	8	9	10

Q13. The statements below provide reasons why households might try to reduce their home's energy use. Please indicate how important each statement is to you. Scale: 0 = Not at all Important; 10 = Extremely Important

	Not at all Important										Extremely Important
Reducing my energy bill(s)	0	1	2	3	4	5	6	7	8	9	10
Using less energy	0	1	2	3	4	5	6	7	8	9	10
Helping the environment	0	1	2	3	4	5	6	7	8	9	10
Setting an example for others	0	1	2	3	4	5	6	7	8	9	10
Avoiding waste	0	1	2	3	4	5	6	7	8	9	10

Q14. Please indicate your level of agreement with each of the following statements:

	Strongly Disagree	Somewhat Disagree	Neither	Somewhat Agree	Strongly Agree
Duke Energy provides excellent customer service	☐	☐	☐	☐	☐
Duke Energy respects its customers	☐	☐	☐	☐	☐
Duke Energy provides service at a reasonable cost	☐	☐	☐	☐	☐

Q15. Before today, were you aware that you could order free or discounted lighting products through the Duke Energy website?

☐ Yes ☐ No – **Skip to Q16**

Q15a. How many **free** light bulbs have you ordered through the Duke Energy website this year? ________

Q15b. How many **discounted** light bulbs have you ordered through the Duke Energy website this year? ________

Q16. Do you own or rent this residence? ☐ Own ☐ Rent

Q17. Including yourself, how many people live in your home? __________

Q18. In what year was your home built? __________

Q19. How many square feet is the above-ground living space? __________

Q20. What is your primary heating fuel? ☐ Electricity ☐ Natural Gas ☐ Oil ☐ Other

Q21. In what year were you born? __________

Thank you! Please return your completed survey using the enclosed envelope.

Appendix D Survey Frequencies: DEO

Q1 First, we'd like to ask you about your overall opinion of Duke Energy. Please rate how satisfied you are with Duke Energy as your electric supplier. Scale: 0 = Not at all Satisfied; 10 = Completely Satisfied

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	0	1	1	3	4	18	9	33	37	51	88	4	249
Percent	**0**	**0**	**0**	**1**	**2**	**7**	**4**	**13**	**15**	**20**	**35**	**2**	**100**
Treatment	2	0	0	0	6	14	11	35	52	39	62	2	223
Percent	**1**	**0**	**0**	**0**	**3**	**6**	**5**	**16**	**23**	**17**	**28**	**1**	**100**
Total	2	1	1	3	10	32	20	68	89	90	150	6	472
Percent	**0**	**0**	**0**	**1**	**2**	**7**	**4**	**14**	**19**	**19**	**32**	**1**	**100**

Q2 We would also like to know how satisfied you are with several aspects of communication from Duke Energy. Please rate your overall satisfaction with each of the following.

Q2_1 The information available about Duke Energy's efficiency programs

Group	Very Satisfied	Somewhat Satisfied	Neither	Somewhat Dissatisfied	Very Dissatisfied	Don't know	Total
Control	84	69	55	7	14	20	249
Percent	**34**	**28**	**22**	**3**	**6**	**8**	**100**
Treatment	80	80	39	7	8	9	223
Percent	**36**	**36**	**17**	**3**	**4**	**4**	**100**
Total	164	149	94	14	22	29	472
Percent	**35**	**32**	**20**	**3**	**5**	**6**	**100**

Q2_2 Duke Energy's commitment to promoting energy efficiency and the wise use of electricity

Group	Very Satisfied	Somewhat Satisfied	Neither	Somewhat Dissatisfied	Very Dissatisfied	Don't know	Total
Control	97	64	48	8	15	17	249
Percent	**39**	**26**	**19**	**3**	**6**	**7**	**100**
Treatment	92	76	29	10	10	6	223
Percent	**41**	**34**	**13**	**4**	**4**	**3**	**100**
Total	189	140	77	18	25	23	472
Percent	**40**	**30**	**16**	**4**	**5**	**5**	**100**

Q2_3 The information Duke Energy provides to help customers save on energy bills

Group	Very Satisfied	Somewhat Satisfied	Neither	Somewhat Dissatisfied	Very Dissatisfied	Don't know	Total
Control	80	81	47	13	15	13	249
Percent	32	33	19	5	6	5	100
Treatment	81	86	30	11	10	5	223
Percent	36	39	13	5	4	2	100
Total	161	167	77	24	25	18	472
Percent	34.11	35	16	5	5	4	100

Q3 When you log in to your Duke Energy account, which of the following have you done? Check all that apply.

Q3_1 I have never logged in

Group	Checked	Not Checked	Total
Control	104	145	249
Percent	42	58	100
Treatment	84	139	223
Percent	38	62	100
Total	188	284	472
Percent	40	60	100

Q3_2 Pay my bill

Group	Checked	Not Checked	Total
Control	97	152	249
Percent	39	61	100
Treatment	88	135	223
Percent	39	61	100
Total	185	287	472
Percent	39	61	100

Q3_3 Review energy consumption graphs

Group	Checked	Not Checked	Total
Control	65	184	249
Percent	26	74	100
Treatment	59	164	223
Percent	26	74	100
Total	124	348	472
Percent	26	74	100

Q3_4 Look for energy efficiency opportunities or ideas

Group	Checked	Not Checked	Total
Control	37	212	249
Percent	**15**	**85**	**100**
Treatment	35	188	223
Percent	**16**	**84**	**100**
Total	72	400	472
Percent	**15**	**85**	**100**

Q3_5 None of the above

Group	Checked	Not Checked	Total
Control	22	227	249
percent	**9**	**91**	**100**
Treatment	30	193	223
percent	**13**	**87**	**100**
Total	52	420	472
percent	**11**	**89**	**100**

Q3_6 Don’t know

Group	Checked	Not Checked	Total
Control	3	246	249
percent	**1**	**99**	**100**
Treatment	5	218	223
percent	**2**	**98**	**100**
Total	8	464	472
percent	**2**	**98**	**100**

Q4 How often do you access the Duke Energy website to search for other information (for example: information about rebate programs, or how to make your home more energy efficient)? Select only one.

Group	Monthly	A few times a year	Once a year	Never	Don't know	Total
Control	35	39	27	145	3	249
Percent	**14**	**16**	**11**	**58**	**1**	**100**
Treatment	28	44	29	121	1	223
Percent	**13**	**20**	**13**	**54**	**0**	**100**
Total	63	83	56	266	4	472
Percent	**13**	**18**	**12**	**56**	**1**	**100**

Q5 If you needed to replace major home equipment or were considering improvements to your home's energy performance today, how likely would you be to check the Duke Energy website for information about energy efficient solutions or incentives? Scale: 0 = Not at all Likely; 10 = Extremely Likely

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	64	19	20	15	11	31	11	15	18	14	22	9	249
Percent	**26**	**8**	**8**	**6**	**4**	**12**	**4**	**6**	**7**	**6**	**9**	**4**	**100**
Treatment	54	20	18	18	8	27	14	16	15	11	13	9	223
Percent	**24**	**9**	**8**	**8**	**4**	**12**	**6**	**7**	**7**	**5**	**6**	**4**	**100**
Total	118	39	38	33	19	58	25	31	33	25	35	18	472
Percent	**25**	**8**	**8**	**7**	**4**	**12**	**5**	**7**	**7**	**5**	**7**	**4**	**100**

Q6 Over the past 12 months, have you taken any actions to reduce your household energy use?

Group	Yes	No	Don't know	Total
Control	173	68	8	249
Percent	**69**	**27**	**3**	**100**
Treatment	155	65	3	223
Percent	**70**	**29**	**1**	**100**
Total	328	133	11	472
Percent	**69**	**28**	**2**	**100**

Q7 What actions have you taken? Check all that apply.

Q7_1 Adjust heating settings to save energy

Group	Not Checked	Checked	Total
Control	94	155	249
Percent	**38**	**62**	**100**
Treatment	97	126	223
Percent	**44**	**57**	**100**
Total	191	281	472
Percent	**40**	**60**	**100**

Q7_2 Adjust cooling settings to save energy

Group	Not Checked	Checked	Total
Control	105	144	249
Percent	**42**	**58**	**100**
Treatment	105	118	223
Percent	**47**	**53**	**100**
Total	210	262	472
Percent	**44**	**56**	**100**

Q7_3 Wash clothes in cold water

Group	Not Checked	Checked	Total
Control	170	79	249
Percent	**68**	**32**	**100**
Treatment	146	77	223
Percent	**65**	**35**	**100**
Total	316	156	472
Percent	**67**	**33**	**100**

Q7_4 Shut down household electronics when not in use

Group	Not Checked	Checked	Total
Control	144	105	249
Percent	**58**	**42**	**100**
Treatment	131	92	223
Percent	**59**	**41**	**100**
Total	275	197	472
Percent	**58**	**42**	**100**

Q7_5 Turn off lights in unused or outdoor areas

Group	Not Checked	Checked	Total
Control	99	150	249
Percent	40	60	100
Treatment	87	136	223
Percent	39	61	100
Total	186	286	472
Percent	39	61	100

Q7_6 Line dry washed clothing

Group	Not Checked	Checked	Total
Control	218	31	249
Percent	88	12	100
Treatment	198	25	223
Percent	89	11	100
Total	416	56	472
Percent	88	12	100

Q7_7 Other

Group	Not Checked	Checked	Total
Control	198	51	249
Percent	80	20	100
Treatment	174	49	223
Percent	78	22	100
Total	372	100	472
Percent	79	21	100

Q7_8 Other

Group	Not Checked	Checked	Total
Control	240	9	249
Percent	96	4	100
Treatment	215	8	223
Percent	96	4	100
Total	455	17	472
Percent	96	4	100

***Q8a*. Have you already made any of the following energy efficiency improvements in your home?**

Q8b. For the items you selected "No" in 8a, how likely are you to make those energy efficiency improvements in the next 12 months? Scale: 0 = Not at all Likely; 10 = Extremely Likely

Q8a_1 Install energy efficient kitchen appliances

Group	Yes	No	Don't know	Total
Control	131	94	24	249
Percent	**53**	**38**	**10**	**100**
Treatment	130	77	16	223
Percent	**58**	**35**	**7**	**100**
Total	261	171	40	472
Percent	**55**	**36**	**8**	**100**

Q8b_x1 Install energy efficient kitchen appliances

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	29	6	10	3	3	7	7	2	7	2	2	16	94
Percent	**31**	**6**	**11**	**3**	**3**	**7**	**7**	**2**	**7**	**2**	**2**	**17**	**100**
Treatment	33	7	7	7	2	2	2	2	2	2	1	10	77
Percent	**43**	**9**	**9**	**9**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**13**	**100**
Total	62	13	17	10	5	9	9	4	9	4	3	26	171
Percent	**36**	**8**	**10**	**6**	**3**	**5**	**5**	**2**	**5**	**2**	**2**	**15**	**100**

Q8a_2 Install energy-efficient heating/cooling system

Group	Yes	No	Don't know	Total
Control	125	102	22	249
Percent	**50**	**41**	**9**	**100**
Treatment	124	84	15	223
Percent	**56**	**38**	**7**	**100**
Total	249	186	37	472
Percent	**53**	**39**	**8**	**100**

Q8b_x2 Install energy-efficient heating/cooling system

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	36	8	9	3	6	7	6	4	1	2	4	16	102
Percent	**35**	**8**	**9**	**3**	**6**	**7**	**6**	**4**	**1**	**2**	**4**	**16**	**100**
Treatment	35	10	3	2	2	6	7	3	3	1	2	10	84
Percent	**42**	**12**	**4**	**2**	**2**	**7**	**8**	**4**	**4**	**1**	**2**	**12**	**100**
Total	71	18	12	5	8	13	13	7	4	3	6	26	186
Percent	**38**	**10**	**6**	**3**	**4**	**7**	**7**	**4**	**2**	**2**	**3**	**14**	**100**

Q8a_3 Install energy-efficient water heater

Group	Yes	No	Don't know	Total
Control	121	104	24	249
Percent	**49**	**42**	**10**	**100**
Treatment	122	80	21	223
Percent	**55**	**36**	**9**	**100**
Total	243	184	45	472
Percent	**51**	**39**	**10**	**100**

Q8b_x3 Install energy-efficient water heater

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	36	5	9	8	3	11	4	3	2	1	4	18	104
Percent	**35**	**5**	**9**	**8**	**3**	**11**	**4**	**3**	**2**	**1**	**4**	**17**	**100**
Treatment	32	8	4	5	0	6	4	3	2	2	2	12	80
Percent	**40**	**10**	**5**	**6**	**0**	**8**	**5**	**4**	**3**	**3**	**3**	**15**	**100**
Total	68	13	13	13	3	17	8	6	4	3	6	30	184
Percent	**37**	**7**	**7**	**7**	**2**	**9**	**4**	**3**	**2**	**2**	**3**	**16**	**100**

Q8a_4 Replace windows or doors

Group	Yes	No	Don't know	Total
Control	126	114	9	249
Percent	**51**	**46**	**4**	**100**
Treatment	97	117	9	223
Percent	**44**	**52**	**4**	**100**
Total	223	231	18	472
Percent	**47**	**49**	**4**	**100**

Q8b_x4 Replace windows or doors

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	52	6	7	5	2	7	7	4	1	4	4	15	114
Percent	46	5	6	4	2	6	6	4	1	4	4	13	100
Treatment	54	11	2	7	4	6	4	2	5	3	4	15	117
Percent	46	9	2	6	3	5	3	2	4	3	3	13	100
Total	106	17	9	12	6	13	11	6	6	7	8	30	231
Percent	46	7	4	5	3	6	5	3	3	3	3	13	100

Q8a_5 Caulk or weatherstrip (windows or doors)

Group	Yes	No	Don't know	Total
Control	124	107	18	249
Percent	50	43	7	100
Treatment	109	106	8	223
Percent	49	48	4	100
Total	233	213	26	472
Percent	49	45	6	100

Q8b_x5 Caulk or weatherstrip (windows or doors)

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	36	5	5	5	3	14	8	5	1	5	5	15	107
Percent	34	5	5	5	3	13	7	5	1	5	5	14	100
Treatment	29	5	6	8	4	15	4	3	5	2	9	16	106
Percent	27	5	6	8	4	14	4	3	5	2	8	15	100
Total	65	10	11	13	7	29	12	8	6	7	14	31	213
Percent	31	5	5	6	3	14	6	4	3	3	7	15	100

Q8a_6 Add insulation to attic, walls, or floors

Group	Yes	No	Don't know	Total
Control	82	150	17	249
Percent	33	60	7	100
Treatment	70	140	13	223
Percent	31	63	6	100
Total	152	290	30	472
Percent	32	61	6	100

Q8b_x6 *Add insulation to attic, walls, or floors*

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	58	14	16	10	6	9	9	6	0	1	3	18	150
Percent	**39**	**9**	**11**	**7**	**4**	**6**	**6**	**4**	**0**	**1**	**2**	**12**	**100**
Treatment	56	11	12	3	9	13	3	7	6	1	2	17	140
Percent	**40**	**8**	**9**	**2**	**6**	**9**	**2**	**5**	**4**	**1**	**1**	**12**	**100**
Total	114	25	28	13	15	22	12	13	6	2	5	35	290
Percent	**39**	**9**	**10**	**4**	**5**	**8**	**4**	**4**	**2**	**1**	**2**	**12**	**100**

Q8a_7 *Contact a HVAC contractor for an estimate*

Group	Yes	No	Don't know	Total
Control	34	196	19	249
Percent	**14**	**79**	**8**	**100**
Treatment	47	161	15	223
Percent	**21**	**72**	**7**	**100**
Total	81	357	34	472
Percent	**17**	**76**	**7**	**100**

Q8b_x7 *Contact a HVAC contractor for an estimate*

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	94	16	15	7	3	8	6	5	3	2	4	33	196
Percent	**48**	**8**	**8**	**4**	**2**	**4**	**3**	**3**	**2**	**1**	**2**	**17**	**100**
Treatment	90	14	6	3	3	6	4	2	5	0	3	25	161
Percent	**56**	**9**	**4**	**2**	**2**	**4**	**2**	**1**	**3**	**0**	**2**	**16**	**100**
Total	184	30	21	10	6	14	10	7	8	2	7	58	357
Percent	**52**	**8**	**6**	**3**	**2**	**4**	**3**	**2**	**2**	**1**	**2**	**16**	**100**

Q8a_8 *Request a home energy audit*

Group	Yes	No	Don't know	Total
Control	18	215	16	249
Percent	**7**	**86**	**6**	**100**
Treatment	15	194	14	223
Percent	**7**	**87**	**6**	**100**
Total	33	409	30	472
Percent	**7**	**87**	**6**	**100**

Q8b_x8 Request a home energy audit

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	83	20	20	9	6	7	8	4	6	3	7	42	215
Percent	**39**	**9**	**9**	**4**	**3**	**3**	**4**	**2**	**3**	**1**	**3**	**20**	**100**
Treatment	89	15	10	9	9	17	4	5	3	3	3	27	194
Percent	**46**	**8**	**5**	**5**	**5**	**9**	**2**	**3**	**2**	**2**	**2**	**14**	**100**
Total	172	35	30	18	15	24	12	9	9	6	10	69	409
Percent	**42**	**9**	**7**	**4**	**4**	**6**	**3**	**2**	**2**	**1**	**2**	**17**	**100**

Q9 How important is it for you to know if your household is using energy wisely?

