Appendix A. Residential Customer Profile

Household Characteristics	n value / Percentage
Home Ownership	n=77
Home owner	79%
Renter	21%
Type of Home	n=76
Single-family home, detached construction	74%
Single-family mobile home	13%
Row house	3%
Two or three family attached residence – traditional structure	1%
Apartment (4+ families) traditional structure	4%
Other	5%
Home Age	n=64
Built before 1959	52%
1960 – 1979	25%
1980 – 1989	11%
1990 – 1997	6%
1998 – 2000	2%
2001 – 2007	3%
2008 – present	2%
Basement	n=79
Heated	52%

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Household Characteristics	n value / Percentage
Unheated	16%
No basement	32%
Age groups	n=78
18-34	9%
35-49	18%
50-59	24%
60-64	17%
65-74	13%
Over 74	19%
Years in Household	n=77
1 to 4	13%
5 to 9	25%
10 to 14	17%
15 to 19	16%
20 or more	30%

Appendix B. Interview Guide

People Working Cooperatively Staff Interview Guide

Duke Energy Ohio – Home Weatherization Program (PWC Low Income Pilot)

Name:	*Interviewer:*
Title:	*Date:*
Company:	*Phone:*

The purpose of the interview is to explore your experience working with Duke Energy Ohio on the PWC Low Income Pilot Program. We use input from a variety of staff involved with the program to describe how the program works, what makes it successful, and where there may be opportunities for improvement. Please feel free to let me know if there are questions that may not apply to your role so that we can focus on the areas with which you have worked most closely. We are also interviewing representatives from Duke Energy Ohio and WIN, so if a question is more appropriate for them, please let me know.

- Thanks you taking the time to speak with me. We also have [NAME] on the line who will be taking notes to help us review all the information discussed in this conversation.
- Duke Energy Ohio has hired Cadmus to assess this program. Part of this assessment is to conduct in-depth interviews with program and implementation staff to make sure we have a thorough understanding of the program.
- We are also looking for your perspective on what you think is going well and what you think may be needed for improvement.

Roles and Responsibilities

My first questions are to give us an overview of your role and responsibilities.

Please describe your roles and responsibilities.

How do you interact with other stakeholders in the Low Income Pilot Program? (probe for: overarching program set-up, and unique relationship, responsibilities, number of staff supervising/assisting).

And how many staff members are dedicated to working with Duke on this program?

a. Has staffing changed in this last program year? In what way?

Does the work you do with Duke customers differ in any way from other customers in other utility territories?

Program Objectives

The next questions are about the program objectives.

1. What are the program objectives?
2. Do you have any specific goals or objectives working within Duke Energy's territory?
3. Were these outcomes consistent with your expectations?

Program Implementation

My next questions are about how the program is implemented.

1. Can you describe how the program operates?
2. What are the duties of the other stakeholders?
3. Does Duke Energy play a role in program implementation and delivery?
4. What are the program's strengths? What is working particularly well?
5. Has the program encountered any obstacles or bottlenecks? How have you managed them?

Working with Participants

1. What are the ways the participants likely hear about this program?
2. What are the motivating factors for participants in this program?
3. What are the key barriers to participation in this program?
4. In your opinion, once a person has chosen to participate, what are the biggest challenges to the participant in implementing the program (managing the work in their homes, timing, choosing optional measures...) ?
5. What aspects of the program's delivery to the participants are working well?
6. What aspects of the program's delivery to the participants could be improved? How?
7. In your opinion, is the program reaching the intended participants? Why or why not?
    a. Are there participants not served in the program that should be reaching?

Data Tracking

1. Please describe the data tracking and data collection processes.

Have there been any difficulties with the data tracking?

Wrap Up

There are just a few more questions about your future outlook on the program.

1. What do you see as future development for the Program with Duke Energy?
2. What, if anything, might affect how the program performs in the future? What do you see as future challenges for the program?
3. What can take this program to the next level? What is the next level?
4. Any other comments or areas we did not cover on which you like to add your views?
5. Finally, would it be alright to contact you with further questions as we are looking over this program data?

Thank you very much for your time today!

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Appendix C. Survey Instrument

Duke Energy People Working Cooperatively Home Weatherization Survey

Table 16. Researchable Questions

Researchable Metrics	Questions
Overall Program	
Are there any recommendations for program improvement in terms of marketing?	C1- C6
Are there any recommendations for program improvement in terms of participant satisfaction?	E1 – E11
What are the installation rates for various measures, and participants' satisfaction with these measures?	D1 – D11
Are there any recommendations for overall program improvement?	F1
What are the participants demographics?	G1 – G10
Are participants interested in having a site visit to verify installation?	H1 – H2

- **Interviewer instructions are in green.**
- **Programming instructions are in red.**

Introduction/Screening

A1. Hello, can I please speak to _____?

1. Yes, speaking to the decision maker **[READ LANGUAGE BELOW A1]**
2. Yes, call transferred to someone else **[READ LANGUAGE BELOW A1]**
3. No **[SKIP TO E10]**
4. DID NOT SPEAK WITH ANYONE **[SKIP TO DISPOSITION]**

I'm calling from Thoroughbred Research Group on behalf of the People Working Cooperatively organization (PWC). Our records indicate that the People Working Cooperatively organization helped you make repairs to your home through the Home Weatherization program. To help improve the People Working Cooperatively Weatherization program, we would like to ask you about your experience with this program. As a token of our appreciation, we will place your name in a drawing for one of 10, $25.00 visa pre-paid gift cards.

Are you the person most familiar with energy-saving equipment installed through the People Working Cooperatively Home Weatherization Program? ***[IF "NO", ASK FOR THAT PERSON.]***
[IF NEEDED: This was when a contractor came out to your residence and installed equipment such as light
bulbs, showerheads or faucet aerators.]
Is this a good time to speak with you? ***[IF NOT, SET UP A CALL BACK APPOINTMENT]***

B1. To confirm our records, did you have energy-saving equipment installed through the People Working Cooperatively Home Weatherization Program at **[SERVICE ADDRESS THAT RECEIVED EQUIPMENT]**? ***[IF NEEDED: This was when a contractor came out to your residence and installed equipment such as light bulbs, showerheads, or faucet aerators].***

1. Yes **[SKIP TO C1]**
2. No ***[THANK AND TERMINATE, SKIP TO DISPOSITION]***
3. (Don't know) ***[THANK AND TERMINATE, SKIP TO DISPOSITION]***
88. (Refused)

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C. Awareness

C1. How did you hear about the Weatherization Program? **[MARK ALL THAT APPLY] [DO NOT READ OPTIONS]**

1. Contractor
2. Duke Energy bill insert
3. Duke Energy website
4. Duke Energy employee, account representative, customer service representative
5. Friend / relative
6. Newspaper/Periodical
7. Program brochure
8. PWC (People Working Cooperatively) website
9. Someone from PWC
10. Someone came to me and explained the program **[WHO? SPECIFY]**
11. Television
12. Word of mouth
13. (Other [SPECIFY:_____])

99. (Don't know)
88. (Refused)

C2. What prompted you to participate in the Weatherization Program?
[DO NOT READ RESPONSES] [MATCH VERBATIMS WITH LIST]

1. Advertisement for the program **(Specify which ad / where they saw it:_____)**
2. Comfort issues in home
3. Contractor Recommendation
4. Current experience with another program (Specify program: _____)
5. Environmental / Ecological concerns
6. Energy audit
7. Energy education tips
8. Friend, family member, colleague Recommendation
9. Investment / Value to home (older homes)
10. Past experience with another program **(Probe for specifics on Organization / Implementer and Program Name: _____)**
11. Save money on my bill
12. Save Energy
13. Technical assistance I could get from the contractor
14. The program offerings
15. To learn more about my home and its energy use
16. Other **(Specify:_____)**

99. (Don't know)
88. (Refused)

C3. Was there any specific service or piece of equipment offered through the program that initially stood out to you as you were deciding to participate in the program?

1. Yes – What specifically stood out to you?
   (SPECIFY:_____)
2. No
99. (Don't know)
88. (Refused)

C4. (IF C3=1, ASK, OTHERWISE SKIP TO C6) Were these services or installations performed as part of the Weatherization Program visit?

1. Yes **(SKIP TO D1)**
2. No
99. (Don't know)
88. (Refused)

C5. (IF C4=2, ASK, OTHERWISE SKIP TO D1) What were you told the reason this particular service or installation did not take place?

1. **(SPECIFY:_____)**
99. (Don't know)

C6. If you were interested in receiving additional information that could help you save money on your bill, what is MOST your preferred method to receive the information? **[MATCH VERBATIMS WITH LIST] (IF "IN THE MAIL," ASK: In your bill, through a customer newsletter, or a regular mailed letter addressed to you?)**

1. Community event/fair
2. Duke Energy's website
3. Duke Energy Newsletter
4. Email
5. In the mail **(Specify format: _____)**
6. Other website **(Specify website:_____)**
7. Phone call
8. Print advertisement
9. None
99. (Don't know)
88. (Refused)

D. Measure Verification

This following questions will ask about the items which were installed by the People Working Cooperatively representative that weatherized your home.

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D1. Just to confirm, the program records indicate that you received the following: (Read measures from sample; only ask about measures that are indicated in the sample; check boxes of those they confirm)

1. Air sealing
2. CFLs
3. Attic Insulation
4. Ceiling Insulation
5. Floor Insulation
6. Foundation Insulation
7. Roof Insulation
8. Wall Insulation
9. Kitchen and Bathroom faucet aerators
10. Energy-efficient showerhead
11. Refrigerator replacement
12. Water heater replacement
13. Water heater pipe wrap
14. Water heater tank insulator
15. Other (Specify)_____
99. (Don't know)
88. (Refused)

(IF D1 NOT 1-14, THANK AND TERMINATE)

D2. Is all of this equipment still installed? (READ LIST OF EQUIPMENT FROM D1, AND RECORD RESPONSE FOR EACH. ASK D3 IMMEDIATELY BEFORE CONTINUING WITH LIST, IF RESPONSE =2)

1. Yes
2. No **(ASK D3 IMMEDIATELY BEFORE CONTINUING WITH LIST)**
99. (Don't know)
88. (Refused)

D3. (SKIP FOR ANY MEASURES STILL INSTALLED) Why is that equipment no longer installed? (OPEN-ENDED) (PROBE FOR SPECIFICS) (RECORD VERBATIM)

D4. Did the Weatherization Program representative leave you with any energy-saving items they did not install?

1. Yes
2. No
99. (Don't know)
88. (Refused)

D5. [IF D4 = YES] What items did the representative leave behind? (DO NOT READ LIST, MATCH VERBATIM TO LIST)

1. Air sealing
2. **(Verify the number left behind)** CFLs

3. Insulation – Attic
4. Insulation - Ceiling
5. Insulation – Floor
6. Insulation – Foundation
7. Insulation - Roof
8. Insulation – Wall
9. **(Verify the number)** Kitchen and Bathroom faucet aerators
10. **(Verify the number left behind)** Energy-efficient showerhead
11. Refrigerator replacement
12. Water heater replacement
13. Water heater pipe wrap
14. Water heater tank insulator
15. Other (Specify)_____
99. (Don't know)
88. (Refused)

D6. [IF D5 = YES] Have you installed any of the items that the representative left behind?

1. Yes
2. No
99. (Don't know)
88. (Refused)

D7. [IF D6 = YES] Which of these items were left behind and installed?

1. Air sealing
2. CFLs
3. Attic Insulation
4. Ceiling Insulation
5. Floor Insulation
6. Foundation Insulation
7. Roof Insulation
8. Wall Insulation
9. Kitchen and Bathroom faucet aerators
10. Energy-efficient showerhead
11. Refrigerator replacement
12. Water heater replacement
13. Water heater pipe wrap
14. Water heater tank insulator
15. Other (Specify)_____
99. (Don't know)
88. (Refused)

D8. Since your weatherization improvements were installed, have you noticed any changes in your home's comfort compared to before the weatherization improvements were installed?

1. Yes **– What have you noticed? – [RECORD ANSWER]**
2. No
99. (Don't Know)
88. (Refused)

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D9. On a scale from 1 to 5, with one being significantly easier and 5 being significantly harder, how would you rate the difficulty in maintaining a comfortable temperature in your home since the PWC representative made the improvements?

1. [RECORD ANSWER 1 - 5]
99. (Don't Know)
88. (Refused)

D10. Since your weatherization improvements were installed, have you noticed any savings in your electric bill?

1. Yes – How much savings have you noticed on your monthly bill – in dollars? - **[RECORD ANSWER]**
2. No (GO TO E1)

99. (Don't Know) (GO TO E1)
88. (Refused) (GO TO E1)

D11. How satisfied are you with any savings you noticed on your electric bill since the weatherization improvements were installed? Would you say you are: [READ OPTIONS UNTIL ANSWERED]

1. Very Satisfied
2. Somewhat Satisfied
3. Neither Satisfied nor Dissatisfied
4. Somewhat Dissatisfied
5. Very Dissatisfied
99. (Don't know)
88. (Refused)

E. Participant Satisfaction

1. What is your overall satisfaction with all of the items installed by the Weatherization Program representative? Would you say you were Very Satisfied, Somewhat Satisfied, Neither Satisfied nor Dissatisfied, Somewhat Dissatisfied, or Very Dissatisfied? **[READ OPTIONS UNTIL ANSWERED]**
    1. Very satisfied
    2. Somewhat satisfied
    3. Neither satisfied nor dissatisfied
    4. Somewhat dissatisfied
    5. Very dissatisfied
    99. Don't know
    88. Refused

2. **[If E1=4 or 5]** And what is the reason for your rating?