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	3	0	3	6	5	38	21	27	41	42	58	5	249
Percent	**1**	**0**	**1**	**2**	**2**	**15**	**8**	**11**	**16**	**17**	**23**	**2**	**100**
Treatment	8	1	8	5	10	28	12	34	42	23	50	2	223
Percent	**4**	**0**	**4**	**2**	**4**	**13**	**5**	**15**	**19**	**10**	**22**	**1**	**100**
Total	11	1	11	11	15	66	33	61	83	65	108	7	472
Percent	**2**	**0**	**2**	**2**	**3**	**14**	**7**	**13**	**18**	**14**	**23**	**1**	**100**

Q10 Which of the following do you do with regard to your household's energy use? Check all that apply.

Q10_1 Track monthly energy use

Group	Not Checked	Checked	Total
Control	166	83	249
Percent	**67**	**33**	**100**
Treatment	110	113	223
Percent	**49**	**51**	**100**
Total	276	196	472
Percent	**58**	**42**	**100**

Q10_2 Track the total amount of your bill

Group	Not Checked	Checked	Total
Control	88	161	249
Percent	**35**	**65**	**100**
Treatment	71	152	223
Percent	**32**	**68**	**100**
Total	159	313	472
Percent	**34**	**66**	**100**

Q10_3 Compare usage to previous months

Group	Not Checked	Checked	Total
Control	83	166	249
Percent	**33**	**67**	**100**
Treatment	86	137	223
Percent	**39**	**61**	**100**
Total	169	303	472
Percent	**36**	**64**	**100**

Q10_4 Compare usage to the same month from last year

Group	Not Checked	Checked	Total
Control	131	118	249
Percent	**53**	**47**	**100**
Treatment	92	131	223
Percent	**41**	**59**	**100**
Total	223	249	472
Percent	**47**	**53**	**100**

Q10_5 None of the above

Group	Not Checked	Checked	Total
Control	220	29	249
Percent	**88**	**12**	**100**
Treatment	198	25	223
Percent	**89**	**11**	**100**
Total	418	54	472
Percent	**89**	**11**	**100**

Q10_6 Don’t know

Group	Not Checked	Checked	Total
Control	243	6	249
Percent	**98**	**2**	**100**
Treatment	219	4	223
Percent	**98**	**2**	**100**
Total	462	10	472
Percent	**98**	**2**	**100**

Q11 How would you rate your knowledge of the different ways you can save energy in your home? Scale: 0 = Not at all Knowledgeable; 10 = Extremely Knowledgeable

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	6	0	6	20	19	36	27	46	48	17	18	6	249
Percent	**2**	**0**	**2**	**8**	**8**	**14**	**11**	**18**	**19**	**7**	**7**	**2**	**100**
Treatment	7	4	3	8	10	34	27	52	43	17	16	2	223
Percent	**3**	**2**	**1**	**4**	**4**	**15**	**12**	**23**	**19**	**8**	**7**	**1**	**100**
Total	13	4	9	28	29	70	54	98	91	34	34	8	472
Percent	**3**	**1**	**2**	**6**	**6**	**15**	**11**	**21**	**19**	**7**	**7**	**2**	**100**

Q12 Duke Energy sends a personalized report called My Home Energy Report to a select group of homes. These documents are mailed in a standard envelope every few months and provide customers with information on how their home's electric energy usage compares with similar homes. Have you seen one of these reports? (Only for treatment group)

Group	Yes	No	Don't know	Missing	Total
Treatment	200	13	**10**	**0**	**223**
Percent	**90**	**6**	**4**	**0**	**100**

Q13 About how many My Home Energy Reports have you received in the past 12 months? (Only for treatment group)

Group	0	1	2	3	4	5	6	7	8	9	10	11	12	Don't know	Missing	Total
Treatment	3	16	14	15	37	8	41	2	3	2	5	2	50	2	23	223
Percent	**1**	**7**	**6**	**7**	**17**	**4**	**18**	**1**	**1**	**1**	**2**	**1**	**22**	**0**	**10**	**100**

Q14 How often do you read the My Home Energy Reports? (Only for treatment group)

Group	Always	Sometimes	Never	Missing	Total
Treatment	140	52	4	27	223
percent	**63**	**23**	**2**	**12**	**100**

Q15 Please indicate how much you agree or disagree with the following statements about My Home Energy Reports. Scale: 0 = Strongly Disagree; 10 = Strongly Agree (Only for treatment group)

Q15_1 I have learned about my household's energy use from My Home Energy Reports

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Missing	Total
Treatment	8	2	3	6	9	23	10	30	28	26	45	2	31	223
Percent	**4**	**1**	**1**	**3**	**4**	**10**	**4**	**13**	**13**	**12**	**20**	**1**	**14**	**100**

Q15_2 I use the reports to tell me how well I am doing at saving energy

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Missing	Total
Treatment	13	5	9	7	8	23	9	29	19	22	46	2	31	223
Percent	**6**	**2**	**4**	**3**	**4**	**10**	**4**	**13**	**9**	**10**	**21**	**1**	**14**	**100**

Q15_3 The tips provided in the reports are pertinent to my home

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Missing	Total
Treatment	9	6	10	12	14	37	16	25	23	11	25	4	31	223
Percent	**4**	**3**	**4**	**5**	**6**	**17**	**7**	**11**	**10**	**5**	**11**	**2**	**14**	**100**

Q15_4 My Home Energy Reports provide the details I need to understand my home's energy use

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Missing	Total
Treatment	8	11	4	9	11	28	16	19	38	14	32	2	31	223
Percent	**4**	**5**	**2**	**4**	**5**	**13**	**7**	**9**	**17**	**6**	**14**	**1**	**14**	**100**

Q15_5 I have discussed My Home Energy Reports with others

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Missing	Total
Treatment	55	22	9	11	5	23	11	7	16	6	22	5	31	223
Percent	**25**	**10**	**4**	**5**	**2**	**10**	**5**	**3**	**7**	**3**	**10**	**2**	**14**	**100**

Q15_6 The information provided about my home's energy use is confusing

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Missing	Total
Treatment	69	27	24	13	3	25	7	8	4	2	6	4	31	223
Percent	**31**	**12**	**11**	**6**	**1**	**11**	**3**	**4**	**2**	**1**	**3**	**2**	**14**	**100**

Q17 Below is a list of My Home Energy Report features. Please rate how useful each feature is to you.
Scale: 0 = Not at all Useful; 10 = Extremely Useful (for treatment group)

Q17_1 Comparison to similar homes

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Missing	Total
Treatment	14	7	7	9	8	23	12	17	23	24	45	3	31	223
Percent	**6**	**3**	**3**	**4**	**4**	**10**	**5**	**8**	**10**	**11**	**20**	**1**	**14**	**100**

Q17_2 Tips to help you save money and energy

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Missing	Total
Treatment	7	4	2	11	5	29	11	20	35	26	37	5	31	223
Percent	**3**	**2**	**1**	**5**	**2**	**13**	**5**	**9**	**16**	**12**	**17**	**2**	**14**	**100**

Q17_3 Examples of the energy use associated with common household items

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Missing	Total
Treatment	8	3	4	7	9	19	12	30	29	26	40	5	31	223
Percent	**4**	**1**	**2**	**3**	**4**	**9**	**5**	**13**	**13**	**12**	**18**	**2**	**14**	**100**

Q17_4 Customized suggestions for your home

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Missing	Total
Treatment	9	6	6	8	12	26	13	21	33	21	27	10	31	223
Percent	**4**	**3**	**3**	**4**	**5**	**12**	**6**	**9**	**15**	**9**	**12**	**4**	**14**	**100**

Q17_5 Graphs that illustrate your home's energy use over time

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Missing	Total
Treatment	7	3	0	3	4	21	9	17	29	29	66	4	31	223
Percent	**3**	**1**	**0**	**1**	**2**	**9**	**4**	**8**	**13**	**13**	**30**	**2**	**14**	**100**

Q17_6 Information about services and offers from Duke Energy

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Missing	Total
Treatment	6	6	3	11	5	37	15	24	30	20	27	8	31	223
Percent	**3**	**3**	**1**	**5**	**2**	**17**	**7**	**11**	**13**	**9**	**12**	**4**	**14**	**100**

Q17a Thinking about the information you have about your home's energy use, please rate how useful each of the following items would be for your household. Scale: 0 = Not at all Useful; 10 = Extremely Useful (for control group)

Q17a_1 Your home's energy use compared to that of similar homes

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Missing	Total
Control	26	7	11	9	4	27	18	35	33	27	34	0	18	249
Percent	10	3	4	4	2	11	7	14	13	11	14	0	7	100

Q17a_2 Tips to help you save money and energy

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Missing	Total
Control	13	4	7	7	2	21	14	34	42	33	60	0	12	249
Percent	5	2	3	3	1	8	6	14	17	13	24	0	5	100

Q17a_3 Examples of the energy use associated with common household items

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Missing	Total
Control	21	6	6	6	8	26	17	35	37	30	44	0	13	249
Percent	8	2	2	2	3	10	7	14	15	12	18	0	5	100

Q17a_4 Customized suggestions for your home

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Missing	Total
Control	23	11	12	8	7	23	15	23	34	33	42	0	18	249
Percent	9	4	5	3	3	9	6	9	14	13	17	0	7	100

Q17a_5 Graphs that illustrate your home's energy use over time

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Missing	Total
Control	22	4	5	8	6	19	16	27	40	29	60	0	13	249
Percent	9	2	2	3	2	8	6	11	16	12	24	0	5	100

Q17a_6 Information about services and offers from Duke Energy

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Missing	Total
Control	20	4	4	8	6	29	21	25	41	35	40	0	16	249
Percent	8	2	2	3	2	12	8	10	16	14	16	0	6	100

Q18 Please rate your satisfaction with the information in the My Home Energy Reports you've received. Scale: 0 = Not at all Satisfied; 10 = Completely Satisfied (Only for treatment group)

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Missing	Total
Treatment	5	3	4	5	5	25	15	24	41	21	40	4	31	223
Percent	**2**	**1**	**2**	**2**	**2**	**11**	**7**	**11**	**18**	**9**	**18**	**2**	**14**	**100**

Q19 Before today, were you aware that you can go online to My Home Energy Interactive to access more features, above and beyond those found in the My Home Energy Report, that provide more ways to save energy?(Only for treatment group)

Group	No	Yes	Don't know	Missing	Total
Treatment	134	47	11	31	223
Percent	**60**	**21**	**5**	**14**	**100**

Q19a Have you signed up to use My Home Energy Interactive?(Only for treatment group)

Group	No	Yes	Missing	Total
Treatment	33	7	7	47
Percent	**70**	**15**	**15**	**100**

Q19b Please rate how useful My Home Energy Interactive is to you for saving energy. Scale: 0 = Not at all Useful; 10 = Extremely Useful (Only for treatment group)

Group	0	1	2	3	4	5	6	7	8	9	10	Missing	Total
Treatment	1	0	0	0	0	1	1	0	1	1	2	0	7
Percent	**14**	**0**	**0**	**0**	**0**	**14**	**14**	**0**	**14**	**14**	**29**	**0**	**100**

Q20 The statements below provide reasons why households might try to reduce their home's energy use. Please indicate how important each statement is to you. Scale: 0 = Not at all Important; 10 = Extremely Important

Q20_1 Reducing my energy bill(s)

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	2	0	2	2	3	12	6	24	31	34	129	4	249
Percent	**1**	**0**	**1**	**1**	**1**	**5**	**2**	**10**	**12**	**14**	**52**	**2**	**100**
Treatment	5	1	0	3	1	14	5	16	22	40	114	2	223
Percent	**2**	**0**	**0**	**1**	**0**	**6**	**2**	**7**	**10**	**18**	**51**	**1**	**100**
Total	7	1	2	5	4	26	11	40	53	74	243	6	472
Percent	**1**	**0**	**0**	**1**	**1**	**6**	**2**	**8**	**11**	**16**	**51**	**1**	**100**

Q20_2 *Using less energy*

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	4	0	1	3	5	19	14	32	41	41	84	5	249
Percent	2	0	0	1	2	8	6	13	16	16	34	2	100
Treatment	6	1	1	6	6	24	9	24	24	35	85	2	223
percent	3	0	0	3	3	11	4	11	11	16	38	1	100
Total	10	1	2	9	11	43	23	56	65	76	169	7	472
percent	2	0	0	2	2	9	5	12	14	16	36	1	100

Q20_3 *Helping the environment*

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	7	2	2	6	7	29	15	22	32	42	79	6	249
Percent	3	1	1	2	3	12	6	9	13	17	32	2	100
Treatment	10	2	3	3	10	22	16	24	30	19	82	2	223
Percent	4	1	1	1	4	10	7	11	13	9	37	1	100
Total	17	4	5	9	17	51	31	46	62	61	161	8	472
Percent	4	1	1	2	4	11	7	10	13	13	34	2	100

Q20_4 *Setting an example for others*

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	32	8	7	18	8	42	16	23	20	21	45	9	249
Percent	13	3	3	7	3	17	6	9	8	8	18	4	100
Treatment	32	9	10	11	11	35	13	19	22	13	41	7	223
Percent	14	4	4	5	5	16	6	9	10	6	18	3	100
Total	64	17	17	29	19	77	29	42	42	34	86	16	472
Percent	14	4	4	6	4	16	6	9	9	7	18	3	100

Q20_5 *Avoiding waste*

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	5	0	4	1	4	15	9	30	45	45	85	6	249
Percent	2	0	2	0	2	6	4	12	18	18	34	2	100
Treatment	7	1	2	5	9	14	10	21	34	34	82	4	223
Percent	3	0	1	2	4	6	4	9	15	15	37	2	100
Total	12	1	6	6	13	29	19	51	79	79	167	10	472
Percent	3	0	1	1	3	6	4	11	17	17	35	2	100

Q21 Please indicate your level of agreement with each of the following statements:

Q21_1 Duke Energy provides excellent customer service

Group	Strongly Disagree	Somewhat Disagree	Neither	Somewhat Agree	Strongly Agree	Don't know	Total
Control	9	5	31	87	98	19	249
Percent	4	2	12	35	39	8	100
Treatment	11	7	38	70	86	11	223
Percent	5	3	17	31	39	5	100
Total	20	12	69	157	184	30	472
Percent	4	3	15	33	39	6	100

Q21_2 Duke Energy respects its customers

Group	Strongly disagree	Somewhat Disagree	Neither	Somewhat Agree	Strongly Agree	Don't know	Total
Control	8	7	33	86	86	29	249
Percent	3	3	13	35	35	12	100
Treatment	12	11	38	69	79	14	223
Percent	5	5	17	31	35	6	100
Total	20	18	71	155	165	43	472
Percent	4	4	15	33	35	9	100

Q21_3 Duke Energy provides service at a reasonable cost

Group	Strongly Disagree	Somewhat Disagree	Neither	Somewhat Agree	Strongly Agree	Don't know	Total
Control	9	27	44	98	48	23	249
Percent	4	11	18	39	19	9	100
Treatment	13	26	45	82	42	15	223
Percent	6	12	20	37	19	7	100
Total	22	53	89	180	90	38	472
Percent	5	11	19	38	19	8	100

Q22 Before today, were you aware that you could order free or discounted lighting products through the Duke Energy website?

Group	Yes	No	Don't know	Total
Control	172	68	9	249
Percent	69	27	4	100
Treatment	146	70	7	223
Percent	65	31	4	100
Total	318	138	16	472
Percent	67	29	3	100

Q22a How many free light bulbs have you ordered through the Duke Energy website this year?

Group	0	1	2	4	5	6	8	9	10	12	16	24	36	Missing	Total
Control	126	7	2	2	1	6	3	1	5	18	1	0	0	0	172
Percent	73	4	1	1	1	3	2	1	3	10	1	0	0	0	100
Treatment	102	6	3	5	0	10	3	0	3	11	0	1	1	1	146
Percent	70	4	2	3	0	7	2	0	2	8	0	1	1	1	100
Total	228	13	5	7	1	16	6	1	8	29	1	1	1	1	318
Percent	72	4	2	2	0	5	2	0	3	9	0	0	0	0	100

Q22b How many discounted light bulbs have you ordered through the Duke Energy website this year?

Group	0	1	2	4	5	6	8	10	12	15	20	24	40	Total
Control	146	2	1	3	1	2	5	1	7	0	2	2	0	172
Percent	85	1	1	2	1	1	3	1	4	0	1	1	0	100
Treatment	122	2	0	2	0	5	3	2	8	1	0	0	1	146
Percent	84	1	0	1	0	3	2	1	5	1	0	0	1	100
Total	268	4	1	5	1	7	8	3	15	1	2	2	1	318
Percent	84	1	0	2	0	2	3	1	5	0	1	1	0	100

Q23 Do you own or rent this residence?

Group	Own	Rent	Missing	Total
Control	238	10	1	249
Percent	96	4	0	100
Treatment	212	5	6	223
Percent	95	2	3	100
Total	450	15	7	472
Percent	95	3	1	100

Q24 Including yourself, how many people live in your home?

Group	1	2	3	4	5	6	7	8	9	11	Missing	Total
Control	52	104	35	33	14	5	0	1	1	0	4	249
Percent	**21**	**42**	**14**	**13**	**6**	**2**	**0**	**0**	**0**	**0**	**2**	**100**
Treatment	43	91	29	34	11	6	1	0	0	1	7	223
Percent	**19**	**41**	**13**	**15**	**5**	**3**	**0**	**0**	**0**	**0**	**3**	**100**
Total	95	195	64	67	25	11	1	1	1	1	11	472
Percent	**20**	**41**	**14**	**14**	**5**	**2**	**0**	**0**	**0**	**0**	**2**	**100**

Q27 What is your primary heating fuel?

Group	Electricity	Natural Gas	Oil	Other	Missing	Total
Control	66	151	14	17	1	249
Percent	**27**	**61**	**6**	**7**	**0**	**100**
Treatment	60	140	8	14	1	223
Percent	**27**	**63**	**4**	**6**	**0**	**100**
Total	126	291	22	31	2	472
Percent	**27**	**62**	**5**	**7**	**0**	**100**

Appendix E Detailed Regression Outputs/Models

Table E-1: Regression Coefficients for Cohort 1

Linear regression, absorbing indicators, Number of obs = 2086841
F(201,2060680) = 3350.95
Prob > F = 0.0000
R-squared = 0.6756
Adj R-squared = 0.6714
Root MSE = 17.1772

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
i.ym						
2009-01	33.658	0.238241	141.28	0.00	33.26613	34.04987
2009-02	11.89564	0.238242	49.93	0.00	11.50377	12.28752
2009-03	-1.09217	0.238241	-4.58	0.00	-1.48404	-0.7003
2009-04	-7.4968	0.238244	-31.47	0.00	-7.88868	-7.10493
2009-05	-8.01203	0.239499	-33.45	0.00	-8.40597	-7.61809
2009-06	1.659879	0.238247	6.97	0.00	1.267996	2.051761
2009-07	14.51272	0.23824	60.92	0.00	14.12085	14.90459
2009-08	3.474049	0.23824	14.58	0.00	3.082179	3.865919
2009-09	-5.0375	0.23824	-21.14	0.00	-5.42937	-4.64563
2009-10	-8.1003	0.238241	-34.00	0.00	-8.49217	-7.70843
2009-11	-2.92265	0.23824	-12.27	0.00	-3.31452	-2.53078
2009-12	11.35304	0.23827	47.65	0.00	10.96112	11.74496
2010-01	33.52158	0.238264	140.69	0.00	33.12968	33.91349
2010-02	12.69858	0.585143	21.70	0.00	11.73611	13.66106
2010-03	-0.38113	0.252244	-1.51	0.13	-0.79603	0.033779
2010-04	-10.4065	0.252568	-41.20	0.00	-10.822	-9.99109
2010-05	-6.75389	0.252849	-26.71	0.00	-7.16979	-6.33799
2010-06	6.521083	0.253217	25.75	0.00	6.104579	6.937588
2010-07	13.4786	0.253694	53.13	0.00	13.06131	13.89589
2010-08	10.52701	0.254018	41.44	0.00	10.10919	10.94483
2010-09	-2.37775	0.254368	-9.35	0.00	-2.79615	-1.95935
2010-10	-10.0158	0.254672	-39.33	0.00	-10.4347	-9.59687
2010-11	-2.47364	0.255033	-9.70	0.00	-2.89314	-2.05415
2010-12	12.22203	0.255338	47.87	0.00	11.80203	12.64202
2011-01	15.64681	0.258612	60.50	0.00	15.22143	16.07219
2011-02	9.036023	0.258949	34.90	0.00	8.610091	9.461956
2011-03	-1.4797	0.25925	-5.71	0.00	-1.90613	-1.05327

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
2011-04	-8.30432	0.259657	-31.98	0.00	-8.73141	-7.87722
2011-05	-6.20606	0.260071	-23.86	0.00	-6.63384	-5.77828
2011-06	2.73492	0.260474	10.50	0.00	2.306479	3.163362
2011-07	13.43376	0.261019	51.47	0.00	13.00442	13.86309
2011-08	8.493033	0.261609	32.46	0.00	8.062724	8.923342
2011-09	-5.93311	0.262204	-22.63	0.00	-6.36439	-5.50182
2011-10	-10.851	0.262676	-41.31	0.00	-11.283	-10.4189
2011-11	-4.91931	0.263226	-18.69	0.00	-5.35228	-4.48635
2011-12	4.542951	0.263701	17.23	0.00	4.109201	4.976702
2012-01	20.35654	0.264092	77.08	0.00	19.92215	20.79094
2012-02	3.740604	0.264486	14.14	0.00	3.305563	4.175645
2012-03	-7.091	0.264871	-26.77	0.00	-7.52667	-6.65532
2012-04	-11.2785	0.265332	-42.51	0.00	-11.7149	-10.842
2012-05	-6.85569	0.265739	-25.80	0.00	-7.29279	-6.41859
2012-06	4.436332	0.266299	16.66	0.00	3.998309	4.874356
2012-07	13.06565	0.266946	48.94	0.00	12.62656	13.50473
2012-08	4.648605	0.267514	17.38	0.00	4.208584	5.088627
2012-09	-6.40255	0.268081	-23.88	0.00	-6.8435	-5.96159
2012-10	-10.4247	0.268641	-38.81	0.00	-10.8665	-9.98278
2012-11	-3.50133	0.269306	-13.00	0.00	-3.9443	-3.05836
2012-12	3.933978	0.269847	14.58	0.00	3.490119	4.377836
2013-01	9.703164	0.270259	35.90	0.00	9.258627	10.1477
2013-02	8.924066	0.27081	32.95	0.00	8.478623	9.369509
2013-03	3.222245	0.271268	11.88	0.00	2.776049	3.668442
2013-04	-6.05386	0.27175	-22.28	0.00	-6.50085	-5.60687
2013-05	-1.63317	0.27233	-6.00	0.00	-2.08111	-1.18523
2013-06	-1.52936	0.27309	-5.60	0.00	-1.97855	-1.08017
2013-07	3.280588	0.273848	11.98	0.00	2.830148	3.731028
2013-08	0.860867	0.274687	3.13	0.00	0.409046	1.312687
2013-09	-3.99203	0.275419	-14.49	0.00	-4.44506	-3.53901
2013-10	-10.6444	0.276131	-38.55	0.00	-11.0986	-10.1902
2013-11	-2.16451	0.276774	-7.82	0.00	-2.61976	-1.70926
2013-12	9.752259	0.277385	35.16	0.00	9.296002	10.20852
2014-01	18.42567	0.278034	66.27	0.00	17.96835	18.883
2014-02	16.53404	0.278484	59.37	0.00	16.07597	16.9921
2014-03	2.683403	0.279001	9.62	0.00	2.224487	3.142318
2014-04	-9.88029	0.279485	-35.35	0.00	-10.34	-9.42058
2014-05	-10.1074	0.280094	-36.09	0.00	-10.5681	-9.64666
2014-06	-1.62427	0.280913	-5.78	0.00	-2.08633	-1.16221

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
2014-07	-0.33151	0.281824	-1.18	0.24	-0.79507	0.132053
2014-08	-0.59193	0.282746	-2.09	0.04	-1.05701	-0.12686
2014-09	-6.96708	0.283586	-24.57	0.00	-7.43354	-6.50063
2014-10	-12.0313	0.284517	-42.29	0.00	-12.4993	-11.5633
2014-11	-1.51317	0.285449	-5.30	0.00	-1.98269	-1.04365
2014-12	10.30468	0.285954	36.04	0.00	9.834325	10.77503
2015-01	12.05155	0.286614	42.05	0.00	11.58012	12.52299
2015-02	15.81157	0.287101	55.07	0.00	15.33933	16.2838
2015-03	2.934723	0.287279	10.22	0.00	2.462191	3.407254
2015-04	-11.0843	0.287552	-38.55	0.00	-11.5573	-10.6113
2015-05	-8.76126	0.287837	-30.44	0.00	-9.23471	-8.28781
2015-06	6.663051	0.288121	23.13	0.00	6.189134	7.136968
2015-07	1.330085	0.288479	4.61	0.00	0.855579	1.80459
2015-08	0.793802	0.288885	2.75	0.01	0.318629	1.268975
2015-09	-6.66738	0.289223	-23.05	0.00	-7.14311	-6.19165
2015-10	-13.6662	0.289538	-47.20	0.00	-14.1425	-13.19
2015-11	-8.85278	0.289737	-30.55	0.00	-9.32936	-8.37621
2015-12	-1.46959	0.289928	-5.07	0.00	-1.94648	-0.9927
2016-01	7.902764	0.290148	27.24	0.00	7.425513	8.380016
2016-02	4.594127	0.290323	15.82	0.00	4.116588	5.071666
2016-03	-7.03991	0.290443	-24.24	0.00	-7.51765	-6.56218
2016-04	-12.0626	0.29075	-41.49	0.00	-12.5408	-11.5843
2016-05	-11.5835	0.291115	-39.79	0.00	-12.0623	-11.1046
2016-06	-0.80367	0.291456	-2.76	0.01	-1.28307	-0.32427
2016-07	6.447346	0.291857	22.09	0.00	5.967284	6.927407
2016-08	6.820104	0.292281	23.33	0.00	6.339344	7.300864
2016-09	-3.11693	0.29275	-10.65	0.00	-3.59846	-2.6354
2016-10	-13.1718	0.293105	-44.94	0.00	-13.6539	-12.6897
2016-11	-8.1103	0.293374	-27.64	0.00	-8.59286	-7.62775
2016-12	4.800887	0.293584	16.35	0.00	4.317985	5.283789
2017-01	4.054243	0.293946	13.79	0.00	3.570744	4.537742
2017-02	-2.70971	0.294211	-9.21	0.00	-3.19364	-2.22577
2017-03	-6.13681	0.294405	-20.84	0.00	-6.62106	-5.65256
2017-04	-13.354	0.294796	-45.30	0.00	-13.8389	-12.8691
2017-05	-11.0478	0.295034	-37.45	0.00	-11.5331	-10.5625
2017-06	-2.82999	0.295306	-9.58	0.00	-3.31572	-2.34425
2017-07	2.010997	0.29579	6.80	0.00	1.524465	2.497529
2017-08	-2.62435	0.296088	-8.86	0.00	-3.11138	-2.13733
2017-09	-9.14015	0.296507	-30.83	0.00	-9.62786	-8.65244

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
2017-10	-11.5932	0.296908	-39.05	0.00	-12.0816	-11.1049
2017-11	-5.15153	0.297148	-17.34	0.00	-5.64029	-4.66276
i.ym#i.treatment						
2010-03	-0.24358	0.226261	-1.08	0.28	-0.61575	0.128584
2010-04	-0.0931	0.226974	-0.41	0.68	-0.46644	0.280241
2010-05	-0.11645	0.227575	-0.51	0.61	-0.49078	0.25788
2010-06	-0.03186	0.228343	-0.14	0.89	-0.40745	0.343727
2010-07	0.222208	0.229385	0.97	0.33	-0.1551	0.599514
2010-08	0.079553	0.230088	0.35	0.73	-0.29891	0.458014
2010-09	-0.32989	0.230807	-1.43	0.15	-0.70953	0.049757
2010-10	-0.0618	0.231497	-0.27	0.79	-0.44258	0.318978
2010-11	0.19674	0.232304	0.85	0.40	-0.18537	0.578846
2010-12	-0.04815	0.232932	-0.21	0.84	-0.43129	0.334985
2011-01	-0.01372	0.23757	-0.06	0.95	-0.40449	0.377048
2011-02	-0.42745	0.231682	-1.84	0.07	-0.80853	-0.04637
2011-03	-0.23787	0.232235	-1.02	0.31	-0.61987	0.144119
2011-04	0.043034	0.233045	0.18	0.85	-0.34029	0.426358
2011-05	0.056262	0.23378	0.24	0.81	-0.32827	0.440796
2011-06	0.167835	0.234561	0.72	0.47	-0.21798	0.553654
2011-07	-0.03597	0.235617	-0.15	0.88	-0.42352	0.351589
2011-08	0.051944	0.236637	0.22	0.83	-0.33729	0.441178
2011-09	-0.03978	0.237745	-0.17	0.87	-0.43084	0.351275
2011-10	-0.0482	0.238624	-0.20	0.84	-0.4407	0.344303
2011-11	0.117067	0.239582	0.49	0.63	-0.27701	0.511144
2011-12	0.313063	0.240519	1.30	0.19	-0.08256	0.708681
2012-01	-0.04584	0.241237	-0.19	0.85	-0.44264	0.350958
2012-02	-0.14044	0.241912	-0.58	0.56	-0.53835	0.257467
2012-03	-0.0324	0.242563	-0.13	0.89	-0.43138	0.366582
2012-04	0.022677	0.243365	0.09	0.93	-0.37762	0.422977
2012-05	-0.18283	0.244097	-0.75	0.45	-0.58433	0.218676
2012-06	0.348565	0.245151	1.42	0.16	-0.05467	0.751804
2012-07	0.02513	0.246295	0.10	0.92	-0.37999	0.430249
2012-08	0.235503	0.247238	0.95	0.34	-0.17117	0.642173
2012-09	0.078695	0.248239	0.32	0.75	-0.32962	0.487011
2012-10	-0.06579	0.249159	-0.26	0.79	-0.47562	0.344046
2012-11	-0.09937	0.250189	-0.40	0.69	-0.51089	0.312156
2012-12	0.045468	0.25109	0.18	0.86	-0.36754	0.458474
2013-01	0.104909	0.251799	0.42	0.68	-0.30926	0.519081
2013-02	0.050228	0.252622	0.20	0.84	-0.3653	0.465754