3. On the same scale, how satisfied are you with the visit you received from the Weatherization Program representative who came to your home and installed the energy efficiency program upgrades? **[READ OPTIONS UNTIL ANSWERED]**
    1. Very satisfied

2. Somewhat satisfied
3. Neither satisfied nor dissatisfied
4. Somewhat dissatisfied
5. Very dissatisfied
99. Don't know
88. Refused

4. **[If E3=4 or 5]** Can you share with me why you gave this rating? **(DO NOT READ LIST, MATCH VERBATIMS TO LIST)**
   1. Bad customer service
   2. Did not clean up
   3. Installer had to come back
   4. Late for appointment
   5. Not respectful of respondent's property
   6. Not knowledgeable
   7. Price
   8. Problem with installation
   9. Problem with equipment
   10. Other **(SPECIFY:_____)**
   99. (Don't know)
   88. (Refused)

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5. **[Refer to D1: Verified Measures] [Randomly Choose 1 Verified Measure]** You stated that the Weatherization Program representative installed **[MEASURE 1]**. How satisfied are you with **[MEASURE 1]**? Would you say you were Very Satisfied, Somewhat Satisfied, Neither Satisfied nor Dissatisfied, Somewhat Dissatisfied, or Very Dissatisfied? **[READ OPTIONS UNTIL ANSWERED]**
   1. Very satisfied
   2. Somewhat satisfied
   3. Neither satisfied nor dissatisfied
   4. Somewhat dissatisfied
   5. Very dissatisfied
   99. Don't know
   88. Refused

6. **[Refer to D1: Verified Measures] [Randomly Choose 1 Verified Measure not asked in E5]** You also stated that the Weatherization Program representative installed **[MEASURE 2]**. On the same scale, how satisfied are you with **[MEASURE 2]**? **[READ OPTIONS UNTIL ANSWERED]**
   1. Very satisfied
   2. Somewhat satisfied
   3. Neither satisfied nor dissatisfied
   4. Somewhat dissatisfied
   5. Very dissatisfied
   99. Don't know
   88. Refused

7. **[Refer to D1: Verified Measures] [Randomly Choose 1 Verified Measure not asked in E5 or E6]** Finally, you stated that the Weatherization Program representative installed **[MEASURE 3]**. Using the same scale, how satisfied are you with **[MEASURE 3]**? **[READ OPTIONS UNTIL ANSWERED]**
   1. Very satisfied
   2. Somewhat satisfied
   3. Neither satisfied nor dissatisfied
   4. Somewhat dissatisfied
   5. Very dissatisfied
   99. Don't know
   88. Refused

8. On the same scale, how would you rate your overall satisfaction with the Weatherization Program? Would you say you were Very Satisfied, Somewhat Satisfied, Neither Satisfied nor Dissatisfied, Somewhat Dissatisfied, or Very Dissatisfied? **[READ OPTIONS UNTIL ANSWERED]**
   1. Very satisfied
   2. Somewhat satisfied
   3. Neither satisfied nor dissatisfied
   4. Somewhat dissatisfied
   5. Very dissatisfied
   99. Don't know
   88. Refused

9. **[If E8=4 or 5]** And what is the reason for your rating?

10. Finally, using the same scale, how would you rate your overall satisfaction with Duke Energy as your energy provider? **[READ OPTIONS UNTIL ANSWERED]**
    1. Very satisfied
    2. Somewhat satisfied
    3. Neither satisfied nor dissatisfied
    4. Somewhat dissatisfied
    5. Very dissatisfied
    99. Don't know
    88. Refused
11. **[If E10=4 or 5]** And what is the reason for your rating?

F. Participant Feedback

1. Do you have any recommendations on how to improve the Weatherization Program that have not already been expressed?
    1. Yes – what recommendations do you have? - **[RECORD ANSWER]**
    2. No
    99. (Don't know)
    88. (Refused)

G. Demographics

The last set of questions deal with household characteristics. These questions are optional, and you do not need to share any information that you are uncomfortable sharing. Please keep in mind that any and all information you provide will remain confidential.

1. In what type of building do you live?
    1. Single-family home, detached construction
    2. Single family home, factory manufactured/modular
    3. Single family, mobile home
    4. Row House
    5. Two or Three family attached residence-traditional structure
    6. Apartment (4 + families)---traditional structure
    7. Condominium---traditional structure
    8. Other _____
    99. DK/NS
    88. Refused

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2. What year was your residence built?
   1. 1959 and before
   2. 1960-1979
   3. 1980-1989
   4. 1990-1997
   5. 1998-2000
   6. 2001-2007
   7. 2008-present
   99. DK/NS

3. How long have you lived in your current home?
   1. **[SPECIFY]** duration in years and months _____
   99. DK/NS
4. Do you own or rent your residence?
   1. Own
   2. Rent
5. Does your home have a heated or unheated basement?
   1. Heated
   2. Unheated
   3. No basement
   99. DK

The following questions are for classification purposes only and will not be used for any other purpose than to help Duke Energy continue to improve service.

6. What is your age group? [Read all]
   1. 18-34
   2. 35-49
   3. 50-59
   4. 60-64
   5. 65-74
   6. Over 74
   7. Prefer not to answer

7. [INTERVIEWER: RECORD GENDER OF RESPONDENT AT CONCLUSION OF SURVEY – DO NOT ASK]
   1. Male
   2. Female
   3. Missing

We've reached the end of the survey. As I mentioned earlier, we would like to enter you in a drawing for one of ten, $25 for your time and feedback today. Should your name be drawn, we are planning to send it to {address on calling sheet}, or would a different address be better?

[Confirm Name & complete address from calling sheet. If needed, record any changes to Name or Address on calling sheet in "Changed Address" column.]

We will have the drawing for the gift cards in about 4 to 6 weeks. If you are a winner you will receive the visa prepaid gift card in an envelope from the Cadmus.

Confirm that respondent wants to use the name and address on the call sheet for the gift card drawing. If "No", record any changes on call sheet.

( ) Yes

( ) No

1. **[IF CUSTOMER DID NOT RECEIVE INSULATION AN/OR AIR SEALING]** Thank you again for time. If your name is drawn we will mail you the visa pre-paid gift card in the next 4 to 6 weeks. Thank you for taking my call. Have a nice rest of your day.

[ONLY READ IF TERMINATED IN SECTION A OR B]

2. Thank you for taking my call. Have a nice rest of your day.

H: Site Verification

(Ask if customer received insulation and/or air sealing)

3. Finally, you qualify to participate in the next step of this study if you are interested. We are selecting a small group of customers who are willing to have an engineer come out to their residence to check that all of the items that were installed through this program are installed correctly and working properly. The visit from the engineer will take less than an hour. Customers willing to participate in this second step of the study will receive a $25.00 visa pre-paid gift card. Would you like to be included in this verification process? (if ask for more info: *we want to ensure the implementers provided the correct materials and that it was correctly installed*.)
   1. Yes
   2. No
   99. (Don't know)
   88. Refused

4. **[IF H1=1]** Great! Someone from Working in Neighborhoods will be contacting to set up the visit. What is the best phone number to reach you to arrange an appointment? **[RECORD ANSWER]**

   Thank you for taking my call.
   Have a nice rest of your day.

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Appendix D: Survey Frequencies

The following provides survey data from the PWC LI Pilot Program Survey.

GENDER	**Base**	**80**
		100%
	MALE	22
		28%
	FEMALE	58
		72%
C1. How did you hear about the Weatherization Program? (MULTIPLE RESPONSE)	Base	74
		100%
	CONTRACTOR	3
		4%
	DUKE ENERGY BILL INSERT	5
		7%
	DUKE ENERGY WEBSITE	2
		3%
	DUKE ENERGY EMPLOYEE, ACCOUNT REPRESENTATIVE, CUSTOMER SERVICE REPRESENTATIVE	2
		3%
	FRIEND / RELATIVE	28
		38%
	PROGRAM BROCHURE	1
		1%
	SOMEONE FROM PWC	8
		11%
	TELEVISION / Radio	11
		15%
	WORD OF MOUTH	7
		9%
	Other Community outreach	8
		11%
	1ST OTHER(SPECIFY)	
	DON'T KNOW	6
	1 CHILDRENS SERVICES	

		1 COMMUNITY 1 COMMUNITY ACTION ACTIVITY 1 DUKE ENERGY ADVERTISEMENT SENT BY MAIL 1 ELDERLY SERVICES PROGRAM 1 I READ ALOT AND LISTEN TO THE RADIO 1 IM ON PIP. 1 OTHER ORGANIZATION+ 1 RADIO 1 SELF SERICE PROGRAM REPRESENATIVE 1 sOMEONE FROM AN ELECTRIC COMPANY 1 WARREN COUNTY 1 WORK
C1. How did you hear about the Weatherization Program? (MULTIPLE RESPONSE)	Base FRIEND / RELATIVE TELEVISION 1ST OTHER(SPECIFY)	3 100% 1 33% 1 33% 1 33%
C1. How did you hear about the Weatherization Program? (MULTIPLE RESPONSE)	Base FRIEND / RELATIVE	1 1 100%
C2. What prompted you to participate in the Weatherization Program? (MULTIPLE RESPONSE)	Base ADVERTISEMENT FOR THE PROGRAM COMFORT ISSUES IN HOME ENVIRONMENTAL / ECOLOGICAL CONCERNS ENERGY EDUCATION TIPS FRIEND, FAMILY MEMBER, COLLEAGUE RECOMMENDATION INVESTMENT / VALUE TO HOME (OLDER HOMES)	76 100% 3 3% 29 30% 1 1% 3 3% 1 4%

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	PAST EXPERIENCE WITH ANOTHER PROGRAM	3 3%
	SAVE MONEY ON MY BILL	19 22%
	SAVE ENERGY	9 12%
	TECHNICAL ASSISTANCE I COULD GET FROM THE CONTRACTOR	1 1%
	THE PROGRAM OFFERINGS	12 7%
	TO LEARN MORE ABOUT MY HOME AND ITS ENERGY USE	2 3%
	1ST OTHER(SPECIFY)	11 14%
	3RD OTHER(SPECIFY)	1 1%
	DON'T KNOW	4

1	DISABILITY
1	FINANCIAL REASONS
1	HOUSE NEED INSULATION
1	I NEED THE SERVICE
1	I NEEDED INSULATION AND ELECTRIC
1	I NEEDED THE WORK DONE AND I DIDNT HAVE THE MONEY
1	I SAW ON TV
1	I WANTED WINDOWNS PUT IN AND A NEW THURMES
1	ITS FREE
1	NEEDED HELP GETTING DONE
1	OUSE WAS DRAFTY AND IM ON A FIXED INCOME
1	TO GET A NEW FURNACE
1	TO HELP ME
1	MY MOTHER
1	I AM IN THERE PROGRAM AND WHEN THE Y WOULD COME OUT AND CHECK MY FURNACE
1	THEY WOULD SPEAK WITH ME.
1	IN M,Y DUKE BILL. FOR WINTERIZATION
1	PUT A HANDICAP RAMP IN.