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
2013-03	-0.19195	0.25338	-0.76	0.45	-0.60872	0.224828
2013-04	-0.01259	0.254245	-0.05	0.96	-0.43079	0.405604
2013-05	0.403411	0.255114	1.58	0.11	-0.01621	0.823036
2013-06	-0.01166	0.256252	-0.05	0.96	-0.43316	0.409835
2013-07	0.119386	0.257463	0.46	0.64	-0.3041	0.542874
2013-08	0.120919	0.258869	0.47	0.64	-0.30488	0.546722
2013-09	0.260647	0.260105	1.00	0.32	-0.16719	0.688482
2013-10	0.083708	0.26111	0.32	0.75	-0.34578	0.513195
2013-11	0.112673	0.262155	0.43	0.67	-0.31853	0.54388
2013-12	0.27753	0.263147	1.05	0.29	-0.15531	0.710369
2014-01	-0.3415	0.264124	-1.29	0.20	-0.77594	0.092949
2014-02	0.326697	0.264793	1.23	0.22	-0.10885	0.762242
2014-03	-0.04485	0.265555	-0.17	0.87	-0.48165	0.391953
2014-04	0.163826	0.266295	0.62	0.54	-0.27419	0.601843
2014-05	0.140569	0.267193	0.53	0.60	-0.29892	0.580063
2014-06	0.059745	0.268432	0.22	0.82	-0.38179	0.501276
2014-07	-0.08855	0.269808	-0.33	0.74	-0.53234	0.35525
2014-08	-0.03252	0.271123	-0.12	0.90	-0.47848	0.413437
2014-09	0.004256	0.272311	0.02	0.99	-0.44366	0.452169
2014-10	0.191885	0.273635	0.70	0.48	-0.2582	0.641974
2014-11	-0.15001	0.274929	-0.55	0.59	-0.60223	0.302208
2014-12	-0.02634	0.275618	-0.10	0.92	-0.47969	0.427014
2015-01	-0.73123	0.276562	-2.64	0.01	-1.18614	-0.27633
2015-02	-0.91757	0.277291	-3.31	0.00	-1.37367	-0.46147
2015-03	-0.57934	0.277638	-2.09	0.04	-1.03601	-0.12266
2015-04	0.137055	0.278132	0.49	0.62	-0.32043	0.594542
2015-05	0.206728	0.278775	0.74	0.46	-0.25182	0.665273
2015-06	-0.23095	0.279417	-0.83	0.41	-0.69055	0.22865
2015-07	-0.17712	0.280214	-0.63	0.53	-0.63803	0.283791
2015-08	-0.04731	0.281002	-0.17	0.87	-0.50952	0.414895
2015-09	-0.20438	0.281635	-0.73	0.47	-0.66763	0.258866
2015-10	0.053158	0.282308	0.19	0.85	-0.4112	0.517513
2015-11	-0.27882	0.282797	-0.99	0.32	-0.74398	0.186344
2015-12	-0.48381	0.283231	-1.71	0.09	-0.94969	-0.01794
2016-01	-1.22131	0.283769	-4.30	0.00	-1.68807	-0.75455
2016-02	-0.87241	0.284172	-3.07	0.00	-1.33983	-0.40499
2016-03	-0.3624	0.284617	-1.27	0.20	-0.83056	0.105752
2016-04	-0.26519	0.285209	-0.93	0.35	-0.73432	0.203934
2016-05	-0.077	0.285947	-0.27	0.79	-0.54734	0.393342

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
2016-06	-0.43007	0.286671	-1.50	0.13	-0.9016	0.041464
2016-07	-0.20179	0.287468	-0.70	0.48	-0.67464	0.271049
2016-08	-0.1328	0.2883	-0.46	0.65	-0.60701	0.341415
2016-09	-0.01316	0.289156	-0.05	0.96	-0.48878	0.462462
2016-10	0.216327	0.289905	0.75	0.46	-0.26052	0.693178
2016-11	0.047822	0.290462	0.16	0.87	-0.42995	0.525589
2016-12	-0.61285	0.290969	-2.11	0.04	-1.09145	-0.13425
2017-01	-0.71776	0.291723	-2.46	0.01	-1.1976	-0.23792
2017-02	-0.29136	0.292218	-1.00	0.32	-0.77201	0.189301
2017-03	-0.24843	0.292641	-0.85	0.40	-0.72978	0.232922
2017-04	0.065642	0.29335	0.22	0.82	-0.41688	0.54816
2017-05	-0.07246	0.293767	-0.25	0.81	-0.55566	0.410748
2017-06	-0.18311	0.294474	-0.62	0.53	-0.66748	0.301254
2017-07	-0.43539	0.295394	-1.47	0.14	-0.92127	0.050485
2017-08	-0.25513	0.296069	-0.86	0.39	-0.74213	0.231856
2017-09	-0.18075	0.296843	-0.61	0.54	-0.66901	0.307519
2017-10	0.064704	0.29761	0.22	0.83	-0.42482	0.55423
2017-11	-0.40673	0.298045	-1.36	0.17	-0.89697	0.083508
2017-12	-1.20039	0.298786	-4.02	0.00	-1.69185	-0.70893
_cons	40.23171	0.212879	188.99	0.00	39.88156	40.58187
N	2086841					

Table E-2: Regression Coefficients for Cohort 2

Linear regression, absorbing indicators, Number of obs = 22935690
F(181,22683653)= 31147.11
Prob > F = 0.0000
R-squared = 0.6744
Adj R-squared = 0.6708
Root MSE = 15.8412

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
i.ym						
2009-01	13.50537	0.924449	14.61	0.00	11.98479	15.02596
2009-02	-3.39661	0.924447	-3.67	0.00	-4.91719	-1.87603
2009-03	-11.723	0.924443	-12.68	0.00	-13.2435	-10.2024
2009-04	-15.5807	0.92444	-16.85	0.00	-17.1012	-14.0601
2009-05	-14.2756	0.924468	-15.44	0.00	-15.7962	-12.755
2009-06	-3.90435	0.924431	-4.22	0.00	-5.42491	-2.3838
2009-07	8.185926	0.924425	8.86	0.00	6.665383	9.706469
2009-08	-1.94389	0.924419	-2.10	0.04	-3.46442	-0.42336
2009-09	-10.7323	0.924414	-11.61	0.00	-12.2529	-9.21182
2009-10	-15.4527	0.924409	-16.72	0.00	-16.9732	-13.9322
2009-11	-12.1263	0.924404	-13.12	0.00	-13.6468	-10.6058
2009-12	-0.97325	0.924402	-1.05	0.29	-2.49376	0.547256
2010-01	13.84006	0.924398	14.97	0.00	12.31956	15.36056
2010-02	-1.64758	0.924395	-1.78	0.07	-3.16808	-0.12709
2010-03	-11.2959	0.924391	-12.22	0.00	-12.8164	-9.77537
2010-04	-17.5314	0.924387	-18.97	0.00	-19.0519	-16.0109
2010-05	-12.4219	0.924381	-13.44	0.00	-13.9424	-10.9014
2010-06	1.594594	0.924376	1.73	0.08	0.07413	3.115058
2010-07	8.958965	0.924372	9.69	0.00	7.438509	10.47942
2010-08	5.934211	0.924367	6.42	0.00	4.413763	7.454659
2010-09	-7.46196	0.924362	-8.07	0.00	-8.9824	-5.94152
2010-10	-16.274	0.924361	-17.61	0.00	-17.7945	-14.7536
2010-11	-11.5881	0.924361	-12.54	0.00	-13.1085	-10.0677
2010-12	-1.19395	0.92436	-1.29	0.20	-2.71439	0.326486
2011-01	0.439206	0.92436	0.48	0.63	-1.08123	1.959643
2011-02	-4.57538	0.92436	-4.95	0.00	-6.09581	-3.05494
2011-03	-11.3485	0.92436	-12.28	0.00	-12.8689	-9.82806
2011-04	-15.8759	0.924361	-17.17	0.00	-17.3963	-14.3554
2011-05	-11.7203	0.92436	-12.68	0.00	-13.2408	-10.1999
2011-06	-1.84896	0.92436	-2.00	0.05	-3.3694	-0.32852

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
2011-07	9.548542	0.924361	10.33	0.00	8.028104	11.06898
2011-08	4.448202	0.924361	4.81	0.00	2.927764	5.96864
2011-09	-10.9462	0.924362	-11.84	0.00	-12.4666	-9.42575
2011-10	-17.0936	0.924364	-18.49	0.00	-18.6141	-15.5732
2011-12	-4.97717	0.935159	-5.32	0.00	-6.51537	-3.43897
2012-01	5.775491	0.9352	6.18	0.00	4.237224	7.313759
2012-02	-7.30458	0.935253	-7.81	0.00	-8.84294	-5.76623
2012-03	-14.7515	0.935323	-15.77	0.00	-16.29	-13.2131
2012-04	-17.2115	0.935402	-18.40	0.00	-18.7501	-15.6729
2012-05	-11.7031	0.935461	-12.51	0.00	-13.2418	-10.1644
2012-06	0.36123	0.93554	0.39	0.70	-1.1776	1.900057
2012-07	9.246664	0.935664	9.88	0.00	7.707634	10.78569
2012-08	0.929468	0.93575	0.99	0.32	-0.6097	2.468639
2012-09	-11.0326	0.935868	-11.79	0.00	-12.5719	-9.4932
2012-10	-16.71	0.935922	-17.85	0.00	-18.2494	-15.1705
2012-11	-11.8893	0.936019	-12.70	0.00	-13.4289	-10.3497
2012-12	-6.21625	0.93609	-6.64	0.00	-7.75598	-4.67651
2013-01	-2.83775	0.936154	-3.03	0.00	-4.37758	-1.29791
2013-02	-3.97465	0.936205	-4.25	0.00	-5.51457	-2.43472
2013-03	-7.858	0.936265	-8.39	0.00	-9.39802	-6.31798
2013-04	-13.9633	0.936338	-14.91	0.00	-15.5035	-12.4232
2013-05	-7.35103	0.936405	-7.85	0.00	-8.89128	-5.81078
2013-06	-5.61524	0.936509	-6.00	0.00	-7.15566	-4.07482
2013-07	-0.49336	0.936604	-0.53	0.60	-2.03393	1.047219
2013-08	-2.43223	0.936704	-2.60	0.01	-3.97297	-0.89149
2013-09	-7.93765	0.936781	-8.47	0.00	-9.47852	-6.39679
2013-10	-16.0229	0.936856	-17.10	0.00	-17.5639	-14.4819
2013-11	-10.8662	0.936936	-11.60	0.00	-12.4073	-9.3251
2013-12	-2.55334	0.937003	-2.73	0.01	-4.09457	-1.0121
2014-01	2.793347	0.937089	2.98	0.00	1.251973	4.334722
2014-02	0.962765	0.937151	1.03	0.30	-0.57871	2.504242
2014-03	-8.24905	0.937205	-8.80	0.00	-9.79061	-6.70748
2014-04	-16.6593	0.937278	-17.77	0.00	-18.201	-15.1176
2014-05	-14.5059	0.93735	-15.48	0.00	-16.0477	-12.9641
2014-06	-5.18962	0.937432	-5.54	0.00	-6.73156	-3.64768
2014-07	-3.91818	0.937531	-4.18	0.00	-5.46028	-2.37608
2014-08	-3.68795	0.937647	-3.93	0.00	-5.23024	-2.14566
2014-09	-10.9968	0.937732	-11.73	0.00	-12.5392	-9.45434
2014-10	-17.6174	0.937838	-18.79	0.00	-19.16	-16.0748

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
2014-11	-10.5086	0.937946	-11.20	0.00	-12.0514	-8.96585
2014-12	-2.4768	0.937988	-2.64	0.01	-4.01965	-0.93394
2015-01	-1.77174	0.938066	-1.89	0.06	-3.31472	-0.22876
2015-02	0.106553	0.938132	0.11	0.91	-1.43654	1.649643
2015-03	-8.69481	0.938174	-9.27	0.00	-10.238	-7.15165
2015-04	-17.4209	0.938257	-18.57	0.00	-18.9642	-15.8776
2015-05	-12.657	0.938336	-13.49	0.00	-14.2004	-11.1135
2015-06	2.664784	0.938401	2.84	0.00	1.121252	4.208316
2015-07	-1.71658	0.938509	-1.83	0.07	-3.26029	-0.17287
2015-08	-2.43427	0.938596	-2.59	0.01	-3.97812	-0.89041
2015-09	-10.1319	0.938724	-10.79	0.00	-11.6759	-8.5878
2015-10	-18.3947	0.938812	-19.59	0.00	-19.9389	-16.8505
2015-11	-15.7489	0.938907	-16.77	0.00	-17.2933	-14.2046
2015-12	-10.4278	0.938993	-11.11	0.00	-11.9723	-8.88333
2016-01	-4.82874	0.939061	-5.14	0.00	-6.37336	-3.28412
2016-02	-7.61928	0.939109	-8.11	0.00	-9.16398	-6.07458
2016-03	-15.365	0.93917	-16.36	0.00	-16.9098	-13.8202
2016-04	-18.2705	0.939254	-19.45	0.00	-19.8154	-16.7256
2016-05	-15.9785	0.939357	-17.01	0.00	-17.5236	-14.4334
2016-06	-4.44375	0.939473	-4.73	0.00	-5.98905	-2.89846
2016-07	3.514431	0.939586	3.74	0.00	1.96895	5.059913
2016-08	4.060904	0.939698	4.32	0.00	2.515239	5.606569
2016-09	-6.11222	0.939789	-6.50	0.00	-7.65804	-4.56641
2016-10	-17.2817	0.939884	-18.39	0.00	-18.8277	-15.7358
2016-11	-15.1774	0.939977	-16.15	0.00	-16.7235	-13.6313
2016-12	-6.17712	0.940054	-6.57	0.00	-7.72337	-4.63087
2017-01	-7.09622	0.940119	-7.55	0.00	-8.64258	-5.54987
2017-02	-12.0947	0.940192	-12.86	0.00	-13.6412	-10.5482
2017-03	-14.4095	0.94024	-15.33	0.00	-15.9561	-12.863
2017-04	-18.9233	0.9403	-20.12	0.00	-20.47	-17.3767
2017-05	-15.2628	0.940371	-16.23	0.00	-16.8096	-13.716
2017-06	-6.38431	0.940447	-6.79	0.00	-7.93121	-4.83741
2017-07	-1.36973	0.940558	-1.46	0.15	-2.91681	0.177347
2017-08	-5.97381	0.940644	-6.35	0.00	-7.52103	-4.42658
2017-09	-12.6024	0.940758	-13.40	0.00	-14.1498	-11.0549
2017-10	-16.6051	0.940847	-17.65	0.00	-18.1527	-15.0576
2017-11	-13.3882	0.940944	-14.23	0.00	-14.9359	-11.8405
2017-12	-9.97947	0.941051	-10.60	0.00	-11.5274	-8.43158
i.ym#i.treatment						

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
2011-12	-0.23177	0.153279	-1.51	0.13	-0.48389	0.020348
2012-01	-0.14604	0.153568	-0.95	0.34	-0.39864	0.106557
2012-02	-0.4773	0.153928	-3.10	0.00	-0.73049	-0.22411
2012-03	-0.36372	0.154392	-2.36	0.02	-0.61767	-0.10976
2012-04	-0.34215	0.154915	-2.21	0.03	-0.59697	-0.08734
2012-05	-0.27768	0.155312	-1.79	0.07	-0.53314	-0.02222
2012-06	-0.10578	0.155841	-0.68	0.50	-0.36212	0.150555
2012-07	-0.11146	0.156646	-0.71	0.48	-0.36912	0.146199
2012-08	-0.25173	0.15721	-1.60	0.11	-0.51031	0.006861
2012-09	-0.36283	0.157966	-2.30	0.02	-0.62266	-0.103
2012-10	-0.39243	0.158331	-2.48	0.01	-0.65286	-0.13199
2012-11	-0.4035	0.158952	-2.54	0.01	-0.66495	-0.14204
2012-12	-0.43371	0.159413	-2.72	0.01	-0.69592	-0.1715
2013-01	-0.59129	0.159819	-3.70	0.00	-0.85417	-0.32841
2013-02	-0.56897	0.160148	-3.55	0.00	-0.83239	-0.30555
2013-03	-0.50299	0.160529	-3.13	0.00	-0.76703	-0.23894
2013-04	-0.34341	0.160989	-2.13	0.03	-0.60821	-0.07861
2013-05	-0.32251	0.161418	-2.00	0.05	-0.58802	-0.057
2013-06	-0.25626	0.162069	-1.58	0.11	-0.52284	0.010318
2013-07	-0.30376	0.162663	-1.87	0.06	-0.57132	-0.0362
2013-08	-0.39164	0.163293	-2.40	0.02	-0.66023	-0.12304
2013-09	-0.41037	0.163778	-2.51	0.01	-0.67976	-0.14098
2013-10	-0.51434	0.164244	-3.13	0.00	-0.78449	-0.24418
2013-11	-0.54752	0.164737	-3.32	0.00	-0.81849	-0.27655
2013-12	-0.49569	0.165153	-3.00	0.00	-0.76735	-0.22404
2014-01	-0.73132	0.165673	-4.41	0.00	-1.00383	-0.45882
2014-02	-0.81297	0.166052	-4.90	0.00	-1.0861	-0.53984
2014-03	-0.69534	0.166377	-4.18	0.00	-0.96901	-0.42168
2014-04	-0.5438	0.16682	-3.26	0.00	-0.81819	-0.2694
2014-05	-0.47441	0.167262	-2.84	0.00	-0.74953	-0.19929
2014-06	-0.43671	0.167761	-2.60	0.01	-0.71265	-0.16077
2014-07	-0.50504	0.168359	-3.00	0.00	-0.78197	-0.22812
2014-08	-0.56684	0.169053	-3.35	0.00	-0.8449	-0.28877
2014-09	-0.48468	0.169559	-2.86	0.00	-0.76357	-0.20578
2014-10	-0.47997	0.170187	-2.82	0.00	-0.75991	-0.20004
2014-11	-0.64975	0.170821	-3.80	0.00	-0.93073	-0.36878
2014-12	-0.57079	0.171076	-3.34	0.00	-0.85219	-0.2894
2015-01	-0.84528	0.171529	-4.93	0.00	-1.12742	-0.56314
2015-02	-1.03462	0.171913	-6.02	0.00	-1.3174	-0.75185