	1 NEEDED HELP+	
C2. What prompted you to participate in the Weatherization Program? (MULTIPLE RESPONSE)	Base	26
		100%
	COMFORT ISSUES IN HOME	4
		15%
	ENVIRONMENTAL / ECOLOGICAL CONCERNS	1
		4%
	FRIEND, FAMILY MEMBER, COLLEAGUE RECOMMENDATION	1
		4%
	INVESTMENT / VALUE TO HOME (OLDER HOMES)	1
		4%
	SAVE MONEY ON MY BILL	7
		27%
	SAVE ENERGY	5
		19%
	THE PROGRAM OFFERINGS	4
		15%
	TO LEARN MORE ABOUT MY HOME AND ITS ENERGY USE	1
		4%
	1ST OTHER(SPECIFY)	2
		8%
C2. What prompted you to participate in the Weatherization Program? (MULTIPLE RESPONSE)	Base	5
		100%
	COMFORT ISSUES IN HOME	1
		20%
	SAVE MONEY ON MY BILL	1
		20%
	SAVE ENERGY	2
		40%
	THE PROGRAM OFFERINGS	1
		20%
C3. Was there any specific service or piece of equipment offered through the program that initially stood out to you as you were deciding to participate in the program?	Base	79
		100%
	YES	48
		61%
	NO	31
		39%

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DON'T KNOW		1
	1	A HANDICAP RAMP
	1	A NEW FURNACE
	1	A REFRIGERATOR TO SAVE ENERGY.
	1	BETTER INSTILLATION.
	1	CARBON MONOXIDE DETECTOR
	1	EXCEPT FOR THE FREEZER I GOT, NO
	1	FURNACE
	1	FURNACE REPLACEMENT
	1	FURNACE, PLUS THEY WERE VERY NICE AND POLITE. W/E THATS IT
	1	HOT WATER TANK AND A FURNACE
	1	I NEEDED HELP IN ANSWERING QUESTIONS CAUSE WE WERE FIRST TIME HOME BUYERS
	1	I NEEDED MY WASHER AND DRIVER MOVED TO THE FIRST FLOOR,OUT OF THE BASEMENT.W/E I NEEDED MY FURNACE SERVICED,AND I NEEDED ELECTRIC OUTLETS FIXED THROUGHOUT THE HOUSE.W/E THATS IT.
	1	I WANT TO HAVE MY WINDOWS, DOORS, WATER HEATER AND INSULATION. CHECKED OUT FOR THE COLD WEATHER. I NEED A ROOF AND GUTTERS BAD.
	1	I WOULD HAVE TO SAY MY GAS AND ELCTRIC BILL. THE WEATHER STRIPING ACROSS MY DOORS AND THE INSULATIONS OF MY PIPES. W/E INSULATION IN MY ATTIC. W/E THEY BLEW IN SOME EXPANDING FOAM AND LAYED NEW PLASTIC DOWN. W/E THEY CHECKED MY FURNACE.
	1	INSULATION
	1	IT WAS BRAND NEW AND NICE AND PRETTY AND CLEAN. W/E IT WAS THE BRAND NEW REFRIDGERATOR. W/E EVERYONE WAS REAL FRIENDLY AND HELPFUL. W/E THATS IT.
	1	JUST HELPING ME SAVE ON ENERGY AND THINGS LIKE THAT
	1	MY FREEZER
	1	MY FURNACE CLEANED AND UR AIR DUCTS
	1	MY FURNACE.
	1	NO OTHER THAN THE FACT THAT I QUALIFIED FOR THE PROGRAM, AND THEY REPLACED MY FREEZEWR FOR FREE, AND THEY DID FREE INSTALATION IN MY ATTIC

1	NOTHING
1	REFRIDGERATOR
1	REFRIDGERATOR.
1	REFRIGERATOR
1	REPLACING THE HOT WATER HEATER. THE INSULATION UNDER THE TRAILER DUE TO GETTING WET NEEDED TO BE REPLLACED.
1	THE APPLIANCES W/E FURNACE W/E LIGHT BULBS ALL THE ENERGY SAVING PAMPLETS THEY GAVE ME W/E THAT IT
1	THE FERNUS AND THE HOT WATER HEATER.
1	THE FERNUS.
1	THE FURNACE. I DIDNT HAVE ANY HEAT IN THE HOUSE.
1	THE FURNACE. IT WASNT WORKING.
1	THE HELP WITH MY FURNACE AND HOT WATER HEATER.
1	THE INSTALATION OF YOUR HOME AND THE INSTALTION OF MY FURNACE W/E THE AIR DUCTS.W/E THATS IT.
1	THE INSULATION IN THE ATTIC AND BASEMENT THE POSSIBILITY OF A NEW FURNACE. W/E THATS IT
1	THE REFRIGATOR AND MY DEEP FREEZER. ALSO MY HOT WATER HEATER.
1	THE REFRIGERATOR
1	THE REFRIGERATOR
1	THE WEATHERAZATION IN THE ATTIC AND WINDOWS. THE WATER HEATER NEEDED TO BE UPDATED AND REPLACED SHORTLY.
1	THE WEATHERIZATION WINDOWS
1	THE WORK THEY DID WAS THE DRYER TO MAKE THE EXAUST GO OUTSIDE
1	THEY BROUGHT A TRUCK AND BLEW IN STUFF TO HELP CONSERVE ENERGY. THEY ALSO HELPED ME WITH THE WINDOWS AND DOORS
1	THEY DO WONDERFUL WORK ON HOUSES AND SO ON
1	THEY GAVE ME A REFRIDGERATOR AND A FREEZER.
1	THEY WERE GONNA REPLACE MY REFRIGERATOR AND WATER HEATER
1	WATER HEATER STOPPPED WORKING AND THEY OFFERED IT.

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		WATER HEATER. W/E FURNACE. W/E THE THING THAT TELLS THE TEMPERATURE IN YOUR HOUSE AND THE HUMIDITY. W/E THE STUFF THEY USE
		1 TO INSULATE MY ATTIC. W/E THATS IT.
		1 WRAPING OF PIPES
C4. Were these services or installations performed as part of the Weatherization Program visit?	Base	45
		100%
	YES	44
		98%
	NO	1
		2%
	DON'T KNOW	3
C6. If you were interested in receiving additional information that could help you save money on your bill, what is your most preferred method to receive the information?	Base	74
		100%
	COMMUNITY EVENT/FAIR	2
		3%
	DUKE ENERGY NEWSLETTER	4
		5%
	EMAIL	9
		12%
	IN THE MAIL(SPECIFY FORMAT)	41
		55%
	PHONE CALL	18
		24%
	DON'T KNOW	6
		1 A FLYER
		1 A POST CARD OR IN MY MAIL.
		1 BILL NEWSLETTER
		1 BY MAIL
		1 IN A MAILER
		1 IN THE BILL
		1 LETTER ADDRESS TO ME
		1 LETTER ADDRESSED TO ME
		1 LETTER TO ME
		1 MAILED LETTER ADDRESSED TO ME
		1 MAILED LETTER ADRESSED TO ME.
		1 NOTHING SPECIFIC JUST IN THE MAIL
		1 ONE ADRTESSED TO ME
		1 REGUALR MAIL.

		1 REGULAR LETTER 1 REGULAR LETTER ADDRES TO ME 1 REGULAR LETTER ADDRESED TO ME 1 REGULAR LETTER ADDRESSED TO ME 1 REGULAR LETTER ADDRESSED TO ME 1 REGULAR LETTER ADDRESSED TO YOU. 1 REGULAR LETTER MAILED TO ME. 1 REGULAR MAIL 1 REGULAR MAIL 1 REGULAR MAIL 1 REGULAR MAIL 1 REGULAR MAIL 1 REGULAR MAIL 1 REGULAR MAIL 1 REGULAR MAIL ADDRESS TO ME 1 REGULAR MAIL ADDRESSED TO ME 1 REGULAR MAIL ADRESED TO ME 1 REGULAR MAIL ADRESSEED TO ME 1 REGULAR MAIL WITH THE MAILBOX AND STAMP AND A LETTER 1 REGULAR MAIL. 1 REGULAR MAILED LETTER ADDRESS TO ME 1 REGULAR MAILED LETTER. 1 REGULAR MAILED LETTER. 1 REGULAR MAILING 1 THROUGH MY REGULAR MAIL OR BILL 1 THRU A LETTER 1 THRU THE MAILBOX
D1. Just to confirm, the program records indicate that you received the following: (MULTIPLE RESPONSE)	Base	80
		100%
	Air sealing	20
		25%
	CFLs	46
		58%
	Attic/Ceiling Insulation	1
		1%
	Kitchen and Bathroom faucet aerators	2
		2%
	Refrigerator replacement	10
		12%

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	Water heater pipe wrap	1 1%
D1. Just to confirm, the program records indicate that you received the following: (MULTIPLE RESPONSE)	Base	44 100%
	CFLs	8 18%
	Attic/Ceiling Insulation	2 5%
	Kitchen and Bathroom faucet aerators	5 11%
	Low-flow showerhead	2 5%
	Refrigerator replacement	16 36%
	Water heater pipe wrap	2 5%
	Water heater tank insulator	1 2%
	1ST OTHER(SPECIFY)	8 18%
D1. Just to confirm, the program records indicate that you received the following: (MULTIPLE RESPONSE)	Base	19 100%
	Attic/Ceiling Insulation	2 11%
	Low-flow showerhead	3 16%
	Refrigerator replacement	3 16%
	Water heater pipe wrap	2 11%
	1ST OTHER(SPECIFY)	3 16%
	2ND OTHER(SPECIFY)	6 32%
D1. Just to confirm, the program records indicate that you received the following: (MULTIPLE RESPONSE)	Base	4 100%
	Wall Insulation	1 25%
		2

	Refrigerator replacement	50%
	3RD OTHER(SPECIFY)	1
		25%
D1. Just to confirm, the program records indicate that you received the following: (MULTIPLE RESPONSE)	Base	1
		100%
	Refrigerator replacement	1
		100%
	1 CARBON MONOXIDE DETECTOR	
	1 FOAM AROUND PIPES	
	1 FOAM IN BASEMENT	
	Already stated Refridge FREEZER	
	Alrady stated fridge FREEZER	
	1 FURNACE	
	1 FURNACE	
	1 FURNACE	
	1 N/A	
	1 NEW REFRIGERATOR	
	1 WALLS	
	1 SMOKE ALARM	
	1 SEALINGS IN WINDOWS/DOORS	
	1 PIECE ON MY FURNACE	
	1 HOT WATER HEATER	
	1 AIR CONDITIONER	
	1 NEW DOORS	
	1 NEW SHOWER HEAD	
D2. Is all of this equipment still installed?	Base	80
		100%
	YES	80
		100%
	NO	-
		-
	DON'T KNOW	-
		-
	REFUSED	-
		-
D4. Did the Weatherization Program representative leave you	Base	78
		100%
	YES	15

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with any energy-saving items they did not install?	NO	19% 63 81%
D5. What items did the representative leave behind? (MULTIPLE RESPONSE)	Base CFLS 1ST OTHER(SPECIFY)	15 100% 11 73% 4 27%
D5. What items did the representative leave behind? (MULTIPLE RESPONSE)	Base CFLS INSULATION - ATTIC/CEILING 1ST OTHER(SPECIFY)	5 100% 1 20% 1 20% 3 60%
D5. What items did the representative leave behind? (MULTIPLE RESPONSE)	Base 1ST OTHER(SPECIFY)	1 100% 1 100%
	1 A PACK OF FURNACE FILTERS 1 BROCHURES 1 CARBON MONOXIDE DETECTOR 1 CARBON MONOXIDE DETECTOR 1 FILTERS THAT GO INSIDE THE FURNACE 1 FURNACE FILTERS 1 INSULATION AIR DUCTS 1 WEATHERIZATION STRIPS	
D6. Have you installed any of the items that the representative left behind?	Base YES NO	15 100% 13 87% 2 13%
D7. Which of these items were left behind and installed? (MULTIPLE RESPONSE)	Base CFLs	4 100% 4 100%
	Base	3

D7. Which of these items were left behind and installed? (MULTIPLE RESPONSE)	DATAFROM(D1_OTHER1)	100% 3 100%
D8. Since your weatherization improvements were installed, have you noticed any changes in your home's comfort compared to before the weatherization improvements were installed?	Base	76
		100%
	YES	63
		83%
	NO	13
		17%
	DON'T KNOW	4
	REFUSED	-
		-

1	BILL IS CHEAPER
1	CHANGE IN MY ELECTRIC P1 ITS LOWER NOW
1	COOLER TEMPERATURE W/E NO THATS IT COOLER, IT HELPS IN THE SUMMER AND TO SAVE ON THE AIR CONDITIONING. IT HELPS SAVE ON THE HEATING IN THE WINTER. THEY
1	INSULATED MY WALLS AND ATTIC
1	DIFFERENCE IN ELECTRIC BILL, SAVING ENEGY
1	BILL IS LESS
1	DURING THE SUMMER MONTHS I CAN KEEP MY THERMOSTAT AT A HIGHER TEMPERATURE AND STILL KEEP MY HOUSE AND COOL AND THE OPPOSITE FOR THE WINTER TIME. W/E MY BILLS SEEM TO NOT AS HIGH AS I HEAR OTHERS. W/E
1	THATS AIT.
1	EASIER TO KEEP HOUSE COOL IN SUMMER AND WARM IN WINTER. W/E THATS IT
1	HOUSE IS WARMER IN WINTER, AND COOLER IN THE SUMMER, AND IVE NOTICED THAT THE
1	WATER IS NOT AS HARD
1	HOW THE FOOD WAS GETTING TAKEN CARE OF. THE LIGHTBULBS ARE LASTING MUCH LONGER. THE ELECTRIC BILL WAS GREAT. P1 THE
1	ELECTRICITY WENT FARTHER AND COST LESS
1	I DONT GET AS COLD
1	I DONT HAVE TO USE MY AIR CONDITIONING AS MUCH, I DONT HAVE TO USE MY HEATER AS
1	MUCH IN THE WINTER
1	I HAVE A WORKING REFRIGERATOR. W/E AND
1	THE LIGHT BULBS.