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
2015-03	-0.66803	0.172166	-3.88	0.00	-0.95121	-0.38484
2015-04	-0.5504	0.172648	-3.19	0.00	-0.83438	-0.26642
2015-05	-0.52021	0.173112	-3.01	0.00	-0.80495	-0.23546
2015-06	-0.44799	0.173494	-2.58	0.01	-0.73336	-0.16261
2015-07	-0.63147	0.174124	-3.63	0.00	-0.91788	-0.34506
2015-08	-0.54564	0.17463	-3.12	0.00	-0.83288	-0.2584
2015-09	-0.67109	0.175363	-3.83	0.00	-0.95953	-0.38264
2015-10	-0.61649	0.175866	-3.51	0.00	-0.90577	-0.32722
2015-11	-0.60576	0.17641	-3.43	0.00	-0.89593	-0.31559
2015-12	-0.62377	0.176897	-3.53	0.00	-0.91474	-0.3328
2016-01	-0.79657	0.177283	-4.49	0.00	-1.08817	-0.50496
2016-02	-0.65379	0.177559	-3.68	0.00	-0.94585	-0.36173
2016-03	-0.52329	0.177906	-2.94	0.00	-0.81592	-0.23066
2016-04	-0.60621	0.178376	-3.40	0.00	-0.89961	-0.3128
2016-05	-0.5023	0.178953	-2.81	0.01	-0.79665	-0.20795
2016-06	-0.45005	0.179599	-2.51	0.01	-0.74546	-0.15464
2016-07	-0.51603	0.180234	-2.86	0.00	-0.81249	-0.21957
2016-08	-0.6453	0.180852	-3.57	0.00	-0.94278	-0.34783
2016-09	-0.63483	0.181363	-3.50	0.00	-0.93314	-0.33651
2016-10	-0.5334	0.181887	-2.93	0.00	-0.83257	-0.23422
2016-11	-0.62582	0.182401	-3.43	0.00	-0.92584	-0.32579
2016-12	-0.77277	0.182823	-4.23	0.00	-1.07349	-0.47205
2017-01	-0.85942	0.183181	-4.69	0.00	-1.16073	-0.55811
2017-02	-0.84454	0.183582	-4.60	0.00	-1.14651	-0.54258
2017-03	-0.82836	0.183844	-4.51	0.00	-1.13075	-0.52596
2017-04	-0.55755	0.184179	-3.03	0.00	-0.86049	-0.2546
2017-05	-0.52045	0.184568	-2.82	0.00	-0.82404	-0.21686
2017-06	-0.45036	0.184987	-2.43	0.01	-0.75464	-0.14608
2017-07	-0.44457	0.185592	-2.40	0.02	-0.74984	-0.1393
2017-08	-0.5193	0.186063	-2.79	0.01	-0.82535	-0.21325
2017-09	-0.48547	0.186675	-2.60	0.01	-0.79252	-0.17842
2017-10	-0.45328	0.187151	-2.42	0.02	-0.76112	-0.14545
2017-11	-0.68276	0.187664	-3.64	0.00	-0.99144	-0.37408
2017-12	-0.76832	0.188246	-4.08	0.00	-1.07795	-0.45868
2018-01	-3.44864	0.946191	-3.64	0.00	-5.00498	-1.89229
_cons	46.12702	0.923819	49.93	0.00	44.60747	47.64656
N	22935690					

Table E-3: Regression Coefficients for Cohort 3

Linear regression, absorbing indicators, Number of obs = 4154320
F(155,4109651) = 6893.48
Prob > F = 0.0000
R-squared = 0.6576
Adj R-squared = 0.6539
Root MSE = 14.9025

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
i.ym						
2009-01	15.83029	1.316024	12.03	0.00	13.66563	17.99496
2009-02	-0.33921	1.31602	-0.26	0.80	-2.50387	1.82545
2009-03	-8.42954	1.316014	-6.41	0.00	-10.5942	-6.26489
2009-04	-12.1567	1.31601	-9.24	0.00	-14.3213	-9.99202
2009-05	-10.8056	1.316164	-8.21	0.00	-12.9705	-8.64068
2009-06	-0.16429	1.315997	-0.12	0.90	-2.32891	2.000336
2009-07	11.02149	1.315989	8.38	0.00	8.856882	13.1861
2009-08	1.765397	1.315981	1.34	0.18	-0.3992	3.929995
2009-09	-7.0917	1.315974	-5.39	0.00	-9.25629	-4.92712
2009-10	-12.0358	1.315965	-9.15	0.00	-14.2004	-9.87127
2009-11	-8.75988	1.315956	-6.66	0.00	-10.9244	-6.59532
2009-12	2.231648	1.31595	1.70	0.09	0.067103	4.396193
2010-01	16.19134	1.315942	12.30	0.00	14.02681	18.35587
2010-02	1.435917	1.315936	1.09	0.28	-0.72861	3.600438
2010-03	-7.84641	1.315927	-5.96	0.00	-10.0109	-5.6819
2010-04	-13.9426	1.315918	-10.60	0.00	-16.1071	-11.7781
2010-05	-8.68094	1.315902	-6.60	0.00	-10.8454	-6.51648
2010-06	5.69077	1.315891	4.32	0.00	3.526321	7.855219
2010-07	13.46138	1.315881	10.23	0.00	11.29694	15.62581
2010-08	10.10199	1.315871	7.68	0.00	7.937574	12.26641
2010-09	-3.62733	1.315863	-2.76	0.01	-5.79173	-1.46293
2010-10	-12.59	1.315855	-9.57	0.00	-14.7544	-10.4256
2010-11	-8.19981	1.315847	-6.23	0.00	-10.3642	-6.03543
2010-12	2.041355	1.31584	1.55	0.12	-0.12301	4.20572
2011-01	3.610591	1.315832	2.74	0.01	1.44624	5.774941
2011-02	-1.46286	1.315825	-1.11	0.27	-3.62721	0.701477
2011-03	-8.09077	1.315818	-6.15	0.00	-10.2551	-5.92644
2011-04	-12.4234	1.315809	-9.44	0.00	-14.5877	-10.2591
2011-05	-7.95751	1.315799	-6.05	0.00	-10.1218	-5.79322
2011-06	2.105109	1.315789	1.60	0.11	-0.05917	4.269389

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
2011-07	13.76131	1.315776	10.46	0.00	11.59705	15.92557
2011-08	8.508009	1.315764	6.47	0.00	6.343769	10.67225
2011-09	-7.18169	1.315754	-5.46	0.00	-9.34592	-5.01747
2011-10	-13.5258	1.315744	-10.28	0.00	-15.69	-11.3616
2011-11	-9.39205	1.315733	-7.14	0.00	-11.5562	-7.22786
2011-12	-1.52802	1.315726	-1.16	0.25	-3.69219	0.636161
2012-01	8.52855	1.315713	6.48	0.00	6.364394	10.69271
2012-02	-4.25473	1.315706	-3.23	0.00	-6.41887	-2.09058
2012-03	-11.3095	1.315696	-8.60	0.00	-13.4737	-9.1454
2012-04	-13.5909	1.315684	-10.33	0.00	-15.7551	-11.4268
2012-05	-7.93975	1.315673	-6.03	0.00	-10.1038	-5.77566
2012-06	4.781373	1.315658	3.63	0.00	2.617308	6.945439
2012-07	13.55559	1.315643	10.30	0.00	11.39155	15.71963
2012-08	4.991952	1.315626	3.79	0.00	2.82794	7.155964
2012-09	-7.49095	1.315607	-5.69	0.00	-9.65493	-5.32697
2012-10	-13.1857	1.31558	-10.02	0.00	-15.3497	-11.0218
2012-11	-8.66617	1.315552	-6.59	0.00	-10.8301	-6.50228
2012-12	-3.02087	1.315497	-2.30	0.02	-5.18467	-0.85707
2013-01	-0.05789	1.315472	-0.04	0.96	-2.22165	2.105869
2013-02	-1.01058	1.315471	-0.77	0.44	-3.17434	1.153175
2013-03	-4.72157	1.315471	-3.59	0.00	-6.88532	-2.55781
2013-04	-10.3018	1.315472	-7.83	0.00	-12.4655	-8.13802
2013-05	-4.31309	1.315471	-3.28	0.00	-6.47685	-2.14933
2013-06	-1.8393	1.315472	-1.40	0.16	-4.00305	0.324463
2013-07	3.246476	1.315472	2.47	0.01	1.082717	5.410235
2013-08	1.490358	1.315472	1.13	0.26	-0.6734	3.654117
2013-09	-4.161	1.315472	-3.16	0.00	-6.32476	-1.99724
2013-10	-12.4439	1.315472	-9.46	0.00	-14.6077	-10.2802
2013-11	-7.55846	1.315472	-5.75	0.00	-9.72222	-5.3947
2013-12	0.629437	1.315472	0.48	0.63	-1.53432	2.793196
2014-02	4.283847	1.332119	3.22	0.00	2.092706	6.474989
2014-03	-4.84529	1.332176	-3.64	0.00	-7.03652	-2.65405
2014-04	-13.1058	1.332255	-9.84	0.00	-15.2972	-10.9145
2014-05	-10.9641	1.33236	-8.23	0.00	-13.1556	-8.77257
2014-06	-1.65615	1.332499	-1.24	0.21	-3.84792	0.535613
2014-07	-0.57132	1.332646	-0.43	0.67	-2.76333	1.620684
2014-08	-0.45932	1.332817	-0.34	0.73	-2.65161	1.732971
2014-09	-7.62282	1.332951	-5.72	0.00	-9.81534	-5.43031
2014-10	-13.9399	1.333055	-10.46	0.00	-16.1326	-11.7472

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
2014-11	-7.16727	1.333211	-5.38	0.00	-9.36021	-4.97434
2014-12	0.914936	1.333262	0.69	0.49	-1.27809	3.107957
2015-01	1.508273	1.333393	1.13	0.26	-0.68496	3.70151
2015-02	3.42109	1.333412	2.57	0.01	1.227823	5.614358
2015-03	-5.17269	1.333459	-3.88	0.00	-7.36604	-2.97935
2015-04	-13.8683	1.333584	-10.40	0.00	-16.0619	-11.6748
2015-05	-9.31454	1.333675	-6.98	0.00	-11.5082	-7.12084
2015-06	5.623084	1.333832	4.22	0.00	3.429124	7.817043
2015-07	1.567858	1.334002	1.18	0.24	-0.62638	3.762096
2015-08	0.987032	1.334144	0.74	0.46	-1.20744	3.181503
2015-09	-6.59856	1.334256	-4.95	0.00	-8.79322	-4.40391
2015-10	-14.7528	1.334375	-11.06	0.00	-16.9476	-12.5579
2015-11	-12.2096	1.334501	-9.15	0.00	-14.4047	-10.0146
2015-12	-6.97741	1.334586	-5.23	0.00	-9.17261	-4.78222
2016-01	-1.54346	1.334693	-1.16	0.25	-3.73884	0.651913
2016-02	-3.92235	1.334785	-2.94	0.00	-6.11788	-1.72683
2016-03	-11.5564	1.33485	-8.66	0.00	-13.7521	-9.36079
2016-04	-14.6018	1.33496	-10.94	0.00	-16.7976	-12.406
2016-05	-12.4292	1.335065	-9.31	0.00	-14.6252	-10.2332
2016-06	-1.03781	1.335205	-0.78	0.44	-3.23403	1.158405
2016-07	7.069403	1.335376	5.29	0.00	4.872904	9.265902
2016-08	7.433074	1.33552	5.57	0.00	5.236338	9.62981
2016-09	-2.85556	1.335685	-2.14	0.03	-5.05256	-0.65855
2016-10	-13.6724	1.335869	-10.23	0.00	-15.8697	-11.4751
2016-11	-11.7731	1.335959	-8.81	0.00	-13.9706	-9.57563
2016-12	-3.00721	1.336075	-2.25	0.02	-5.20486	-0.80956
2017-01	-3.69113	1.336198	-2.76	0.01	-5.88898	-1.49328
2017-02	-8.55336	1.336247	-6.40	0.00	-10.7513	-6.35543
2017-03	-10.8806	1.336316	-8.14	0.00	-13.0786	-8.68256
2017-04	-15.105	1.336397	-11.30	0.00	-17.3032	-12.9068
2017-05	-11.5199	1.336575	-8.62	0.00	-13.7184	-9.32147
2017-06	-2.54099	1.336736	-1.90	0.06	-4.73972	-0.34225
2017-07	2.257698	1.336873	1.69	0.09	0.058737	4.456659
2017-08	-2.53041	1.337078	-1.89	0.06	-4.72971	-0.33112
2017-09	-8.90496	1.33726	-6.66	0.00	-11.1046	-6.70536
2017-10	-12.7456	1.337397	-9.53	0.00	-14.9454	-10.5458
2017-11	-9.98015	1.337535	-7.46	0.00	-12.1802	-7.7801
2017-12	-6.7788	1.337667	-5.07	0.00	-8.97907	-4.57853
i.ym#i.treatment						

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
2014-02	-0.64262	0.237692	-2.70	0.01	-1.03359	-0.25165
2014-03	-0.425	0.238079	-1.79	0.07	-0.8166	-0.03339
2014-04	-0.10806	0.238595	-0.45	0.65	-0.50051	0.284396
2014-05	0.058405	0.239276	0.24	0.81	-0.33517	0.451979
2014-06	-0.04684	0.240159	-0.20	0.85	-0.44187	0.348186
2014-07	0.026792	0.241096	0.11	0.91	-0.36978	0.423361
2014-08	0.053864	0.242166	0.22	0.82	-0.34446	0.452193
2014-09	-0.03343	0.243021	-0.14	0.89	-0.43316	0.366305
2014-10	-0.32037	0.243696	-1.31	0.19	-0.72122	0.080471
2014-11	-0.63409	0.244659	-2.59	0.01	-1.03652	-0.23167
2014-12	-0.83135	0.245003	-3.39	0.00	-1.23435	-0.42836
2015-01	-1.05145	0.245811	-4.28	0.00	-1.45577	-0.64713
2015-02	-1.3084	0.245967	-5.32	0.00	-1.71298	-0.90382
2015-03	-0.74967	0.246288	-3.04	0.00	-1.15478	-0.34456
2015-04	-0.18964	0.24705	-0.77	0.44	-0.596	0.216724
2015-05	0.002759	0.247642	0.01	0.99	-0.40458	0.410093
2015-06	-0.03464	0.248592	-0.14	0.89	-0.44354	0.374255
2015-07	-0.21295	0.249625	-0.85	0.39	-0.62355	0.197643
2015-08	-0.29304	0.250509	-1.17	0.24	-0.70509	0.119013
2015-09	-0.41181	0.251217	-1.64	0.10	-0.82502	0.001405
2015-10	-0.36862	0.251938	-1.46	0.14	-0.78302	0.045786
2015-11	-0.41275	0.252706	-1.63	0.10	-0.82842	0.002912
2015-12	-0.57568	0.253226	-2.27	0.02	-0.9922	-0.15916
2016-01	-0.82763	0.25387	-3.26	0.00	-1.2452	-0.41005
2016-02	-0.87597	0.254413	-3.44	0.00	-1.29444	-0.45749
2016-03	-0.4284	0.254819	-1.68	0.09	-0.84754	-0.00926
2016-04	-0.31165	0.255478	-1.22	0.22	-0.73187	0.108579
2016-05	-0.11818	0.256131	-0.46	0.64	-0.53948	0.303119
2016-06	-0.18302	0.256971	-0.71	0.48	-0.6057	0.239661
2016-07	-0.40376	0.257975	-1.57	0.12	-0.82809	0.020572
2016-08	-0.47457	0.258815	-1.83	0.07	-0.90029	-0.04886
2016-09	-0.40484	0.259783	-1.56	0.12	-0.83215	0.02246
2016-10	-0.22089	0.260825	-0.85	0.40	-0.64991	0.208124
2016-11	-0.3479	0.261379	-1.33	0.18	-0.77783	0.082033
2016-12	-0.64881	0.262056	-2.48	0.01	-1.07985	-0.21777
2017-01	-0.85281	0.262762	-3.25	0.00	-1.28502	-0.4206
2017-02	-0.7696	0.263077	-2.93	0.00	-1.20232	-0.33687
2017-03	-0.61782	0.263484	-2.34	0.02	-1.05122	-0.18443
2017-04	-0.26737	0.263982	-1.01	0.31	-0.70158	0.166841

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
2017-05	-0.19594	0.264976	-0.74	0.46	-0.63178	0.239912
2017-06	-0.31496	0.265898	-1.18	0.24	-0.75233	0.1224
2017-07	-0.32777	0.266705	-1.23	0.22	-0.76646	0.11092
2017-08	-0.18293	0.26784	-0.68	0.49	-0.62349	0.257625
2017-09	-0.15882	0.268871	-0.59	0.55	-0.60108	0.28343
2017-10	-0.35776	0.26965	-1.33	0.18	-0.8013	0.085774
2017-11	-0.57589	0.270413	-2.13	0.03	-1.02068	-0.1311
2017-12	-0.69887	0.271156	-2.58	0.01	-1.14488	-0.25286
2018-01	-0.45711	1.391567	-0.33	0.74	-2.74603	1.831816
_cons	40.62627	1.313566	30.93	0.00	38.46564	42.78689
N	4154320					

Table E-4: Regression Coefficients for Cohort 4

Linear regression, absorbing indicators, Number of obs = 3174028
F(154,3122508) = 3767.17
Prob > F = 0.0000
R-squared = 0.6676
Adj R-squared = 0.6621
Root MSE = 15.6123

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
i.ym						
2011-01	1.044185	1.257627	0.83	0.41	-1.02443	3.112799
2011-02	-4.42119	1.257494	-3.52	0.00	-6.48959	-2.3528
2011-03	-12.3231	1.257337	-9.80	0.00	-14.3913	-10.255
2011-04	-17.8589	1.25721	-14.21	0.00	-19.9268	-15.7909
2011-05	-15.3425	1.257086	-12.20	0.00	-17.4102	-13.2748
2011-06	-7.44068	1.25697	-5.92	0.00	-9.50821	-5.37315
2011-07	2.745766	1.25686	2.18	0.03	0.678414	4.813117
2011-08	-1.85759	1.256762	-1.48	0.14	-3.92478	0.209602
2011-09	-14.9556	1.256691	-11.90	0.00	-17.0227	-12.8885
2011-10	-19.0598	1.256631	-15.17	0.00	-21.1268	-16.9929
2011-11	-14.3126	1.256585	-11.39	0.00	-16.3795	-12.2457
2011-12	-6.72031	1.256569	-5.35	0.00	-8.78718	-4.65343
2012-01	5.080585	1.256567	4.04	0.00	3.013715	7.147455
2012-02	-7.72861	1.256567	-6.15	0.00	-9.79548	-5.66174
2012-03	-16.4683	1.258315	-13.09	0.00	-18.538	-14.3985
2012-04	-19.0962	1.257577	-15.18	0.00	-21.1648	-17.0277
2012-05	-14.5458	1.258213	-11.56	0.00	-16.6154	-12.4763
2012-06	-3.69768	1.259156	-2.94	0.00	-5.7688	-1.62655
2012-07	4.709551	1.260815	3.74	0.00	2.635694	6.783409
2012-08	-2.90726	1.262346	-2.30	0.02	-4.98364	-0.83088
2012-09	-13.6534	1.263251	-10.81	0.00	-15.7312	-11.5755
2012-10	-18.0531	1.267086	-14.25	0.00	-20.1373	-15.9689
2012-11	-12.6181	1.267192	-9.96	0.00	-14.7025	-10.5338
2012-12	-6.3789	1.280498	-4.98	0.00	-8.48514	-4.27267
2013-01	-2.07627	1.280791	-1.62	0.11	-4.18298	0.030449
2013-02	-2.37873	1.280985	-1.86	0.06	-4.48576	-0.27169
2013-03	-6.79379	1.281313	-5.30	0.00	-8.90136	-4.68622
2013-04	-14.137	1.281571	-11.03	0.00	-16.245	-12.029
2013-05	-11.0478	1.281975	-8.62	0.00	-13.1564	-8.93911
2013-06	-9.63392	1.282333	-7.51	0.00	-11.7432	-7.52467

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
2013-07	-5.56919	1.282784	-4.34	0.00	-7.67918	-3.45919
2013-08	-7.05762	1.283241	-5.50	0.00	-9.16836	-4.94687
2013-09	-11.6443	1.283659	-9.07	0.00	-13.7558	-9.53289
2013-10	-17.2762	1.283984	-13.46	0.00	-19.3881	-15.1642
2013-11	-10.796	1.28427	-8.41	0.00	-12.9084	-8.68354
2013-12	-1.92438	1.284571	-1.50	0.13	-4.03731	0.188552
2014-01	5.010175	1.284908	3.90	0.00	2.896689	7.123661
2014-02	3.48926	1.285171	2.72	0.01	1.37534	5.603179
2014-03	-6.62891	1.285357	-5.16	0.00	-8.74313	-4.51469
2014-04	-16.8318	1.28584	-13.09	0.00	-18.9468	-14.7167
2014-05	-16.5155	1.286219	-12.84	0.00	-18.6312	-14.3999
2014-06	-9.18805	1.286472	-7.14	0.00	-11.3041	-7.07199
2014-07	-8.24412	1.286889	-6.41	0.00	-10.3609	-6.12738
2014-08	-8.02746	1.2874	-6.24	0.00	-10.1451	-5.90988
2014-09	-13.9921	1.287781	-10.87	0.00	-16.1103	-11.8739
2014-10	-18.5117	1.288122	-14.37	0.00	-20.6304	-16.3929
2014-11	-10.0388	1.288546	-7.79	0.00	-12.1583	-7.91933
2014-12	-1.96809	1.288787	-1.53	0.13	-4.08796	0.151773
2015-01	-0.03658	1.289189	-0.03	0.98	-2.1571	2.08395
2015-02	3.036511	1.289386	2.36	0.02	0.915658	5.157363
2015-03	-7.17848	1.28964	-5.57	0.00	-9.29975	-5.05721
2015-04	-17.862	1.289925	-13.85	0.00	-19.9837	-15.7403
2015-05	-14.5947	1.290243	-11.31	0.00	-16.717	-12.4725
2015-06	-2.64958	1.290509	-2.05	0.04	-4.77228	-0.52688
2015-07	-6.05123	1.290924	-4.69	0.00	-8.17461	-3.92785
2015-08	-6.54344	1.291303	-5.07	0.00	-8.66745	-4.41944
2015-09	-13.0645	1.291631	-10.11	0.00	-15.189	-10.9399
2015-10	-19.3393	1.291949	-14.97	0.00	-21.4644	-17.2143
2015-11	-15.8571	1.292242	-12.27	0.00	-17.9826	-13.7315
2015-12	-10.5942	1.292492	-8.20	0.00	-12.7202	-8.46824
2016-01	-3.09558	1.29273	-2.39	0.02	-5.22193	-0.96923
2016-02	-5.38706	1.292874	-4.17	0.00	-7.51365	-3.26047
2016-03	-14.5132	1.293067	-11.22	0.00	-16.6401	-12.3863
2016-04	-18.3252	1.293312	-14.17	0.00	-20.4526	-16.1979
2016-05	-17.4671	1.29366	-13.50	0.00	-19.595	-15.3393
2016-06	-8.06633	1.294014	-6.23	0.00	-10.1948	-5.93786
2016-07	-1.60375	1.294323	-1.24	0.22	-3.73273	0.525219
2016-08	-1.03105	1.294795	-0.80	0.43	-3.1608	1.098698
2016-09	-9.48412	1.295116	-7.32	0.00	-11.6144	-7.35384

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
2016-10	-18.796	1.29546	-14.51	0.00	-20.9269	-16.6652
2016-11	-15.5226	1.295626	-11.98	0.00	-17.6537	-13.3915
2016-12	-5.69476	1.295867	-4.39	0.00	-7.82627	-3.56325
2017-01	-6.20463	1.296224	-4.79	0.00	-8.33673	-4.07254
2017-02	-11.5067	1.296472	-8.88	0.00	-13.6392	-9.37415
2017-03	-13.9281	1.296606	-10.74	0.00	-16.0609	-11.7954
2017-04	-19.2785	1.296957	-14.86	0.00	-21.4118	-17.1452
2017-05	-17.042	1.297214	-13.14	0.00	-19.1757	-14.9082
2017-06	-9.61753	1.297514	-7.41	0.00	-11.7518	-7.4833
2017-07	-5.19245	1.297921	-4.00	0.00	-7.32734	-3.05756
2017-08	-8.93753	1.298419	-6.88	0.00	-11.0732	-6.80183
2017-09	-14.3772	1.298722	-11.07	0.00	-16.5134	-12.241
2017-10	-17.2896	1.298971	-13.31	0.00	-19.4262	-15.153
2017-11	-12.6823	1.29934	-9.76	0.00	-14.8196	-10.5451
2017-12	-9.04062	1.299715	-6.96	0.00	-11.1785	-6.90278
i.ym#i.treatment						
2012-04	0.237626	0.144576	1.64	0.10	-0.00018	0.475433
2012-05	-0.52	0.151065	-3.44	0.00	-0.76848	-0.27152
2012-06	-1.08986	0.149562	-7.29	0.00	-1.33587	-0.84385
2012-07	-1.7651	0.158944	-11.11	0.00	-2.02654	-1.50366
2012-08	-1.27546	0.168424	-7.57	0.00	-1.55249	-0.99843
2012-09	-0.72219	0.174543	-4.14	0.00	-1.00929	-0.43509
2012-10	-0.37533	0.202875	-1.85	0.06	-0.70903	-0.04163
2012-11	-0.32172	0.20254	-1.59	0.11	-0.65486	0.011433
2012-12	-1.06041	0.280422	-3.78	0.00	-1.52167	-0.59916
2013-01	-1.1321	0.281001	-4.03	0.00	-1.5943	-0.66989
2013-02	-1.30581	0.282072	-4.63	0.00	-1.76977	-0.84184
2013-03	-1.26326	0.283791	-4.45	0.00	-1.73005	-0.79646
2013-04	-0.95906	0.285174	-3.36	0.00	-1.42813	-0.48999
2013-05	0.509301	0.287236	1.77	0.08	0.036839	0.981763
2013-06	0.151749	0.289148	0.52	0.60	-0.32386	0.627355
2013-07	0.690087	0.291447	2.37	0.02	0.210699	1.169475
2013-08	0.339306	0.293761	1.16	0.25	-0.14389	0.8225
2013-09	0.191907	0.295861	0.65	0.52	-0.29474	0.678555
2013-10	-0.74012	0.297492	-2.49	0.01	-1.22945	-0.25078
2013-11	-0.96414	0.298929	-3.23	0.00	-1.45583	-0.47245
2013-12	-0.95814	0.300406	-3.19	0.00	-1.45226	-0.46401
2014-01	-1.52458	0.302023	-5.05	0.00	-2.02136	-1.02779
2014-02	-1.43994	0.303292	-4.75	0.00	-1.93881	-0.94107

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
2014-03	-1.70853	0.304208	-5.62	0.00	-2.20891	-1.20815
2014-04	-1.14359	0.306461	-3.73	0.00	-1.64767	-0.6395
2014-05	-0.60048	0.308242	-1.95	0.05	-1.1075	-0.09347
2014-06	0.160174	0.309473	0.52	0.60	-0.34886	0.669212
2014-07	0.268763	0.31145	0.86	0.39	-0.24353	0.781053
2014-08	0.184992	0.313795	0.59	0.56	-0.33116	0.70114
2014-09	-0.07723	0.315562	-0.24	0.81	-0.59629	0.441821
2014-10	-0.74351	0.317141	-2.34	0.02	-1.26516	-0.22186
2014-11	-1.10897	0.319053	-3.48	0.00	-1.63377	-0.58418
2014-12	-0.63301	0.320135	-1.98	0.05	-1.15959	-0.10643
2015-01	-1.31065	0.321903	-4.07	0.00	-1.84014	-0.78117
2015-02	-1.8188	0.322811	-5.63	0.00	-2.34978	-1.28783
2015-03	-1.22415	0.323939	-3.78	0.00	-1.75698	-0.69132
2015-04	-0.87618	0.325217	-2.69	0.01	-1.41111	-0.34124
2015-05	-0.73186	0.326647	-2.24	0.03	-1.26915	-0.19458
2015-06	0.997661	0.327823	3.04	0.00	0.458441	1.536882
2015-07	0.170019	0.329643	0.52	0.61	-0.3722	0.712233
2015-08	0.185375	0.33132	0.56	0.58	-0.3596	0.730348
2015-09	-0.24148	0.332761	-0.73	0.47	-0.78882	0.305864
2015-10	-0.83085	0.334147	-2.49	0.01	-1.38047	-0.28123
2015-11	-0.97089	0.33541	-2.89	0.00	-1.5226	-0.41919
2015-12	-0.75684	0.336504	-2.25	0.02	-1.31034	-0.20334
2016-01	-1.40514	0.33753	-4.16	0.00	-1.96033	-0.84995
2016-02	-1.59279	0.33816	-4.71	0.00	-2.14902	-1.03657
2016-03	-1.22719	0.339001	-3.62	0.00	-1.78479	-0.66958
2016-04	-1.0297	0.340057	-3.03	0.00	-1.58905	-0.47036
2016-05	-0.64813	0.341511	-1.90	0.06	-1.20987	-0.08639
2016-06	0.114666	0.342997	0.33	0.74	-0.44951	0.678846
2016-07	0.845125	0.34432	2.45	0.01	0.278768	1.411481
2016-08	0.787457	0.34624	2.27	0.02	0.217942	1.356972
2016-09	0.226538	0.347589	0.65	0.51	-0.3452	0.798272
2016-10	-0.34274	0.349018	-0.98	0.33	-0.91683	0.23134
2016-11	-0.43832	0.349751	-1.25	0.21	-1.01361	0.13697
2016-12	-0.60592	0.350759	-1.73	0.08	-1.18286	-0.02897
2017-01	-0.73708	0.352204	-2.09	0.04	-1.31641	-0.15776
2017-02	-0.52708	0.353208	-1.49	0.14	-1.10806	0.053896
2017-03	-0.7163	0.353787	-2.02	0.04	-1.29823	-0.13438
2017-04	-0.76317	0.355192	-2.15	0.03	-1.34741	-0.17893
2017-05	-0.3668	0.356236	-1.03	0.30	-0.95275	0.21916

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
2017-06	0.047923	0.357481	0.13	0.89	-0.54008	0.635928
2017-07	0.362789	0.35911	1.01	0.31	-0.22789	0.953473
2017-08	-0.10735	0.361065	-0.30	0.77	-0.70125	0.486547
2017-09	-0.67874	0.362255	-1.87	0.06	-1.2746	-0.08289
2017-10	-0.72628	0.3633	-2.00	0.05	-1.32386	-0.12871
2017-11	-1.02939	0.364735	-2.82	0.00	-1.62933	-0.42946
2017-12	-0.8533	0.366204	-2.33	0.02	-1.45565	-0.25095
2018-01	-1.08168	1.349991	-0.80	0.42	-3.30222	1.138858
_cons	45.22401	1.254647	36.05	0.00	43.1603	47.28772
N	3174028					

Table E-5: Regression Coefficients for Cohort 5

Linear regression, absorbing indicators, Number of obs = 3396623
F(144,3329203) = 4019.90
Prob > F = 0.0000
R-squared = 0.6521
Adj R-squared = 0.6451
Root MSE = 15.0213