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			I HAVE NOTICED EVERY MONTH MY GAS AND ELECTIC BILL ARE A LITTLE LESS THAN BEFORE
		1	W/E THAT IT
			I HAVE NOTICED IT ABOUT FIFTY PERCENT THE ROOMS ARE STILL COOL BUT HAVE NOTICE AN
		1	IMPROVEMENT.
			I NOTICED ITS MORE COLD, JUST IN THE KITCHEN IT FREEZES. FOR SOME REASON THEY COULDNT
		1	GET THE DOOR RIGHT
			IM NOT GETTING AS MUCH AIR THROUGHOUT
		1	THE HOUSE AS BEFORE. W/E THATS IT
			IN THE WINTER ITS WARM AND MY BILL ISNT
		1	THAT HIGH. W/E THATS IT
			IN THE WINTER THERE IS NO DRAFT COMING IN FROM THE DOOR. THEY PUT PLASTIC ON TWO
x		1	WINDOWS.
			IT BASICLY COOLER IN SUMMER AND WARMER
x		1	IN THE WINTER.
			IT NOT UNBARABLE TO WASH MY CLOTHES . W/E ITS COMFORTABLE WITH THE AIR CONDITIONING I THINK THEY DID SOMETHING
x		1	WITH THE THERMOSTAT
x		1	IT STAYS WARMER AND COOLER
x		1	ITS BRIGHTER IN MY HOME.
			ITS NOT DRAFTY. IN THE SUMMER THERE IS NO
x		1	AIR COMING IN FROM THE OUTSIDE.
x		1	ITS WARMER IN MY HOME
x		1	ITS WARMER. W/E THATS IT.
		1	LOWER UTILITY BILLS
			MY ELECTRIC BILL IS BETTER WITH THESE NEW
		1	LIGHT BULBS. W/E THATS IT
		1	MY ELECTRIC BILL IS SMALLERW/E THATS IT.
		1	MY ELECTRIC BILL WENT DOWN
		1	MY FOODS BEEN COLDER.
			MY FURNACE KEEPS ME WARM AND MY
x		1	REFRIGERATOR WORKS WONDERFULLY.
			MY FURNACE WORKS ALOT BETTER AND MY INSULATION IS ALOT BETTER W/E THATS IT P/ THEY GAVE ME A NEW FURNACE.P/2 I DONT FEEL AND AIR COMING IN MY HOUSE WHEN ITS
x		1	COLD OUTSIDE.
			MY GAS AND ELECTRIC BILL HAVE GONE DOWN
		1	W/E THATS IT

			MY GAS AND ELECTRIC BILL ISNT SO HIGH AND MY HOUSE STAYS WARMER THAN IT USED TO.
		1	W/E THATS ABOUT IT.
		1	MY GAS/ELECTRIC BILL IS LOWER, ITS WARMER IN THE WINTER AND COOLER IN THE SUMMER.
x		1	MY HOME IS NOT WINDY BECAUSE OF THE INSTALATION OF THE WINDOWS AND ALSO INSULATED MY ATTIC
x		1	MY HOUSE ISNT HAS COLD AS IT WAS ITS INSULATED NOW W/E THATS IT
		1	MY UNTILITY BILL WENT DOWN ANDY HOUSE IS WELL INSULATED,AND COOLS DOWN AND HEATS UP WHEN IT SHOULD,W/E THATS IT.
		1	SEEMS LIKE THE BILLS A LITTLE BIT LOWER.
		1	THE AIR CONDITIONER RUNS LESS TIME AND MY BILL IS LOWER.
x		1	THE AIR IS BETTER THEY GAVE ME A NEW FURNACE FOR THE AIR
x		1	THE BASEMENT, IT WAS COLD BUT ITS MUCH BETTER NOW. ITS NOT AS COLD.
		1	THE BILL IS A LITTLE BIT CHEAPER
		1	THE BILL IS LOWER AND THE TEMPERATURE STAYS CONSISTENT.
		1	THE COST OF MY FUEL BILL, MY HOUSE IS ALOT OF EASIER TO KEEP COOL AND HEATED W/E THAT IT
x		1	THE DRAFT ON THE FLOOR CAUSE THEY DID SOMETHING DOWNSTAIRS. P1 ITS WARMER AND LESS DRAFTY
		1	THE ELECTRIC MIGHT HAVE BEEN CHEAPER, THE CFLS ARE STILL BURNING AND ITS BEEN A COUPLE. W/E THATS IT
x		1	THE FERNUS IS CERTAINTLY BETTER THAN WHAT HE HAD IT HELPS. THE THINGS THEY DID HELP CUT OUT THE AIR IT HELPED. P1 THE OTHER FERNUS WASNT WORKING SUFFICENTLY IT WORKS BETTER AND STAYS WARMER AND WE HAVE NO HEAT LOSS.
		1	THE FRIDGE WORKS MORE PROPERLY, THE LIGHTS ARE DIMMER BUT WHEN YOU GET USED TO THEM THEY ARE NOT BAD EITHER. W/E I HAVE SEEN A LITTLE BIT OF A DROP ON THE ELECTRIC BILL. W/E THATS IT.
x		1	THE FURNACE WORKS GOOD. ITS COMFORTABLE
x		1	THE FURNACE WORKS.

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x		1	THE HEATING MY HOUSE IS ALOT WARMER IT MUCH EASIER
x		1	THE HOUSE IN WINTER IT HOLD S HEAT AND SUMMER IT COOLER. W/E THAT IT
x		1	THE INSULATION IS AFFECTING MY HOUSE BY KEEPING IT WARMER.
		1	THE LOW COST ELECTRIC BILL AND HEATING BILL W/E THE COMFORT OF IT ALL.
		1	THE NEW REFRIGERATOR IS ALOT BETTER. W/E THE SHOWER HEAD IS BETTER. P/1 MY NEW REFRIGERATOR KEEPS MY FOOD COLD AND IT WAS NOT LEAKING. AND THE ENERGY SAVING LIGHT BULBS HELP.
		1	THE NEW STORM DOOR HELPS, ITS EASIER TO HEAT, AND IT IS CLEANER
		1	THE ONE ROOM THAT HAS A CRWLSPACE AND THEY NEED TO SEND SOMEONE SMALLER TO SEAL THAT WALL
x		1	THE TEMPERATURE IS GOOD
		1	THEY CHECK MY WINDOWS AND DOORS AND SO ON. THAT I COULD SAVE SOME MONEY ON MY BILL
		1	THEY HAVE HELPED MY BILL.
		1	THEY PUT IN AIR VENTS IN THE BASEMENT. AND IT ELIMATES THE MOISTURE. THEY PUT AIR VENTS ALSO IN THE ATTIC.
		1	WE DIDNT NEED TO USE HEAT OR AIR CONDITIONING AS MUCH

D9. On a scale from 1 to 5, with one being significantly easier and 5 being significantly harder, how would you rate the difficulty in maintaining a comfortable temperature in your home since the PWC representative made the improvements?	Base	70
		100%
	SIGNIFICANTLY EASIER	35
		50%
	02	15
		21%
	03	11
		16%
	04	4
		6%
	SIGNIFICANTLY HARDER	5
		7%
	DON'T KNOW	9
	REFUSED	1

D10. Since your weatherization improvements were installed, have you noticed any savings in your electric bill?	Base	74
	YES	100%
	NO	57
	DON'T KNOW	77%
		17
		23%
		6
D10. How much savings have you noticed on your monthly bill - in dollars? (RECORD IN WHOLE DOLLARS.)	Base	47
	DON'T KNOW/REFUSED	100%
		10
	5	3
		6%
	10	8
		17%
	12	1
		2%
	15	2
		4%
	20	4
		9%
	25	1
		2%
	30	3
		6%
	40	3
		6%
	45	2
		4%
	50	7
		15%
	60	1
		2%
	75	2
		4%
	80	1
		2%
	100	6
		13%

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	120	1 2%
	200	2 4%
D11. How satisfied are you with any savings you noticed on your electric bill since the weatherization improvements were installed? (READ LIST ONLY IF NECESSARY)	Base	57 100%
	VERY SATISFIED	44 77%
	SOMEWHAT SATISFIED	10 18%
	NEITHER SATISFIED NOR DISSATISFIED	1 2%
	SOMEWHAT DISSATISFIED	1 2%
	VERY DISSATISFIED	1 2%
E1. What is your overall satisfaction with all of the items installed by the Weatherization Program representative? (READ LIST ONLY IF NECESSARY)	Base	80 100%
	VERY SATISFIED	59 74%
	SOMEWHAT SATISFIED	12 15%
	NEITHER SATISFIED NOR DISSATISFIED	2 2%
	SOMEWHAT DISSATISFIED	2 2%
	VERY DISSATISFIED	5 6%
E2. And what is the reason for your rating? (RECORD VERBATIM RESPONSE.)	Base	7 100%
	I DEFINATELY NEEDED THE REFRIGERATOR	1 14%
	IT CUT MY BILL DOWN, AND I STILL GET LIGHT THATS BETTER, AND LASTS LONGER	1 14%
	NO REASON	1 14%

	THE WERE SUPPOSE TO HAVE A PLUMBER COME OUT AND HE NEVER CALLED. I WENT BY THERE THEY SAID IT WAS NEVER APPROVED BY THE PROGRAM.	14%
	THEY DIDNT DO ANYTHING. IM STILL GETTING COLD DRAFTS AND MY ENERGY BILL IS STILL HIGH	1 14%
	THEY DIDNT DO WHAT THEY SAID WERE GOING OT DO AND DISCONNECTED THE HEAT TO ONE ROOM ENTIRELY AND ITS CONSTANTLY FREEZING. W/E THATS IT.	1 14%
	THEY DIDNT FINISH MY WORK . THEY MORE OR LESS LIED TO US. P1 THEY DIDNT PUT IN THE WATER REVATION THEY TOLD ME I COULD GET NEW DOORS ANDS WINDOWS AND I DIDNT GET THEM.	1 14%
E3. On the same scale, how satisfied are you with the visit you received from the Weatherization Program representative who came to your home and installed the energy efficiency program upgrades?	Base	79 100%
	VERY SATISFIED	66 84%
	SOMEWHAT SATISFIED	8 10%
	NEITHER SATISFIED NOR DISSATISFIED	3 4%
	VERY DISSATISFIED	2 3%

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	DON'T KNOW	1
E4. Can you share with me why you gave this rating? (MULTIPLE RESPONSE)	Base	2
		100%
	BAD CUSTOMER SERVICE	1
		50%
	1ST OTHER(SPECIFY)	1
		50%
E4. Can you share with me why you gave this rating? (MULTIPLE RESPONSE)	Base	1
		100%
	1ST OTHER(SPECIFY)	1
		100%
	1 HE WAS ON HIS PHONE	
	1 THE REP WAS VERY UNPROFESSIONAL	
E5. RANDOMLY SELECTED VERIFIED MEASURE FOR E5	Base	80
		100%
	Air sealing	16
		20%
	CFLs	35
		44%
	Attic/Ceiling Insulation	1
		1%
	Kitchen and Bathroom faucet aerators	3
		4%
	Low-flow showerhead	1
		1%
	Refrigerator replacement	21
		26%
	Water heater pipe wrap	2
		2%
	Water heater tank insulator	1
		1%
E6. RANDOMLY SELECTED VERIFIED MEASURE FOR E6	Base	44
		100%
	Air sealing	3
		7%
	CFLs	15
		34%
		2

	Attic/Ceiling Insulation	5%
	Kitchen and Bathroom faucet aerators	4 9%
	Low-flow showerhead	2 5%
	Refrigerator replacement	8 18%
	Water heater pipe wrap	2 5%
	DATAFROM(D1_OTHER1)	6 14%
	DATAFROM(D1_OTHER2)	2 5%
E7. RANDOMLY SELECTED VERIFIED MEASURE FOR E7	Base	19 100%
	Air sealing	1 5%
	CFLs	3 16%
	Attic/Ceiling Insulation	1 5%
	Low-flow showerhead	2 11%
	Refrigerator replacement	2 11%
	Water heater pipe wrap	1 5%
	DATAFROM(D1_OTHER1)	5 26%
	DATAFROM(D1_OTHER2)	3 16%
	DATAFROM(D1_OTHER3)	1 5%
E5. How satisfied are you with ANSWERFROM(E5_MEASURE)?	Base	79 100%
	VERY SATISFIED	56 71%
	SOMEWHAT SATISFIED	12 15%

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	NEITHER SATISFIED NOR DISSATISFIED	7 9%
	SOMEWHAT DISSATISFIED	1 1%
	VERY DISSATISFIED	3 4%
	DON'T KNOW	1
	REFUSED	- -
E6. On the same scale, how satisfied are you with ANSWERFROM(E6_MEASURE)?	Base	42 100%
	VERY SATISFIED	34 81%
	SOMEWHAT SATISFIED	4 10%
	NEITHER SATISFIED NOR DISSATISFIED	1 2%
	VERY DISSATISFIED	3 7%
	DON'T KNOW	2
E7. Using the same scale, how satisfied are you with ANSWERFROM(E7_MEASURE)?	Base	19 100%
	VERY SATISFIED	15 79%
	SOMEWHAT SATISFIED	2 11%
	NEITHER SATISFIED NOR DISSATISFIED	1 5%
	VERY DISSATISFIED	1 5%
E8. On the same scale, how would you rate your overall satisfaction with the Weatherization Program?	Base	80 100%
	VERY SATISFIED	55 69%
	SOMEWHAT SATISFIED	14 18%
	NEITHER SATISFIED NOR DISSATISFIED	6 8%