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
i.ym						
2011-01	-0.79134	2.367867	-0.33	0.74	-4.68613	3.103457
2011-02	-5.37459	2.367808	-2.27	0.02	-9.26929	-1.47989
2011-03	-11.8633	2.367733	-5.01	0.00	-15.7579	-7.96876
2011-04	-16.7398	2.367642	-7.07	0.00	-20.6343	-12.8454
2011-05	-13.6797	2.367551	-5.78	0.00	-17.5739	-9.78538
2011-06	-5.22351	2.367456	-2.21	0.03	-9.11763	-1.32939
2011-07	5.47678	2.367328	2.31	0.02	1.58287	9.37069
2011-08	0.541239	2.367188	0.23	0.82	-3.35244	4.434918
2011-09	-13.3896	2.36703	-5.66	0.00	-17.283	-9.49618
2011-10	-17.7309	2.36679	-7.49	0.00	-21.6239	-13.8378
2011-11	-13.4235	2.366583	-5.67	0.00	-17.3162	-9.53081
2011-12	-5.98437	2.366336	-2.53	0.01	-9.87665	-2.09209
2012-01	1.772697	2.365879	0.75	0.45	-2.11883	5.664222
2012-02	-8.68761	2.365529	-3.67	0.00	-12.5786	-4.79666
2012-03	-16.2434	2.365243	-6.87	0.00	-20.1338	-12.3529
2012-04	-18.6031	2.365073	-7.87	0.00	-22.4933	-14.7129
2012-05	-14.0099	2.36491	-5.92	0.00	-17.8999	-10.12
2012-06	-3.04445	2.364788	-1.29	0.20	-6.93418	0.845284
2012-07	5.249506	2.364718	2.22	0.03	1.359889	9.139123
2012-08	-2.35799	2.364606	-1.00	0.32	-6.24742	1.531444
2012-09	-13.223	2.364505	-5.59	0.00	-17.1122	-9.33371
2012-10	-17.2755	2.364438	-7.31	0.00	-21.1646	-13.3863
2012-11	-12.2444	2.364385	-5.18	0.00	-16.1334	-8.35531
2012-12	-7.11356	2.364357	-3.01	0.00	-11.0026	-3.22454
2013-01	-3.40395	2.364387	-1.44	0.15	-7.29303	0.485119
2013-02	-4.2457	2.364582	-1.80	0.07	-8.13509	-0.35631
2013-03	-8.49192	2.364413	-3.59	0.00	-12.381	-4.6028
2013-04	-14.7359	2.364363	-6.23	0.00	-18.625	-10.8469
2013-05	-10.1763	2.364395	-4.30	0.00	-14.0653	-6.28717
2013-06	-8.00528	2.364368	-3.39	0.00	-11.8943	-4.11624

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
2013-07	-3.61878	2.364346	-1.53	0.13	-7.50778	0.270226
2013-08	-5.1005	2.364257	-2.16	0.03	-8.98936	-1.21164
2013-09	-10.1174	2.364197	-4.28	0.00	-14.0061	-6.22861
2013-10	-16.6778	2.364317	-7.05	0.00	-20.5668	-12.7888
2013-11	-11.0799	2.364253	-4.69	0.00	-14.9688	-7.19109
2013-12	-3.39206	2.364399	-1.43	0.15	-7.28115	0.497037
2014-01	2.140682	2.364401	0.91	0.37	-1.74841	6.029776
2014-02	0.720863	2.364509	0.30	0.76	-3.16841	4.610136
2014-03	-8.39129	2.364671	-3.55	0.00	-12.2808	-4.50175
2014-04	-16.6034	2.364673	-7.02	0.00	-20.4929	-12.7138
2014-05	-14.7831	2.365005	-6.25	0.00	-18.6732	-10.893
2014-06	-6.37936	2.365341	-2.70	0.01	-10.27	-2.48872
2014-07	-5.20879	2.365836	-2.20	0.03	-9.10025	-1.31734
2014-08	-4.65268	2.365841	-1.97	0.05	-8.54414	-0.76122
2014-09	-11.0591	2.365847	-4.67	0.00	-14.9505	-7.1676
2014-10	-16.7262	2.368932	-7.06	0.00	-20.6228	-12.8297
2014-11	-9.70513	2.368953	-4.10	0.00	-13.6017	-5.80855
2014-12	-0.99582	2.389075	-0.42	0.68	-4.9255	2.93386
2015-01	0.29612	2.389444	0.12	0.90	-3.63417	4.226407
2015-02	2.8108	2.389686	1.18	0.24	-1.11988	6.741484
2015-03	-6.53708	2.390247	-2.73	0.01	-10.4687	-2.60547
2015-04	-16.9058	2.3907	-7.07	0.00	-20.8382	-12.9735
2015-05	-12.8708	2.391238	-5.38	0.00	-16.8041	-8.9376
2015-06	1.098396	2.391497	0.46	0.65	-2.83527	5.032059
2015-07	-2.83757	2.391833	-1.19	0.24	-6.77179	1.096645
2015-08	-3.3909	2.39238	-1.42	0.16	-7.32602	0.544213
2015-09	-10.4237	2.392775	-4.36	0.00	-14.3594	-6.4879
2015-10	-17.7216	2.393162	-7.41	0.00	-21.658	-13.7852
2015-11	-14.6003	2.393701	-6.10	0.00	-18.5376	-10.663
2015-12	-9.0002	2.394051	-3.76	0.00	-12.9381	-5.06233
2016-01	-2.11148	2.394515	-0.88	0.38	-6.05011	1.827147
2016-02	-4.52782	2.394644	-1.89	0.06	-8.46666	-0.58898
2016-03	-13.4116	2.39506	-5.60	0.00	-17.3511	-9.47207
2016-04	-16.905	2.395579	-7.06	0.00	-20.8453	-12.9646
2016-05	-15.417	2.395879	-6.43	0.00	-19.3579	-11.4762
2016-06	-4.68546	2.396281	-1.96	0.05	-8.62699	-0.74392
2016-07	2.948629	2.396816	1.23	0.22	-0.99378	6.891042
2016-08	3.661512	2.397369	1.53	0.13	-0.28181	7.604834
2016-09	-5.51977	2.397913	-2.30	0.02	-9.46398	-1.57555

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
2016-10	-16.2892	2.398367	-6.79	0.00	-20.2342	-12.3443
2016-11	-13.4358	2.398722	-5.60	0.00	-17.3813	-9.49023
2016-12	-3.58976	2.399056	-1.50	0.13	-7.53586	0.356334
2017-01	-4.37201	2.399512	-1.82	0.07	-8.31886	-0.42516
2017-02	-9.45315	2.399832	-3.94	0.00	-13.4005	-5.50578
2017-03	-12.1121	2.400158	-5.05	0.00	-16.06	-8.16416
2017-04	-17.1635	2.400827	-7.15	0.00	-21.1125	-13.2145
2017-05	-13.7779	2.401108	-5.74	0.00	-17.7274	-9.82843
2017-06	-5.37289	2.401682	-2.24	0.03	-9.32331	-1.42248
2017-07	-0.40708	2.401975	-0.17	0.87	-4.35798	3.543814
2017-08	-4.72768	2.402374	-1.97	0.05	-8.67923	-0.77612
2017-09	-11.1736	2.402678	-4.65	0.00	-15.1256	-7.22152
2017-10	-14.7826	2.403301	-6.15	0.00	-18.7357	-10.8295
2017-11	-11.1782	2.403728	-4.65	0.00	-15.132	-7.2244
2017-12	-7.3204	2.404237	-3.04	0.00	-11.275	-3.36579
i.ym#i.treatment						
2013-02	0.48938	0.335472	1.46	0.14	-0.06242	1.041183
2013-03	1.609639	0.246725	6.52	0.00	1.203813	2.015466
2013-04	0.499004	0.19726	2.53	0.01	0.174541	0.823467
2013-05	0.419776	0.200238	2.10	0.04	0.090413	0.749139
2013-06	0.611274	0.165868	3.69	0.00	0.338446	0.884103
2013-07	1.012872	0.15472	6.55	0.00	0.758379	1.267364
2013-08	0.863891	0.14629	5.91	0.00	0.623266	1.104517
2013-09	0.894973	0.146675	6.10	0.00	0.653714	1.136232
2013-10	0.20919	0.149764	1.40	0.16	-0.03715	0.455531
2013-11	0.126932	0.1288	0.99	0.32	-0.08493	0.338789
2013-12	0.576344	0.132239	4.36	0.00	0.358831	0.793857
2014-01	0.955794	0.123129	7.76	0.00	0.753264	1.158323
2014-02	0.864054	0.125816	6.87	0.00	0.657105	1.071002
2014-03	0.418062	0.125652	3.33	0.00	0.211383	0.62474
2014-04	-0.2393	0.122388	-1.96	0.05	-0.44061	-0.03798
2014-05	-0.45929	0.129621	-3.54	0.00	-0.6725	-0.24608
2014-06	-0.10947	0.132191	-0.83	0.41	-0.32691	0.107961
2014-07	-0.05455	0.13955	-0.39	0.70	-0.28409	0.174992
2014-08	-0.42453	0.138038	-3.08	0.00	-0.65158	-0.19748
2014-09	-0.55224	0.13855	-3.99	0.00	-0.78014	-0.32435
2014-10	-0.83891	0.186849	-4.49	0.00	-1.14625	-0.53157
2014-11	-0.58557	0.184359	-3.18	0.00	-0.88881	-0.28232
2014-12	-1.63146	0.368814	-4.42	0.00	-2.2381	-1.02481

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
2015-01	-1.86261	0.37066	-5.03	0.00	-2.47229	-1.25293
2015-02	-2.14667	0.372367	-5.76	0.00	-2.75916	-1.53418
2015-03	-1.58295	0.376213	-4.21	0.00	-2.20176	-0.96413
2015-04	-0.22306	0.379324	-0.59	0.56	-0.847	0.400867
2015-05	0.081293	0.382971	0.21	0.83	-0.54864	0.711225
2015-06	0.277628	0.384761	0.72	0.47	-0.35525	0.910504
2015-07	0.226508	0.387065	0.59	0.56	-0.41016	0.863173
2015-08	0.317747	0.390706	0.81	0.42	-0.32491	0.960401
2015-09	0.026114	0.393339	0.07	0.95	-0.62087	0.673098
2015-10	-0.28919	0.395885	-0.73	0.47	-0.94036	0.361987
2015-11	-0.65828	0.399353	-1.65	0.10	-1.31516	-0.0014
2015-12	-1.19507	0.401603	-2.98	0.00	-1.85565	-0.53449
2016-01	-2.08072	0.404551	-5.14	0.00	-2.74615	-1.4153
2016-02	-2.00569	0.405398	-4.95	0.00	-2.67251	-1.33887
2016-03	-1.0241	0.408007	-2.51	0.01	-1.69521	-0.35299
2016-04	-0.635	0.411227	-1.54	0.12	-1.31141	0.041406
2016-05	-0.13234	0.413111	-0.32	0.75	-0.81185	0.547168
2016-06	0.266782	0.415612	0.64	0.52	-0.41684	0.950402
2016-07	0.286965	0.418909	0.69	0.49	-0.40208	0.976008
2016-08	0.168796	0.422256	0.40	0.69	-0.52575	0.863346
2016-09	-0.22014	0.425551	-0.52	0.60	-0.92011	0.479829
2016-10	-0.17853	0.428267	-0.42	0.68	-0.88297	0.525903
2016-11	-0.87475	0.430392	-2.03	0.04	-1.58268	-0.16682
2016-12	-1.89705	0.432377	-4.39	0.00	-2.60824	-1.18585
2017-01	-1.75955	0.435038	-4.04	0.00	-2.47512	-1.04397
2017-02	-1.39792	0.436904	-3.20	0.00	-2.11656	-0.67927
2017-03	-1.13704	0.438796	-2.59	0.01	-1.8588	-0.41529
2017-04	-0.54677	0.442627	-1.24	0.22	-1.27483	0.181287
2017-05	-0.48212	0.444253	-1.09	0.28	-1.21286	0.248608
2017-06	-0.25748	0.447529	-0.58	0.57	-0.9936	0.478639
2017-07	-0.15932	0.449242	-0.35	0.72	-0.89826	0.579618
2017-08	-0.31207	0.451504	-0.69	0.49	-1.05473	0.430586
2017-09	-0.28225	0.453244	-0.62	0.53	-1.02777	0.463276
2017-10	-0.35476	0.456706	-0.78	0.44	-1.10597	0.39646
2017-11	-1.01194	0.459073	-2.20	0.03	-1.76705	-0.25683
2017-12	-1.5715	0.46189	-3.40	0.00	-2.33124	-0.81176
2018-01	-0.60123	2.406188	-0.25	0.80	-4.55906	3.356596
_cons	43.21286	2.363137	18.29	0.00	39.32585	47.09988
N	3396623					

Table E-6: Regression Coefficients for Cohort 7

Linear regression, absorbing indicators, Number of obs = 750601
F(63, 728546) = 3152.89
Prob > F = 0.0000
R-squared = 0.7060
Adj R-squared = 0.6971
Root MSE = 15.2753

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
i.ym						
2014-11	-7.26034	0.924925	-7.85	0.00	-8.78171	-5.73898
2014-12	4.361706	0.924914	4.72	0.00	2.840356	5.883057
2015-01	6.013904	0.924923	6.50	0.00	4.49254	7.535269
2015-02	9.644006	0.924936	10.43	0.00	8.12262	11.16539
2015-03	-3.14425	0.92495	-3.40	0.00	-4.66566	-1.62284
2015-04	-17.1629	0.92497	-18.56	0.00	-18.6844	-15.6415
2015-05	-14.8509	0.924995	-16.06	0.00	-16.3724	-13.3295
2015-06	0.406939	0.925016	0.44	0.66	-1.11458	1.928457
2015-07	-4.8033	0.92505	-5.19	0.00	-6.32488	-3.28173
2015-08	-5.40433	0.92508	-5.84	0.00	-6.92595	-3.88271
2015-09	-12.8328	0.925108	-13.87	0.00	-14.3545	-11.3111
2015-10	-19.9047	0.925134	-21.52	0.00	-21.4264	-18.383
2015-12	-7.70765	0.935126	-8.24	0.00	-9.2458	-6.1695
2016-01	1.647	0.935176	1.76	0.08	0.10877	3.18523
2016-02	-1.67969	0.935217	-1.80	0.07	-3.21799	-0.14139
2016-03	-13.3181	0.935244	-14.24	0.00	-14.8564	-11.7798
2016-04	-18.3492	0.935316	-19.62	0.00	-19.8877	-16.8108
2016-05	-17.8878	0.935401	-19.12	0.00	-19.4264	-16.3492
2016-06	-7.10457	0.935482	-7.59	0.00	-8.6433	-5.56583
2016-07	0.12754	0.935576	0.14	0.89	-1.41135	1.666427
2016-08	0.482488	0.935677	0.52	0.61	-1.05657	2.021542
2016-09	-9.46182	0.935789	-10.11	0.00	-11.0011	-7.92258
2016-10	-19.538	0.935873	-20.88	0.00	-21.0774	-17.9986
2016-11	-14.4788	0.935938	-15.47	0.00	-16.0183	-12.9394
2016-12	-1.56666	0.935988	-1.67	0.09	-3.10622	-0.02709
2017-01	-2.32486	0.936076	-2.48	0.01	-3.86457	-0.78515
2017-02	-9.09225	0.936139	-9.71	0.00	-10.6321	-7.55244
2017-03	-12.5225	0.936186	-13.38	0.00	-14.0624	-10.9826
2017-04	-19.7389	0.936281	-21.08	0.00	-21.2789	-18.1988
2017-05	-17.4378	0.936339	-18.62	0.00	-18.9779	-15.8976

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
2017-06	-9.21324	0.936405	-9.84	0.00	-10.7535	-7.67298
2017-07	-4.38076	0.936523	-4.68	0.00	-5.9212	-2.84031
2017-08	-9.03093	0.936596	-9.64	0.00	-10.5715	-7.49037
2017-09	-15.5589	0.936699	-16.61	0.00	-17.0997	-14.0182
2017-10	-18.0189	0.936797	-19.23	0.00	-19.5598	-16.478
2017-11	-11.5846	0.936856	-12.37	0.00	-13.1255	-10.0436
2017-12	-6.44204	0.936946	-6.88	0.00	-7.98318	-4.9009
i.ym#i.treatment						
2015-12	-0.40906	0.230291	-1.78	0.08	-0.78786	-0.03026
2016-01	-0.45562	0.230724	-1.97	0.05	-0.83513	-0.07611
2016-02	-0.45447	0.231055	-1.97	0.05	-0.83452	-0.07442
2016-03	-0.37419	0.231307	-1.62	0.11	-0.75465	0.006282
2016-04	-0.15014	0.231833	-0.65	0.52	-0.53147	0.231192
2016-05	-0.14915	0.232436	-0.64	0.52	-0.53147	0.233174
2016-06	-0.15165	0.233002	-0.65	0.52	-0.53491	0.231603
2016-07	-0.16235	0.233685	-0.69	0.49	-0.54673	0.222026
2016-08	-0.30046	0.234377	-1.28	0.20	-0.68598	0.085054
2016-09	-0.08918	0.235055	-0.38	0.70	-0.47581	0.297448
2016-10	-0.06086	0.235607	-0.26	0.80	-0.4484	0.326675
2016-11	-0.21107	0.236084	-0.89	0.37	-0.5994	0.177253
2016-12	-0.44802	0.236428	-1.89	0.06	-0.83691	-0.05913
2017-01	-0.52205	0.236915	-2.20	0.03	-0.91174	-0.13236
2017-02	-0.48038	0.237304	-2.02	0.04	-0.87071	-0.09004
2017-03	-0.37907	0.237634	-1.60	0.11	-0.76994	0.011804
2017-04	-0.24665	0.238195	-1.04	0.30	-0.63844	0.145149
2017-05	-0.41182	0.238577	-1.73	0.08	-0.80424	-0.01939
2017-06	-0.51574	0.239089	-2.16	0.03	-0.909	-0.12247
2017-07	-0.60941	0.239815	-2.54	0.01	-1.00387	-0.21495
2017-08	-0.48128	0.240322	-2.00	0.05	-0.87657	-0.08598
2017-09	-0.31428	0.240952	-1.30	0.19	-0.71061	0.082056
2017-10	-0.34781	0.241555	-1.44	0.15	-0.74513	0.049514
2017-11	-0.70039	0.241989	-2.89	0.00	-1.09843	-0.30236
2017-12	-0.95435	0.242561	-3.93	0.00	-1.35333	-0.55537
2018-01	0.867744	1.157041	0.75	0.45	-1.03542	2.770909
_cons	47.94967	0.919055	52.17	0.00	46.43795	49.46138
N	750601					

Table E-7: Regression Coefficients for Cohort 8

Linear regression, absorbing indicators, Number of obs = 608048
F(56, 587789) = 2182.18
Prob > F = 0.0000
R-squared = 0.6930
Adj R-squared = 0.6824
Root MSE = 13.7594

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
i.ym						
2014-12	0.731718	1.187918	0.62	0.54	-1.22224	2.685672
2015-01	0.734351	1.177481	0.62	0.53	-1.20244	2.671138
2015-02	2.97039	1.173135	2.53	0.01	1.040752	4.900029
2015-03	-8.34427	1.170044	-7.13	0.00	-10.2688	-6.41972
2015-04	-16.8926	1.168161	-14.46	0.00	-18.814	-14.9711
2015-05	-12.3101	1.167076	-10.55	0.00	-14.2298	-10.3904
2015-06	-0.85276	1.165597	-0.73	0.46	-2.77	1.064483
2015-07	-2.18732	1.165145	-1.88	0.06	-4.10381	-0.27082
2015-08	-2.11759	1.165132	-1.82	0.07	-4.03407	-0.20112
2015-09	-8.84264	1.165132	-7.59	0.00	-10.7591	-6.92617
2015-10	-15.9764	1.16513	-13.71	0.00	-17.8929	-14.06
2015-11	-12.797	1.16513	-10.98	0.00	-14.7135	-10.8805
2015-12	-7.59512	1.165129	-6.52	0.00	-9.51159	-5.67865
2016-01	-1.25798	1.165128	-1.08	0.28	-3.17445	0.658491
2016-02	-3.73061	1.165127	-3.20	0.00	-5.64707	-1.81414
2016-03	-12.0587	1.165127	-10.35	0.00	-13.9751	-10.1422
2016-04	-15.157	1.165126	-13.01	0.00	-17.0735	-13.2406
2016-05	-13.2065	1.165125	-11.33	0.00	-15.123	-11.29
2016-06	-3.39831	3.04203	-1.12	0.26	-8.40201	1.60539
2016-07	4.890848	1.179401	4.15	0.00	2.950903	6.830794
2016-08	5.762749	1.179678	4.89	0.00	3.822349	7.70315
2016-09	-3.45025	1.180042	-2.92	0.00	-5.39125	-1.50925
2016-10	-14.1601	1.180281	-12.00	0.00	-16.1015	-12.2187
2016-11	-11.6564	1.180599	-9.87	0.00	-13.5983	-9.71447
2016-12	-2.41279	1.180822	-2.04	0.04	-4.35507	-0.47051
2017-01	-3.03473	1.181029	-2.57	0.01	-4.97736	-1.09211
2017-02	-8.1273	1.181327	-6.88	0.00	-10.0704	-6.18418
2017-03	-10.5431	1.181577	-8.92	0.00	-12.4867	-8.59961
2017-04	-15.0904	1.181819	-12.77	0.00	-17.0344	-13.1465
2017-05	-11.7212	1.18212	-9.92	0.00	-13.6657	-9.77682

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
2017-06	-3.18196	1.182557	-2.69	0.01	-5.12709	-1.23682
2017-07	1.906723	1.183003	1.61	0.11	-0.03915	3.852593
2017-08	-2.65411	1.183374	-2.24	0.02	-4.6006	-0.70763
2017-09	-9.04506	1.183668	-7.64	0.00	-10.992	-7.0981
2017-10	-12.5214	1.183984	-10.58	0.00	-14.4689	-10.5739
2017-11	-9.3964	1.184287	-7.93	0.00	-11.3444	-7.44842
2017-12	-5.74546	1.184577	-4.85	0.00	-7.69391	-3.797
i.ym#i.treatment						
2016-07	0.290628	0.247801	1.17	0.24	-0.11697	0.698225
2016-08	0.161177	0.249785	0.65	0.52	-0.24968	0.572038
2016-09	0.085939	0.252263	0.34	0.73	-0.329	0.500875
2016-10	-0.00659	0.253992	-0.03	0.98	-0.42437	0.411194
2016-11	-0.30318	0.256016	-1.18	0.24	-0.72429	0.117928
2016-12	-0.79188	0.257521	-3.07	0.00	-1.21546	-0.36829
2017-01	-0.86775	0.258847	-3.35	0.00	-1.29352	-0.44198
2017-02	-0.44285	0.260639	-1.70	0.09	-0.87156	-0.01414
2017-03	-0.49264	0.262191	-1.88	0.06	-0.9239	-0.06137
2017-04	-0.41158	0.263786	-1.56	0.12	-0.84547	0.022312
2017-05	-0.31756	0.265615	-1.20	0.23	-0.75446	0.119337
2017-06	-0.16606	0.268235	-0.62	0.54	-0.60726	0.27515
2017-07	-0.16087	0.270878	-0.59	0.55	-0.60643	0.284681
2017-08	-0.02269	0.273054	-0.08	0.93	-0.47182	0.426444
2017-09	0.007415	0.274856	0.03	0.98	-0.44468	0.459513
2017-10	-0.25862	0.276652	-0.93	0.35	-0.71367	0.196433
2017-11	-0.42896	0.278278	-1.54	0.12	-0.88668	0.028773
2017-12	-0.62361	0.280098	-2.23	0.03	-1.08434	-0.16289
2018-01	0.117962	1.313059	0.09	0.93	-2.04183	2.277755
_cons	41.31562	1.16106	35.58	0.00	39.40585	43.2254
N	608048					

Table E-8: Regression Coefficients for Cohort 9

Linear regression, absorbing indicators, Number of obs = 750601
F(63, 728546) = 3152.89
Prob > F = 0.0000
R-squared = 0.7060
Adj R-squared = 0.6971
Root MSE = 15.2753

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
i.ym						
2014-11	-7.26034	0.924925	-7.85	0.00	-8.78171	-5.73898
2014-12	4.361706	0.924914	4.72	0.00	2.840356	5.883057
2015-01	6.013904	0.924923	6.50	0.00	4.49254	7.535269
2015-02	9.644006	0.924936	10.43	0.00	8.12262	11.16539
2015-03	-3.14425	0.92495	-3.40	0.00	-4.66566	-1.62284
2015-04	-17.1629	0.92497	-18.56	0.00	-18.6844	-15.6415
2015-05	-14.8509	0.924995	-16.06	0.00	-16.3724	-13.3295
2015-06	0.406939	0.925016	0.44	0.66	-1.11458	1.928457
2015-07	-4.8033	0.92505	-5.19	0.00	-6.32488	-3.28173
2015-08	-5.40433	0.92508	-5.84	0.00	-6.92595	-3.88271
2015-09	-12.8328	0.925108	-13.87	0.00	-14.3545	-11.3111
2015-10	-19.9047	0.925134	-21.52	0.00	-21.4264	-18.383
2015-12	-7.70765	0.935126	-8.24	0.00	-9.2458	-6.1695
2016-01	1.647	0.935176	1.76	0.08	0.10877	3.18523
2016-02	-1.67969	0.935217	-1.80	0.07	-3.21799	-0.14139
2016-03	-13.3181	0.935244	-14.24	0.00	-14.8564	-11.7798
2016-04	-18.3492	0.935316	-19.62	0.00	-19.8877	-16.8108
2016-05	-17.8878	0.935401	-19.12	0.00	-19.4264	-16.3492
2016-06	-7.10457	0.935482	-7.59	0.00	-8.6433	-5.56583
2016-07	0.12754	0.935576	0.14	0.89	-1.41135	1.666427
2016-08	0.482488	0.935677	0.52	0.61	-1.05657	2.021542
2016-09	-9.46182	0.935789	-10.11	0.00	-11.0011	-7.92258
2016-10	-19.538	0.935873	-20.88	0.00	-21.0774	-17.9986
2016-11	-14.4788	0.935938	-15.47	0.00	-16.0183	-12.9394
2016-12	-1.56666	0.935988	-1.67	0.09	-3.10622	-0.02709
2017-01	-2.32486	0.936076	-2.48	0.01	-3.86457	-0.78515
2017-02	-9.09225	0.936139	-9.71	0.00	-10.6321	-7.55244
2017-03	-12.5225	0.936186	-13.38	0.00	-14.0624	-10.9826
2017-04	-19.7389	0.936281	-21.08	0.00	-21.2789	-18.1988
2017-05	-17.4378	0.936339	-18.62	0.00	-18.9779	-15.8976

x-var	Coeff.	Std. Err.	t	P-val	90% Confidence Int.	
2017-06	-9.21324	0.936405	-9.84	0.00	-10.7535	-7.67298
2017-07	-4.38076	0.936523	-4.68	0.00	-5.9212	-2.84031
2017-08	-9.03093	0.936596	-9.64	0.00	-10.5715	-7.49037
2017-09	-15.5589	0.936699	-16.61	0.00	-17.0997	-14.0182
2017-10	-18.0189	0.936797	-19.23	0.00	-19.5598	-16.478
2017-11	-11.5846	0.936856	-12.37	0.00	-13.1255	-10.0436
2017-12	-6.44204	0.936946	-6.88	0.00	-7.98318	-4.9009
i.ym#i.treatment						
2015-12	-0.40906	0.230291	-1.78	0.08	-0.78786	-0.03026
2016-01	-0.45562	0.230724	-1.97	0.05	-0.83513	-0.07611
2016-02	-0.45447	0.231055	-1.97	0.05	-0.83452	-0.07442
2016-03	-0.37419	0.231307	-1.62	0.11	-0.75465	0.006282
2016-04	-0.15014	0.231833	-0.65	0.52	-0.53147	0.231192
2016-05	-0.14915	0.232436	-0.64	0.52	-0.53147	0.233174
2016-06	-0.15165	0.233002	-0.65	0.52	-0.53491	0.231603
2016-07	-0.16235	0.233685	-0.69	0.49	-0.54673	0.222026
2016-08	-0.30046	0.234377	-1.28	0.20	-0.68598	0.085054
2016-09	-0.08918	0.235055	-0.38	0.70	-0.47581	0.297448
2016-10	-0.06086	0.235607	-0.26	0.80	-0.4484	0.326675
2016-11	-0.21107	0.236084	-0.89	0.37	-0.5994	0.177253
2016-12	-0.44802	0.236428	-1.89	0.06	-0.83691	-0.05913
2017-01	-0.52205	0.236915	-2.20	0.03	-0.91174	-0.13236
2017-02	-0.48038	0.237304	-2.02	0.04	-0.87071	-0.09004
2017-03	-0.37907	0.237634	-1.60	0.11	-0.76994	0.011804
2017-04	-0.24665	0.238195	-1.04	0.30	-0.63844	0.145149
2017-05	-0.41182	0.238577	-1.73	0.08	-0.80424	-0.01939
2017-06	-0.51574	0.239089	-2.16	0.03	-0.909	-0.12247
2017-07	-0.60941	0.239815	-2.54	0.01	-1.00387	-0.21495
2017-08	-0.48128	0.240322	-2.00	0.05	-0.87657	-0.08598
2017-09	-0.31428	0.240952	-1.30	0.19	-0.71061	0.082056
2017-10	-0.34781	0.241555	-1.44	0.15	-0.74513	0.049514
2017-11	-0.70039	0.241989	-2.89	0.00	-1.09843	-0.30236
2017-12	-0.95435	0.242561	-3.93	0.00	-1.35333	-0.55537
2018-01	0.867744	1.157041	0.75	0.45	-1.03542	2.770909
_cons	47.94967	0.919055	52.17	0.00	46.43795	49.46138
N	750601					

Appendix F Awareness and Engagement

The increased engagement and awareness generated by the MyHER program can be difficult to measure. Nexant designed a survey approach that measures different aspects of the MyHER effect, but no one survey question can fully capture the numerous and subtle effects of MyHER that ultimately resulted in the observed energy impacts. Instead, one might expect the overall pattern of survey responses to signal a difference in behavior and attitudes between the MyHER treatment and control group.

Nexant developed a framework for measuring this pattern of MyHER influence by applying straightforward statistical concepts to develop a holistic look at the program's influence on customer behavior. While a single survey question may not result in statistically significant differences between the treatment and control group, if the treatment group responds more favorably than the control group to a set of survey questions, then we can estimate the probability that the collection of responses fits a hypothesis of MyHER influence.

Nexant assigned each survey question a category. Table F-1 shows the categories, the count of questions in each category for which the treatment group provided a more favorable response than the control group, and the number of questions in each category. A response is considered "favorable" if the treatment group gave a response that is consistent with the program objectives of MyHER.

Table F-1: Classification of Survey Responses and Treatment Group "Success Rate"

Question Category	Count of Questions where T>C	Number of Questions in Topic Area	Portion of Questions where T>C
Duke Energy's Public Stance on Energy Efficiency	3	3	100%
Customer Engagement with Duke Energy Website	4	5	80%
Customers' Reported Energy-saving Behaviors	2	7	29%
Customers' Past & Future Equipment Purchases	6	16	38%
Customer Motivation, Engagement & Awareness of Energy Efficiency	4	11	36%
Customer Satisfaction with Duke Energy	0	4	0%
Total	**19**	**46**	**41%**

If the MyHER program had no effect on participants' awareness, attitudes, and opinions, then we would expect the control group to score better than the treatment group on approximately half of the survey questions. However, the treatment group provided answers consistent with a MyHER treatment effect in only approximately 41% of the survey questions, which does not represent an uplift from the expected percentage of 50%. Thus we cannot make the case that

MyHER had wide-ranging enhancing effects across all the various engagement and attitudinal areas probed by the survey.

We call out, however, three particular survey areas of note. First, DEO treatment customers fared particularly poorly in the area of general satisfaction with Duke Energy: treatment customers reported lower satisfaction scores than control customers for all four general satisfaction questions. Nexant recommends that the MyHER program staff coordinate with any internal customer satisfaction data collection efforts to cross-reference these findings with any learnings on DEO customer satisfaction. The lower satisfaction scores for DEO treatment customers may indicate an opportunity for new messaging or content in Ohio.

Two other survey areas show particularly consistent MyHER uplift in DEO customer engagement with the Duke Energy website in addition to satisfaction with Duke Energy's stance on energy efficiency. In these two cases 7 out of 8 questions show more favorable responses for the treatment group. Using standard statistical techniques (specifically, the non-parametric sign test), Nexant calculates the probability of randomly obtaining this result is 3%.

What does that 3% probability mean? Consider a series of coin flips. What is the probability of obtaining 7 heads in 8 coin flips if there is a 50/50 chance of obtaining a heads or tails on any one coin flip? This same principle can be applied to the survey: what is the probability that the treatment group gives a more favorable response to 7 out of 8 survey questions if MyHER has no influence on customer awareness and attitudes about energy efficiency? The answer, 3%, is "very low". Thus we conclude that the survey responses in these two survey areas favorably affects DEO customer attitudes and actions in the areas of satisfaction with Duke Energy's stance on energy efficiency and engagement with the Duke Energy website.[14]

[14] The technical way of putting this is to say that we reject the hypothesis that MyHERs have no effect on customer satisfaction with Duke Energy's stance on energy efficiency and on customer engagement with the Duke Energy website.

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APPENDIX H - ENERGY EFFICIENCY EDUCATION FOR SCHOOLS

REPORT

Energy Efficiency Education in Schools Program Year 2017 - 2018 Evaluation Report

Submitted to Duke Energy Ohio
in partnership with Research into Action

October 22nd, 2018

Principal authors:

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