	SOMEWHAT DISSATISFIED	2
		2%
	VERY DISSATISFIED	3
		4%
		1 NO REASON
		1 THEY DIDNT COMPLETE THE PROGRAM.
		1 THEY WERE UNPROFESSIONAL BY YELLING LOUD. THEY DISTURBED MY WIFE WHO WAS SICK W/E ALSO HAD TO HAVE CARPETS CLEAN WERE PRETTY UPSET ABOUT THE WHOLE INCIDENT AND WISH WE HAVENMT DONE IT. WE HAD TO HAVE A FRIEND COME FIX THINGS FOR US. P1 THEIR ATTITUDES THE MESSED UP THE
		1 FERNUS OR THE LEAKING DOOR.
E10. Finally, using the same scale, how would you rate your overall satisfaction with Duke Energy as your energy provider?	Base	78
		100%
	VERY SATISFIED	43
		55%
	SOMEWHAT SATISFIED	21
		27%
	NEITHER SATISFIED NOR DISSATISFIED	7
		9%
	SOMEWHAT DISSATISFIED	4
		5%
	VERY DISSATISFIED	3
		4%
	DON'T KNOW	2
		I JUST THINK THEY GO UP TO MUCH P1 THEY
		1 ARE MORE EXPENSIVE
		I PAY SO MUCH A MONTH CAUSE I WAS ON A PAYMENT PLAN. THEY WERE VERY NICE TO DO
		1 THAT. THE PIP PROGRAM
		1 NO REASON
		1 THE RATES ARE VERY EXPENSIVE W/E THATS IT
		THE RESPENTATIVES ARE RUDE AND THEY
		1 ATTITUDE PROBLEM
		THEY DONT SEEM TO BE VERY HELPFUL WHEN YOU DO HAVE A HIGH BILL AND TRYING TO PAY FOR IT. THEY SEEM TO CUT YOU OFF JUST LIKE THAT AND THEY DONT WORK WITH PEOPLE.
		W/E NOT WILLING TO REALLY WORK WITH YOU
		1 WHEN PAYING YOU BIL, THEY WANT TO CHARGE

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			YOU IF THEY COME OUT THAT DAY TO TURN THE SERVICE BACK ON. ITS 5O DOLLARS. W/E THATS IT. THEY USED TO COME INTO THE CENTER AND READ. NO ONE KNOW THATS THE PROBLEM. WE GETY THE BILL AND CANT UNDERSTAND. THAT IS
		1	THE POSITION
F1. Do you have any recommendations on how to improve the Weatherization Program that have not already been expressed?	Base		80
			100%
	YES		22
			28%
	NO		58
			72%
More measures		1	BETTER STRIPPING. P1 IT JUST KEPT PEELING OFF AND WOULDNT STAY ON
More measures		1	FOR THEM TO DO WINDOWS AND HANDICAP STEPS/RAMPS.
Better customer service		1	GET PEOPLE THAT DONT LIE TO YOU AND THAT WILL COMPLETE THEIR JOB.
Check up		1	I STILL NEED HELP IS ALL
Better customer service		1	I THINK THEY NEED TO COMMUNICATE MORE. COMMUNICATION IS VERY IMPORTANT. TOOK TWO SETS OF GUYS GO GET JOB DONE
Better customer service		1	I THINK THEY NEED TO TAKE EMERGENCY AND ELDER PEOPLE FIRST PRIORITY IF IT RAINING ON YOU INSIDE YOUR HOUSE THAT ITS AN EMEGERENCY. THEY SHOULD DELIVER THE SERVICES THE PROMISE YOU.
More measures		1	I WISH THE COULD FIX STORM DOORS.
Check up		1	IF I HAVE A PROBLEM THEY WILL COME AND TAKE A LOOK. THEY HAVE THE EXPERIENCE I DONT HAVE
Check up		1	INSTALATION IN THE FAMILY ROOM W/E CHECK TO SEE WHAT INSTALATION NEEDS CHECK. DOWNSAIRS IS JUST COLD. UPSTAIRS IS HOT
Better customer service		1	IT WOULD BE NICE IF THE SERVICEMEN DIDN'T LEAVE A MESS. P/1 THE FOAM WENT ON THE WALLS. ON THE FLOOR AND IN MY CHRISTMAS BOXES. THERE WERE TWO PEOPLE AND THE ONE WAS JUST STANDING THERE WHEN THE ONE COULD HAVE BEEN CLEANING. AND THEY LEFT THE BOTTLES THERE.
Better customer service		1	MAKE IT A LITTLE FASTER PROCESS, IM STILL WAITING FOR THEM TO COME BACK AND WEATHERIZE THE HOUSE. ITS BEEN ABPOUT 6

		OR 8 MONTHS SINCE THEY INSTALLED IN THE FRIDGE. W/E THATS IT.
Better customer service	1	MORE PROFESSIONALISM
Check up	1	STICK TO WHAT THEY SAID THEY WOULD DO AND DO A FOLLOW UP CALL
Better customer service	1	TAKING MORE TIME, NOT BEING IN A RUSH TO DO THINGS- BEING MORE PROFESSIONAL. A RUSHED JOB CAN MAKE IT LOOK SLOPPY
More measures	1	THE SHOULD DO STORM WINDOWS
Better customer service	1	THE SHOULD NT HAVE A WAITING LIST / POOL THE SHOULD CHANGED THAT.
Better customer service	1	THE WORD NEEDS TO BE OUT THERE BETTER TO LET PEOPLE KNOW WHAT KIND OF JOBS THEY DO.
More measures	1	THEY CAN GIVE INFORMATION TO DO THE CAULKING. P/1 MORE HANDS ON ASSISTANCE. TO DO THE CAULKING.
More measures	1	THEY CAN HELP MY SEAL MY WINDOWS,BE ABLE TO FINISH AND SERVICE MY BACK DOOR,THATS IT.
Check up	1	THEY COULD COME BACK AND CHECK THIER WORK W/E NOPE THATS IT
Check up	1	THEY NEED TO DO A BETTER FOLLOW UP AFTER INSTALLING THINGS
More measures	1	WINDOW WEATHER TREATMENT

G1. In what type of building do you live? (READ LIST IF NECESSARY. SINGLE RESPONSE.)	Base	76
		100%
	Single-family home, detached construction	56
		74%
	Single family, mobile home	10
		13%
	Row House	2
		3%
	Two or Three family attached residence-traditional structure	1
		1%
	Apartment (4 + families)---traditional structure	3
		4%
	OTHER(SPECIFY)	4
		5%
	DON'T KNOW	3

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	REFUSED		1
		1	BRICK HOUSE
		1	BRICK HOUSE
		1	ONE STORY SINGLE FAMILY HOME.
		1	RANCH STYLE HOUSE
G2. What year was your residence built? (DO NOT READ LIST. SINGLE RESPONSE.)	Base		64
			100%
	1959 AND BEFORE		33
			52%
	1960-1979		16
			25%
	1980-1989		7
			11%
	1990-1997		4
			6%
	1998-2000		1
			2%
	2001-2007		2
			3%
	2008-PRESENT		1
			2%
	DON'T KNOW		15
	REFUSED		1
G3. How long have you lived in your current home? (DO NOT READ LIST. SINGLE RESPONSE.)		1	1
		1	2
		1	2
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		1	2
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		1 62
		1 88
G4. Do you own or rent your residence? (DO NOT READ LIST. SINGLE RESPONSE.)	Base	77
		100%
	OWN	61
		79%
	RENT	16
		21%
	DON'T KNOW	2
	REFUSED	1
G5. Does your home have a heated or unheated basement? (DO NOT READ LIST. SINGLE RESPONSE.)	Base	79
		100%
	HEATED	41
		52%
	UNHEATED	13
		16%
	NO BASEMENT	25

	REFUSED	32% 1
G6. Which of the following groups include your age?	Base	78 100%
	18-34	7 9%
	35-49	14 18%
	50-59	19 24%
	60-64	13 17%
	65-74	10 13%
	Over 74	15 19%
	REFUSED	2

CADMUS

Appendix E: Attachment A – Impact Assumptions for PWC Pilot

The following list contains the deemed energy savings values from Attachment A in PWC's Statement of Work. The impact values includes line losses of 6.84%, i.e., are the expected savings at the plant.

Impact Assumptions for PWC Pilot			
Measure	Measure Net Savings Per Unit	Measure Life IN USE	Measure Unit
Electrically Heated Homes			
Refrigerator Replacement	1263.00	8	Per Refrigerator
CFL	38.90	5	Per CFL
Faucet Aerator (1.5 GPM assumed)	18.70	5	Per Aerator
Energy Efficient Shower Head (1.625 GPM Avg Assumed)	157.68	5	Per Showerhead
Water Heater Tank Wrap	59.30	5	Per Water Heater
Water Heater Pipe Insulation	99.80	10	Per Water Heater
Water Heater Replacement (Electric)	117.21	13	Per Water Heater
Water Heater Replacement (Gas)	0.00	13	Per Water Heater
Attic/Ceiling/Roof Insulation (Space Heating Only)	2.14	25	Per Installed Square Foot
Attic/Ceiling/Roof Insulation (Space Cooling Only)	0.03	25	Per Installed Square Foot
Wall Insulation (Space Heating Only)	4.36	25	Per Installed Square Foot
Wall Insulation (Space Cooling Only)	0.07	25	Per Installed Square Foot
Floor Insulation (Space Heating Only)	0.70	25	Per Installed Square Foot
Floor Insulation (Space Cooling Only)	0.00	25	Per Installed Square Foot
Foundation Insulation (Space Heating Only)	0.90	25	Per Installed Square Foot
Air Sealing (Space Heating Only)	1.10	15	Per CFM Reduction
Air Sealing (Space Cooling Only)	0.02	15	Per CFM Reduction
Non-Electrically Heated Homes			
Refrigerator Replacement	1263.00	8	Per Refrigerator
CFL	38.90	5	Per CFL
Faucet Aerator (1.5 GPM assumed)	18.70	5	Per Aerator
Energy Efficient Shower Head (1.625 GPM Avg Assumed)	157.68	5	Per Showerhead
Water Heater Tank Wrap	59.30	5	Per Water Heater
Water Heater Pipe Insulation	99.80	10	Per Water Heater
Water Heater Replacement (Electric)	117.21	13	Per Water Heater
Water Heater Replacement (Gas)	0.00	13	Per Water Heater
Attic/Ceiling/Roof Insulation (Space Heating Only)	0.00	25	Per Installed Square Foot
Attic/Ceiling/Roof Insulation (Space Cooling Only)	0.03	25	Per Installed Square Foot
Wall Insulation (Space Heating Only)	0.00	25	Per Installed Square Foot
Wall Insulation (Space Cooling Only)	0.07	25	Per Installed Square Foot
Floor Insulation (Space Heating Only)	0.00	25	Per Installed Square Foot
Floor Insulation (Space Cooling Only)	0.00	25	Per Installed Square Foot
Foundation Insulation (Space Heating Only)	0.00	25	Per Installed Square Foot
Air Sealing (Space Heating Only)	0.00	15	Per CFM Reduction
Air Sealing (Space Cooling Only)	0.02	15	Per CFM Reduction

In December 2014, TecMarket Works completed the attached desk review memo with recommended updates to deemed per-unit savings.

Combining the desk review memo results with the verification rates by measure from Table 13 and Table 14, results in the recommended revised deemed savings values to be used going forward (under the columns Evaluated per-unit Gross Impacts w/o line losses), found in the charts on the following two pages.

Electrically Heated Homes

Measure Name	Impact Assumptions for PWC Pilot, includes line losses	Measure Life	Measure Unit	Desk Review Savings per Unit, includes line losses	Verification Realization Rate	Evaluated per-unit Gross Impacts, includes line losses	Gross Realization Rate	Claimed per-unit Gross Impacts, w/o line losses	Evaluated per-unit Gross Impacts, w/o line losses	Quantity Reported	Total Claimed Gross Impacts	Total Evaluated Gross impacts w/o losses
Refrigerator Replacement	1,263	8	Per Refrigerator	896	100%	896	71%	1182.12	838.62	169	199,778	141,727
CFL	38.9	5	Per CFL	40.5	93%	37.7	97%	36.41	35.25	4,158	151,388	146,582
Faucet Aerator (1.5 GPM assumed)	18.7	5	Per Aerator	26.7	75%	20.0	107%	17.50	18.74	272	4,761	5,098
Energy Efficient Shower Head (1.625 GPM Assumed)	157.68	5	Per Showerhead	288	60%	173	110%	147.58	161.73	87	12,840	14,071
Water Heater Tank Wrap	59.3	5	Per Water Heater	138	150%	207	349%	55.50	193.74	23	1,277	4,456
Water Heater Pipe Insulation	99.8	10	Per Water Heater	327	77%	252	252%	93.41	235.67	86	8,033	20,267
Water Heater Replacement (Electric)	117.21	13	Per Water Heater	133	100%	133	113%	109.70	124.48	35	3,840	4,357
Water Heater Replacement (Gas)	-	13	Per Water Heater	-	n/a	-		0.00	0.00		-	-
Attic/Ceiling/Roof Insulation (Space Heating Only)	2.14	25	Per Installed Square Foot	1.36	94%	1.28	60%	2.00	1.20	17,269	34,589	20,663
Attic/Ceiling/Roof Insulation (Space Cooling Only)	0.03	25	Per Installed Square Foot	0.27	94%	0.25	846%	0.03	0.24	10,656	299	2,531
Wall Insulation (Space Heating Only)	4.36	25	Per Installed Square Foot	2.22	85%	1.89	43%	4.08	1.77	1,578	6,439	2,787
Wall Insulation (Space Cooling Only)	0.07	25	Per Installed Square Foot	0.42	85%	0.36	510%	0.07	0.33	896	59	299
Floor Insulation (Space Heating Only)	0.70	25	Per Installed Square Foot	0.80	100%	0.80	114%	0.66	0.75	6,376	4,177	4,774
Floor Insulation (Space Cooling Only)	-	25	Per Installed Square Foot	-	100%	-		0.00	0.00	6,376	-	-
Foundation Insulation (Space Heating Only)	0.9	25	Per Installed Square Foot	2.84	n/a	2.84	316%	0.84	2.66		-	-
Air Sealing (Space Heating Only)	1.1	15	Per CFM Reduction	1.75	100%	1.75	159%	1.03	1.64	18,980	19,541	31,088
Air Sealing (Space Cooling Only)	0.02	15	Per CFM Reduction	0.13	100%	0.13	650%	0.02	0.12	10,159	190	1,236
										Total	***447,211***	***399,937***
										Electric Home GRR		***89.4%***

Non-Electrically Heated Homes

Measure Name	Impact Assumptions for PWC Pilot, includes line losses	Measure Life	Measure Unit	Desk Review Savings per Unit, includes line losses	Verification Realization Rate	Evaluated per-unit Gross Impacts, includes line losses	Gross Realization Rate	Claimed per-unit Gross Impacts, w/o line losses	Evaluated per-unit Gross Impacts, w/o line losses	Quantity Reported	Total Claimed Gross Impacts	Total Evaluated Gross impacts w/o losses
Refrigerator Replacement	1,263	8	Per Refrigerator	1,364	100%	1,364	108%	1182.12	1276.65	397	469,301	506,831
CFL	38.9	5	Per CFL	59.0	93%	54.9	141%	36.41	51.36	9,717	353,785	499,028
Faucet Aerator (1.5 GPM assumed)	18.7	5	Per Aerator	26.7	75%	20.025	107%	17.50	18.74		-	-
Energy Efficient Shower Head (1.625 GPM Assumed)	157.68	5	Per Showerhead	288	60%	172.8	110%	147.58	161.73		-	-
Water Heater Tank Wrap	59.3	5	Per Water Heater	138	150%	207	349%	55.50	193.74		-	-
Water Heater Pipe Insulation	99.8	10	Per Water Heater	327	77%	251.79	252%	93.41	235.67		-	-
Water Heater Replacement (Electric)	117.21	13	Per Water Heater	133	100%	133	113%	109.70	124.48		-	-
Water Heater Replacement (Gas)	0	13	Per Water Heater	0	n/a	0		0.00	0.00	2	-	-
Attic/Ceiling/Roof Insulation (Space Heating Only)	0	25	Per Installed Square Foot	0	94%	0		0.00	0.00	90,218	-	-
Attic/Ceiling/Roof Insulation (Space Cooling Only)	0.03	25	Per Installed Square Foot	0.27	94%	0.2538	846%	0.03	0.24	65,393	1,836	15,534
Wall Insulation (Space Heating Only)	0	25	Per Installed Square Foot	0	85%	0		0.00	0.00	35,116	-	-
Wall Insulation (Space Cooling Only)	0.07	25	Per Installed Square Foot	0.42	85%	0.357	510%	0.07	0.33	24,273	1,590	8,111
Floor Insulation (Space Heating Only)	0	25	Per Installed Square Foot	0	100%	0		0.00	0.00	8,392	-	-
Floor Insulation (Space Cooling Only)	0	25	Per Installed Square Foot	0	100%	0		0.00	0.00	5,746	-	-
Foundation Insulation (Space Heating Only)	0	25	Per Installed Square Foot	0	n/a	0		0.00	0.00		-	-
Air Sealing (Space Heating Only)	0	15	Per CFM Reduction	0	100%	0		0.00	0.00	119,648	-	-
Air Sealing (Space Cooling Only)	0.02	15	Per CFM Reduction	0.13	100%	0.13	650%	0.02	0.12	114,630	2,146	13,948
										Total	***828,659***	***1,043,451***
										Gas Home GRR		***125.9%***
										Program Total	***1,275,870***	***1,443,388***
										Program Total GRR		***113.1%***

Appendix F: Desk Review of the PWC Low Income Pilot Program

TecMarket Business Center
165 Netherwood Road
2nd Floor, Suite A
Oregon, WI 53575

Memorandum

To: Roshena Ham, Duke Energy
From: TecMarket Works and BuildingMetrics, Inc.
Date: December 31, 2014
Subject: Draft Desk Review of the PWC Low Income Pilot Program

Introduction

TecMarket Works has completed a desk review for Duke Energy's pilot study of the People Working Cooperatively (PWC) Low Income (LI) Pilot Program. The purpose of this memo is to review engineering estimates of energy impacts associated with the measures implemented through this pilot study, and make suggested changes to the deemed per unit savings estimates.

Energy Savings Calculations

A series of energy savings calculations were conducted during program design. These estimates formed the basis of the deemed measure net savings per unit values embedded in the PWC contract. A copy of the deemed savings table is shown in Table 1 and Table 2. Note, different savings values were used for some measures, depending on the heating fuel. Net savings in this context generally refers to savings after freeridership and line losses[1].

[1] Line losses refer to energy losses due to the resistance in the transmission and distribution system between the power plant and the end-use customer.

Table 1. Deemed Savings Values for Electrically Heated Homes

Measure Number	Measure Name	Measure Net Savings per Unit	Measure Life (IN USE)	Measure Unit
1	Refrigerator Replacement	1263.00	8	Per Refrigerator
2	CFL	38.90	5	Per CFL
3	Faucet Aerator (1.5 GPM assumed)	18.70	5	Per Aerator
4	Energy Efficient Shower Head (1.625 GPM Assumed)	157.68	5	Per Showerhead
5	Water Heater Tank Wrap	59.30	5	Per Water Heater
6	Water Heater Pipe Insulation	99.80	10	Per Water Heater
7	Water Heater Replacement (Electric)	117.21	13	Per Water Heater
8	Water Heater Replacement (Gas)	0.00	13	Per Water Heater
9	Attic/Ceiling/Roof Insulation (Space Heating Only)	2.14	25	Per Installed Square Foot
10	Attic/Ceiling/Roof Insulation (Space Cooling Only)	0.03	25	Per Installed Square Foot
11	Wall Insulation (Space Heating Only)	4.36	25	Per Installed Square Foot
12	Wall Insulation (Space Cooling Only)	0.07	25	Per Installed Square Foot
13	Floor Insulation (Space Heating Only)	0.70	25	Per Installed Square Foot
14	Floor Insulation (Space Cooling Only)	0.00	25	Per Installed Square Foot
15	Foundation Insulation (Space Heating Only)	0.90	25	Per Installed Square Foot
16	Air Sealing (Space Heating Only)	1.10	15	Per CFM Reduction
17	Air Sealing (Space Cooling Only)	0.02	15	Per CFM Reduction

Table 2. Deemed Savings Values for Non-Electrically Heated Homes

Measure Number	Measure Name	Measure Net Savings per Unit	Measure Life (IN USE)	Measure Unit
1	Refrigerator Replacement	1263.00	8	Per Refrigerator
2	CFL	38.90	5	Per CFL
3	Faucet Aerator (1.5 GPM assumed)	18.70	5	Per Aerator
4	Energy Efficient Shower Head (1.625 GPM Assumed)	157.68	5	Per Showerhead
5	Water Heater Tank Wrap	59.30	5	Per Water Heater
6	Water Heater Pipe Insulation	99.80	10	Per Water Heater
7	Water Heater Replacement (Electric)	117.21	13	Per Water Heater
8	Water Heater Replacement (Gas)	0.00	13	Per Water Heater
9	Attic/Ceiling/Roof Insulation (Space Heating Only)	0.00	25	Per Installed Square Foot
10	Attic/Ceiling/Roof Insulation (Space Cooling Only)	0.03	25	Per Installed Square Foot
11	Wall Insulation (Space Heating Only)	0.00	25	Per Installed Square Foot
12	Wall Insulation (Space Cooling Only)	0.07	25	Per Installed Square Foot
13	Floor Insulation (Space Heating Only)	0.00	25	Per Installed Square Foot
14	Floor Insulation (Space Cooling Only)	0.00	25	Per Installed Square Foot
15	Foundation Insulation (Space Heating Only)	0.00	25	Per Installed Square Foot
16	Air Sealing (Space Heating Only)	0.00	15	Per CFM Reduction
17	Air Sealing (Space Cooling Only)	0.02	15	Per CFM Reduction

To conduct the desk review, the following steps were followed:

1. The sources of the original savings estimates were investigated, including the engineering methods used and the parameter values driving the equations.
2. The engineering methods were examined for relevance to the program, and were revised as necessary. Parameters associated with the program participation were also revised.

A Net-to-Gross Ratio (NTGR) was applied by Duke Energy to most, but not all measures. A value of 0.75 was used most commonly, but some measures used an NTGR of 0.85. The reason for the varying NTGRs was not apparent in the documentation. A line loss factor of 1.064 was also applied to a few measures. Ex-post evaluations of low income programs in Ohio (and elsewhere in the Duke Energy system) have used a NTGR of 1.0, and have not included line losses. This desk review uses the same net-to-gross assumptions as other low-income program

evaluations, namely the NTGR is deemed at 1.0. Line losses are included in all calculations, using a revised line loss factor of 1.06842.

These steps, as implemented for each of the measures, are described in the following sections.

Measure 1: Refrigerator Replacement

The original source of the savings estimate for refrigerator replacements was the evaluation of the low income refrigerator replacement program[2]. This program was implemented by PWC, and involved measurement of the energy consumption of the existing refrigerator, and replacement of the refrigerator with a new unit if the measured energy consumption of the existing unit exceeded a pre-set threshold. The results of the study are summarized in Table 3 below.

Table 3. Low Income Refrigerator Program Evaluation Results

Measure	Participation Count	Verified per unit impacts	Gross Verified kWh Impacts	Gross Verified kW Impacts	Verified per unit kW Impacts
Frigidaire: 15 cubic feet	29	1,132	32,836	5.1	0.175
Frigidaire: 18 cubic feet	230	1,211	278,482	43	0.187
Frigidaire: 21 cubic feet	253	1,164	294,481	45.3	0.179
Whirlpool: 15 cubic feet	5	1,093	5,465	0.8	0.169
Whirlpool: 18 cubic feet	24	1,180	28,329	4.4	0.182
Whirlpool: 21 cubic feet	28	1,181	33,078	5.1	0.182
TOTAL	**569**	**1,182**	**672,671**	**104**	**0.182**

The average gross savings from the study is 1,182 kWh per refrigerator. The original deemed savings value was 1,263 kWh. The differences between the gross kWh estimates from the evaluation report and the deemed savings value used by the program are attributed to line losses. According to Duke Energy, an additional line loss factor was added to the savings estimate. Based in the difference in the savings per unit, the line loss factor used is 1.064. The net-to-gross ratio was set to 1.0. Note, the savings shown in the evaluation report and the deemed savings values are for the refrigerator only. HVAC interactive effects were not included. Net savings including interactive effects are calculated from:

$$\Delta kWh = UES \times (1 + WHF_c) \times NTGR \times LLF$$
$$\Delta kW = UDS \times (1 + WHFd) \times NTGR \times LLF$$

Where:

UES = unit energy savings (kWh per refrigerator)
UDS = unit demand savings (kW per refrigerator)
WHF_c = waste heat factor applied to energy consumption
WHF_d = waste heat factor applied to peak demand
NTGR = net-to-gross ratio
LLF = line loss factor

[2] Evaluation of Duke Energy's Low Income Refrigerator Replacement Program in Ohio. December 20, 2011.

A multiplier accounting for HVAC interactions with annual energy savings is called the "waste heat factor" (WHFc). Interior lighting and appliances release heat into the conditioned space during normal operation. This heat contributes to meeting the heating load of the building during the heating season, and must be removed by the air conditioner during the cooling season. Energy efficient lighting and appliances use less energy, and therefore release less heat into the conditioned space. The waste heat factor accounts for the net change in space heating and cooling energy due to the installation of energy efficient lighting and appliances. The WHFc depends on the heating fuel, and whether the refrigerator is located in an air conditioned space. A similar factor (WHFd) is applied to demand savings calculations.

Heating System Type	Cooling System Type	WHF_c	WHF_d
Non-electric	Any	0.08	0.21
Electric	Any	-0.29	0.21

The revised net energy savings calculations are shown below:

ΔkWh (electric heat) = UES x $(1 + WHF_c)$ x 1.0 x 1.06842
= 1182 x (1 – 0.29) x 1.0 x 1.06842
= 896 kWh

ΔkWh (non-electric heat) = UES x $(1 + WHF_c)$ x 1.0 x 1.06842
= 1182 x (1 + 0.08) x 1.0 x 1.06842
= 1364 kWh

ΔkW = UDS x $(1 + WHF_d)$ x 1.0 x 1.06842
= 0.182 x (1 + 0.21) x 1.0 x 1.06842
= 0.235

A comparison to the original savings value is shown in Table 4.

Table 4. Refrigerator Savings Estimate Comparison

Measure	Heating Fuel Type	Original Estimate	Recommended Revised Estimate	Comments
Refrigerator Replacement	Electric	1,263	896	HVAC interactions and line losses included
Refrigerator Replacement	Non-electric	1,263	1364	HVAC interactions and line losses included

Measure 2: CFLs

The deemed savings value used by the program came from the 2010 Ohio Residential Smart $aver CFL Program evaluation, adjusted for EISA effects on baseline lamp watts over the 5 year CFL lifetime.[3] The Residential CFL program promoted both 13W and 20W CFLs. According to information on the LI Pilot program design calculations obtained from Duke Energy, the deemed savings values included line losses.

[3] EISA is an acronym for the Energy Independence and Security Act of 2007. EISA places phased input watt restrictions on incandescent lamps that affects the baseline lamp watts over the lifetime of a CFL

The savings for CFLs for the LI Pilot program were calculated using a consistent methodology based on the quantities and types of CFLs promoted under the program. Savings per lamp were calculated from the following engineering equations:

$\Delta kWh = (W_{base} - W_{ee}) /1000 * ISR * HOURS * (1+WHF_e) * NTGR * LLF$
$\Delta kW = (W_{base} - W_{ee} /1000 * ISR * (1+WHF_d) * CF * NTGR * LLF$

Where:

Wbase = Baseline lamp watts
Wee = Efficient lamp watts
ISR = In Service Rate or percentage of units tracked that are installed.
= 1.0 for direct install programs
HOURS = Average hours of use per year
= 1040 (2.85 hrs per day)
WHF_e = Waste Heat Factor for Energy to account for HVAC interactions with efficient lighting
= -0.29 (electric heat)
= 0.08 (non-electric heat)
WHF_d = Waste Heat Factor for demand to account for HVAC interactions with efficient lighting.
= 0.21
CF = Summer Peak Coincidence Factor for measure
= 0.11 (indoor lamps)
= 0.0 (outdoor lamps)
NTGR = net-to-gross ratio
LLF = line loss factor

A list of the types and quantities of lamps provided by PWC in the LI Pilot program is shown below. The assumed lamp baseline watts in 2013, along with EISA adjustments for each lamp through 2017, are also shown in Table 5 below.

Table 5. EISA Adjustments to CFL Baseline

Description	Total	W_{ee}	W_{base} with EISA adjustments				
			2013	2014	2015	2016	2017
14w CFL Full Spiral	156	14	60	60	50.65	49.8	48.1
150w Spiral Bulb	5	40	150	150	150	150	150
23w CFL (100)	157	23	84.6	83.2	80.4	77.6	74.8
40w Globe	46	18	40	40	33.4	31.2	29
60w Dimmable Bulb	27	14	60	60	50.65	49.8	48.1
75w Outdoor	52	18	75	61.8	57.4	53	53
Torchiere Floor Lamp	5	55	150	150	150	150	150

The difference between the program and baseline lamp watts across the 2013-2017 period is shown below in Table 6.

Table 6. Lamp Watt Savings by Year

Description	Total	Baseline – Program Lamp Watts					
		2013	2014	2015	2016	2017	Average
14w CFL Full Spiral	156	46.0	46.0	36.7	35.8	34.1	39.7
150w Spiral Bulb	5	110.0	110.0	110.0	110.0	110.0	110.0
23w CFL (100)	157	61.6	60.2	57.4	54.6	51.8	57.1
40w Globe	46	22.0	22.0	15.4	13.2	11.0	16.7
60w Dimmable Bulb	27	46.0	46.0	36.7	35.8	34.1	39.7
75w Outdoor	52	57.0	43.8	39.4	35.0	35.0	42.0
Torchiere Floor Lamp	5	95.0	95.0	95.0	95.0	95.0	95.0
Total	448	56.0	54.0	48.0	46.0	44.1	49.6
Indoor	396	55.9	55.4	49.2	47.4	45.3	50.6
Outdoor	52	57.0	43.8	39.4	35.0	35.0	42.0

The average installed watt difference across the 2013-17 period for indoor lamps is 50.6 W per lamp and for outdoor lamps is 42.0 W per lamp. Energy savings are calculated as follows:

Indoor lamps:

ΔkWh = $(W_{base} - W_{ee})$ /1000 * ISR * HOURS * $(1+WHF_e)$ * NTGR * LLF

ΔkWh (elec ht) = 50.6 /1000 *1.0 * 2.85 * 365 * (1 – 0.29) * 1.0 * 1.06842
= 39.7 kWh/yr

ΔkWh (nonelec ht) = 50.6 /1000 *1.0 * 2.85 * 365 * (1 + 0.08) * 1.0 * 1.06842
= 60.6 kWh/yr

ΔkW = $(W_{base} - W_{ee})$ /1000 * ISR * $(1+WHF_d)$ * CF * NTGR * LLF
= 50.6 / 1000 * 1.0 * (1 + 0.21) * 0.11 * 1.0 * 1.06842
= 0.0072

Outdoor lamps:

ΔkWh = $(W_{base} - W_{ee})$ /1000 * ISR * HOURS * NTGR * LLF
= 42.0 / 1000 * 1.0 * 2.85 * 365 * 1.0 * 1.06842
= 46.7 kWh/yr

ΔkW = 0

The weighted average savings across all lamps are shown below:

ΔkWh (elec ht) = 40.5
ΔkWh (nonelec ht) = 59.0
ΔkW = 0.0064

A comparison to the original savings value is shown in Table 7.

Table 7. CFL Savings Estimate Comparison

Measure	Heating Fuel Type	Original Estimate	Recommended Revised Estimate	Comments
CFL	Electric	38.9	40.5	Includes HVAC interactions and line losses
CFL	Non-electric	38.9	59.0	Includes HVAC interactions and line losses

Measure 3: Faucet Aerators

The program installs 1.5 gpm faucet aerators in the participant homes. The original deemed savings estimates were prepared using algorithms from the Ohio Draft TRM, with a NTGR of 0.75. Line losses were not included. The savings for this measure were also calculated using the Draft Ohio TRM (modified for line losses), as shown below.

$$\Delta kWh = ISR * (GPM_{base} - GPM_{low}) / GPM_{base} * \#\ people * gals/day * days/year * DR / F/home * 8.3 * (T_{ft} - T_{mains}) / 1{,}000{,}000 / DHW\ RE / 0.003412 * NTGR * LLF$$

Where:

ISR	= In Service Rate or fraction of units that get installed = 1.0 for direct install program
GPM_{base}	= Gallons per Minute of baseline faucet = 2.22
GPM_{low}	= Gallons per Minute of low flow faucet = 1.5
# people	= Average number of people per household = 2.46
gals/day	= Average gallons per day used by all faucets in home = 10.9
days/y	= Days faucet used per year = 365
DR	= Percentage of water flowing down drain (if water is collected in a sink, a faucet aerator will not result in any saved water) = 50%
F/home	= Average number of faucets in the home = 3.5
8.3	= Constant to convert gallons to lbs
T_{ft}	= Assumed temperature of water used by faucet = 80
T_{mains}	= Assumed temperature of water entering house = 57.8
DHW RE	= Recovery efficiency of electric hot water heater = 0.98
0.003412	= Constant to converts MMBtu to kWh
NTGR	= Deemed net-to-gross ratio for LI programs = 1.0

LLF = Line loss factor
= 1.0684
ΔkWh = 1.0 * (2.22 – 1.5) / 2.22 * 2.46 * 10.9 * 365 *
0.5 / 3.5 * 8.3 * (80-57.8) / 1,000,000 / 0.98 / 0.003412 * 1.0 * 1.0684
= 26.7
ΔkW = ΔkWh/hours * CF

Where:

Hours = Average number of hours per year spent using faucet
= (Gal/person * # people * 365) / F/home / GPM / 60
= (10.9 * 2.46 * 365) / 3.5 / 2.2 / 60
= 21 hours
CF = Summer Peak Coincidence Factor for measure
= 0.00262
ΔkW = 26.7 / 21 * 0.00262
= 0.003

A comparison to the original savings value is shown in Table 8.

Table 8. Faucet Aerator Savings Estimate Comparison

Measure	Heating Fuel Type	Original Estimate	Recommended Revised Estimate	Comments
Faucet Aerator (1.5 gpm)	Electric	18.7	26.7	Only applied to electric water heater regardless of space heating fuel type
Faucet Aerator (1.5 gpm)	Non-electric	18.7	26.7	Only applied to electric water heater regardless of space heating fuel type

The deemed savings estimate and the recommended revised estimate vary only by the NTGR.

Measure 4: Energy Efficient Showerheads

The program installs both 1.5 gpm and 1.75 gpm showerheads in the participant homes. The original deemed savings estimates were prepared using algorithms from the Ohio Draft TRM, with a NTGR of 0.85. An average baseline flow rate of 2.87 gpm, and an average low flow showerhead flowrate of 1.625 gpm was used for the calculations. Line losses were not included. The Draft Ohio TRM calculation is shown below:

$\Delta kWh = ISR * (GPM_{base} - GPM_{low}) * kWh/GPM_{reduced} * NTGR$

Where:

ISR = In Service Rate or fraction of units that get installed
= 1.0 for direct install
GPM_{base} = Gallons Per Minute of baseline showerhead
= 2.87

GPM_{low}	= Gallons Per Minute of low flow showerhead
	= 1.625 (average installed size)
$kWh/GPM_{reduced}$	= 149 kWh/gpm
NTGR	= 0.85
ΔkWh	= 1.0 * (2.87 – 1.625) * 149 * 0.85
	= 157.7 kWh

The Draft Ohio TRM uses a deemed savings value per gpm of flow reduction based on a gas consumption billing analysis from a utility in Canada. The savings for this measure were calculated using a more fundamental approach as shown below.

$\Delta kWh = ISR * (GPM_{base} - GPM_{low}) * min/day * \#people * shower/per * 8.3 * (T_{shower} - T_{mains}) * 365 / DHW\ Recovery\ Efficiency / 3412 / showers/home * NTGR * LLF$

ISR	= In Service Rate or fraction of units that get installed
	= 1.0 for direct install
GPM_{base}	= Gallons Per Minute of baseline showerhead
	= 2.87
GPM_{low}	= Gallons Per Minute of low flow showerhead
	= 1.625 (average installed size)
#people	= 2.46 average
showers/per	= showers per person per day
	= 0.58
min/day-person	= Average shower duration minutes per shower
	= 8.36
8.3	= Constant to convert gallons to lbs
T_{shower}	= Assumed temperature of shower water
	= 100
T_{mains}	= Assumed temperature of water entering house
	= 57.8
DHW RE	= Recovery efficiency of electric hot water heater
	= 0.98
3412	= Constant to convert Btu to kWh
showers/home	= number of showers installed in each home
	= 2.1 average
NTGR	= 1.0
	= Default for LI programs
LLF	= line loss factor
	= 1.0684
ΔkWh	= 1 * (2.87 – 1.625) * 8.36 * 2.46 * 0.58 * 8.3 * (100 – 57.8) * 365 / .98 / 3412 / 2.1 * 1.0 * 1.0684
	= 288 kWh/yr

A comparison to the original savings value is shown in Table 9.

Table 9. Showerhead Savings Estimate Comparison

Measure	Heating Fuel Type	Original Estimate	Recommended Revised Estimate	Comments
Low Flow Showerhead (1.625 gpm)	Electric	157.7	288	Only applied to electric water heater regardless of space heating fuel type
Low Flow Showerhead (1.625 gpm)	Non-electric	157.7	288	Only applied to electric water heater regardless of space heating fuel type

Measure 5: Water Heater Tank Wrap

The original deemed savings estimates were prepared using algorithms from the Ohio Draft TRM, with a NTGR of 0.85. The Draft Ohio TRM algorithm for water heater tank wraps is as follows:

$$\Delta kWH = kWH_{base} * ((EF_{new} - EF_{base})/EF_{new})$$

Where:

kWH_{base} = Average kWH consumption of electric domestic hot water tank
= 3460
EF_{new} = Assumed efficiency of electric tank with tank wrap installed
= 0.88
EF_{base} = Assumed efficiency of electric tank without tank wrap installed
= 0.86

The Draft Ohio TRM approach uses a deemed value approach based on nationwide average values for water heating energy use. Tank wraps affect standby losses, not total consumption. The savings for this measure were calculated using a more fundamental approach:

$$\Delta kWh = units \times \frac{(UA_{base} - UA_{ee}) \times \overline{\Delta T}}{3412 \times \eta_{elec}} \times 8760 \times NTGR \times LLF$$

$$\Delta kW = \Delta kWh/8760$$

Where:

ΔkWh = gross annual electricity savings
units = number of water heater tank wraps installed under the program
UA_{base} = overall heat transfer coefficient of base water heater (Btu/hr-°F)
UA_{ee} = overall heat transfer coefficient of water heater with insulating blanket (Btu/hr-°F)
ΔT = temperature difference between the water inside the tank and the ambient air (°F)
= 65°F
3412 = conversion factor (Btu/kWh)
8760 = conversion factor (hr/yr)
100000 = conversion factor (Btu/therm)

η_{elec} = electric water heater efficiency
= 0.98
NTGR = Net-to-gross ratio
= 1.0
LLF = Line loss factor
= 1.06842

The tank heat loss coefficient can be calculated from the energy factor (EF) as follows:

$$UA = \frac{\frac{1}{EF} - \frac{1}{RE}}{67.5 \times \left(0.000584 - \frac{1}{RE \times Cap}\right)}$$

where:

RE_{base} = recovery efficiency
= 0.98 for an electric water heater
Cap_{base} = water heater capacity (Btu/hr)
= 15,400 Btu/hr for a typical 4500 Watt water heater element

The Draft Ohio TRM recommends a change in EF from 0.86 to 0.88 as a result of insulating an electric water heater tank. Applying this change to the equation above results in a reduction in the tank overall heat transfer coefficient from 4.1 Btu/hr-F to 3.3 Btu/hr-F.

$$\Delta kWh = units \times \frac{(UA_{base} - UA_{ee}) \times \overline{\Delta T}}{3412 \times \eta_{elec}} \times 8760 \times NTGR \times LLF$$

= (4.1-3.3) x 65 x 8760 / 0.98 / 3412 x 1.0 x 1.06842
= 138 kWh/yr

ΔkW = ΔkWh/8760
= 138 / 8760
= 0.016 kW

A comparison to the original savings value is shown in Table 10.

Table 10. Water Heater Tank Wrap Savings Estimate Comparison

Measure	Heating Fuel Type	Original Estimate	Recommended Revised Estimate	Comments
Water heater wrap	Electric	59.3	138	Only applied to electric water heater regardless of space heating fuel type
Water heater wrap	Non-electric	59.3	138	Only applied to electric water heater regardless of space heating fuel type

Measure 6: Water Heater Pipe Insulation

The original deemed savings estimates were prepared using algorithms from the Ohio Draft TRM, with a NTGR of 0.75. The Draft Ohio TRM algorithm for water heater pipe insulation is as follows:

$$\Delta kWh = ((1/R_{exist} - 1/R_{new}) * (L * C) * \Delta T * 8{,}760) / \eta_{DHW} / 3412 * NTGR$$

Where:

R_{exist}	= R value of uninsulated pipe = 1.0
R_{new}	= R value of insulated pipe = 5
L	= length of pipe insulation installed = 5 ft.
C	= circumference of uninsulated pipe = 0.196 ft
ΔT	= difference between hot water and room temp = 65 degF
η_{DHW}	= water heater efficiency = 0.98
NTGR	= net-to-gross ratio = 0.75
ΔkWh	= ((1/1 – 1/5) * (5 * 0.196) * 65 * 8,760) / 0.98 / 3412 * 0.75 = 100.3 kWh

This value is within 0.5% of the 99.8 kWh value used in the deemed savings table. The desk review used the same calculation procedure (modified for line losses), but updated some of the input parameters as shown below:

R_{exist}	= R value of uninsulated pipe = 0.57 (Ref. ASHRAE Handbook of Fundamentals)
R_{new}	= R value of insulated pipe = 5.4 (Ref. pipe insulation mfg literature)
C	= circumference of uninsulated pipe = 0.229 ft (assume ¾ in nominal pipe; 0.875in OD)
NTGR	= 1.0
LLF	= 1.06842

The revised calculation is shown below:

ΔkWh	= ((1/0.57 – 1/5.4) * (5 * 0.229) * 65 * 8,760) / 0.98 / 3412 * 1.0 * 1.06842 = 327 kWh
ΔkW	= ΔkWh/8760 = 327/8760 = 0.037 kW

A comparison to the original savings value is shown in Table 11.

Table 11. Water Heater Pipe Insulation Savings Estimate Comparison

Measure	Heating Fuel Type	Original Estimate	Recommended Revised Estimate	Comments
Pipe Insulation	Electric	99.8	327	Only applied to electric water heater regardless of space heating fuel type
Pipe Insulation	Non-electric	99.8	327	Only applied to electric water heater regardless of space heating fuel type

Measure 7: Water Heater Replacement (Electric)

The original deemed savings estimates were prepared using the following algorithm.

$$\Delta kWh = (T_{WH} - T_{entering}) \times \#\,people \times gal/day \times 8.33 \times 1 \times 365 \times \left(\frac{1}{EF_{Base}} - \frac{1}{EF_{Eff}}\right) \times \frac{1}{3{,}412}$$

where:

T_{wh} = Water heater setpoint temperature
= 126.5 deg F

$T_{entering}$ = Cold water entering temperature
= 60.45 deg F

people = number of people in the home
= 2.3

gal/day = average hot water consumption per person
= 23 gal/person

EF_{base} = Energy Factor of baseline water heater
= 0.92 (New, standard efficiency water heater)

EF_{eff} = Energy Factor of efficient water heater
= 0.95 (Efficient water heater)

Note, this algorithm is different from the algorithm used in the Draft Ohio TRM, which is applicable to gas water heater replacements only, but is conceptually the same as the algorithm used in the Draft Ohio TRM for heat pump water heaters. The deemed savings were calculated as follows.

ΔkWh = (130 – 60.45) x 2.3 x 23 x 8.33 x 1 x 365 x (1/0.92 – 1/0.95) / 3412
= 117.2 kWh

The savings used in the PWC contract for this measure were not subject to a NTGR or line loss adjustment. The same approach (modified for line losses) was used for the desk review, with several parameters updated consistent with the values used in other measure calculations. The revised parameters are shown below.

T_{wh} = Water heater setpoint temperature
= 130 deg F

$T_{entering}$ = Cold water entering temperature

= 57.8 deg F
people = number of people in the home
= 2.46
NTGR = Net-to-gross ratio
= 1.0
LLF = Line loss factor
= 1.06842

ΔkWh = (130 – 57.8) x 2.46 x 23 x 8.33 x 1 x 365 x (1/0.92 – 1/0.95) / 3412 x 1.0 x 1.06842
= 133 kWh

The demand savings approach is consistent with the Draft Ohio TRM approach for heat pump water heaters:

ΔkW = ΔkWh / Hours * CF

Where:
Hours = Full load hours of hot water heater
= 2533
CF = Summer Peak Coincidence Factor for measure
= 0.346

ΔkW = 133 / 2533 * 0.346
= 0.018 kW

A comparison to the original savings value is shown in Table 12.

Table 12. Water Heater Replacement (Electric) Savings Estimate Comparison

Measure	Heating Fuel Type	Original Estimate	Recommended Revised Estimate	Comments
Water Heater Replacement	Electric	117.2	133	Electric water heater assumed regardless of space heating fuel type
Water Heater Replacement	Non-electric	117.2	133	Electric water heater assumed regardless of space heating fuel type

Measure 8-Water Heater Replacement (Gas)

No electricity savings assigned to this measure.

Shell Measures

Measures 9 through 17 refer to upgrades to the building shell, including attic/ceiling/roof insulation, wall insulation, floor insulation, foundation insulation, and air leakage sealing. Energy savings for these measures were estimated from DOE-2 simulations of prototypical residential buildings. Prototypes specific to low-income housing served by PWC were developed. Two prototypes were developed: a “high mass” solid brick construction representing construction practices in the city and a standard frame wall construction representing

construction practices in rural areas. The prototype simulation models were developed with input from PWC staff on typical building construction practices, HVAC system types and HVAC system efficiency. A detailed description of the prototype building is shown in *Appendix A: Residential Prototype Model Description*.

Measure 9: Attic/Ceiling/Roof Insulation (Space Heating Only)

The original deemed savings estimates were prepared using algorithms from the Ohio Draft TRM, with a NTGR of 0.75. The program assumes the average attic insulation R-value is R-10, consistent with the prototype description; with an updated R-value of R-38. The Draft Ohio TRM algorithm for attic insulation is as follows:

$$\Delta kWh/SF = ((1/R_{exist} - 1/R_{new}) * HDD * 24) / 3412 / \eta_{Heat} * NTGR$$

Where:

R_{exist} = R-value of existing attic insulation
= 10
R_{new} = R-value of updated attic insulation
= 38
HDD = heating degree days for Cincinnati
= 3853
n_{Heat} = heating system efficiency
= 0.70
NTGR = 0.75

The program deemed savings were calculated as follows:

$$\Delta kWh = ((1/10 - 1/38) * 3853 * 24) / 3412 / 0.70 * 0.75$$
$$= 2.14 \text{ kWh/SF}$$

The program savings calculations used a degree-day based approach, which is less rigorous than the simulation based approach described above. The R-values of the existing and new attic/ceiling/roof should consider the R-value of the entire assembly, not just the insulation. Also, the efficiency of electric resistance heaters is generally higher than 70%; electric resistance baseboard heaters are generally considered to be 100% efficient, neglecting a small amount of losses from the rear of the heater that don't enter the conditioned space.

The simulation-based approach was used to develop simple unit energy savings across a variety of pre and post insulation R-value combinations:

$\Delta kWh/SF$ = $(\Delta kWh/kSF) / 1000 * NTGR * LLF$
$\Delta kW/SF$ = $(\Delta kW/kSF) / 1000 * NTGR * LLF$

where:

$\Delta kWh/SF$ = electricity savings per SF of insulation
$\Delta kWh/kSF$ = electricity savings per 1000 SF from prototypical DOE-2 models
$\Delta kW/SF$ = peak demand savings per SF of insulation

ΔkW/kSF = peak demand savings per 1000 SF from prototypical DOE-2 models
NTGR = net-to-gross ratio
= 1.0
LLF = line loss factor
= 1.06842

Program design calculations assumed an initial ceiling insulation R-value of R-10, upgraded to R-38. R-values of the other ceiling assembly components are embedded in the simulation inputs. Results from the DOE-2 simulations are shown in *Appendix B: Prototypical Simulation Model Results*. The savings values were interpolated to match the program assumptions for pre- and post-installation R-values. The brick and frame construction results are equally weighted.

Pre R-value	Post R-value	Gross kWh/SF of insulation installed		
		Frame	Brick	Avg
10	38	1.29	1.25	1.27

Net kWh/SF = 1.27 x 1.0 x 1.06842
= 1.36

No summer peak demand savings are expected from electrically heated homes.

A comparison to the original savings value is shown in Table 13.

Table 13. Attic/Ceiling/Roof Insulation Savings Estimate Comparison

Measure	Heating Fuel Type	Original Estimate	Recommended Revised Estimate	Comments
Attic/Ceiling/Roof Insulation (Space Heating Only)	Electric	2.14	1.36	Electric heating only
Attic/Ceiling/Roof Insulation (Space Heating Only)	Non-electric	0	0	Electric heating only

Measure 10: Attic/Ceiling/Roof Insulation (Space Cooling Only)

The original deemed savings estimates were prepared using algorithms from the Ohio Draft TRM, with a NTGR of 0.75. The program assumes the average attic insulation R-value is R-10, consistent with the prototype description; with an updated R-value of R-38. The Draft Ohio TRM algorithm for attic insulation is as follows.

$$\Delta kWh/SF = ((1/R_{exist} - 1/R_{new}) * CDH * DUA) / 1000 / \eta_{Cool} * NTGR$$

Where:

R_{exist} = R-value of existing attic insulation
= 10
R_{new} = R-value of updated attic insulation
= 38
CDH = cooling degree hours for Cincinnati

= 7711
DUA = deemed usage adjustment factor
= 0.75
n_{Cool} = cooling system efficiency (SEER)
= 10.5
NTGR = 0.75

The program deemed savings were calculated as follows:

ΔkWh = ((1/10– 1/38) * 7711* 0.75) / 1000 / 10.5 * 0.75
= 0.03 kWh/SF

The program savings calculation used a degree-hour based approach with a deemed adjustment factor, which is less rigorous than the simulation based approach described above. The R-values of the existing and new attic/ceiling/roof should consider the R-value of the entire assembly, not just the insulation. The cooling system seasonal efficiency of SEER 10.5 is larger than prototype assumption of SEER 8.5.

The desk review used a simulation-based approach to develop simple unit energy savings across a variety of pre and post insulation R-value combinations:

ΔkWh/SF = (ΔkWh/kSF) / 1000 * NTGR * LLF
ΔkW/SF = (ΔkW/kSF) / 1000 * NTGR * LLF

where:

ΔkWh/SF = electricity savings per SF of insulation
ΔkWh/kSF = electricity savings per 1000 SF from prototypical DOE-2 models
ΔkW/SF = peak demand savings per SF of insulation
ΔkW/kSF = peak demand savings per 1000 SF from prototypical DOE-2 models
NTGR = net-to-gross ratio
= 1.0
LLF = line loss factor
= 1.06842

Program design calculations assumed an initial ceiling insulation R-value of R-10, upgraded to R-38. R-values of the other ceiling assembly components are embedded in the simulation inputs. Results from the DOE-2 simulations are shown in *Appendix B: Prototypical Simulation Model Results*. The savings values were interpolated to match the program assumptions for pre- and post-installation R-values. The brick and frame construction results are equally weighted.

Pre R-value	Post R-value	Gross kWh/SF of insulation installed		
		Frame	Brick	Avg
10	38	0.26	0.24	0.25

For example, on page 32, the cooling savings (from the AC with gas heat section) for frame houses going from R-0 to R-38 insulation is 936.7 kWh/kSF, and the savings going from R-11 to R-38 is 188.9 kWh/kSF. The weighted average for R-10 to R-38 is

1/11 * 936.7 + 10/11 * 188.8 = 256.8 kWh/kSF = 0.26 kWh/SF

The cooling savings (from the AC with gas heat section) for brick houses going from R-0 to R-38 insulation is 880.7 kWh/kSF, and the savings going from R-11 to R-38 is 178.5 kWh/kSF. The weighted average for R-10 to R-38 is

1/11 * 880.7 + 10/11 * 178.5 = 242.3 kWh/kSF = 0.24 kWh/SF

The average across brick and frame houses is the simple average of each value (assuming brick and frame houses are treated in equal numbers):

Avg savings = (0.26 + 0.24) / 2 = 0.25

The weighted gross kW savings were very small; on the order of 0.18 kW/kSF.

Net kWh/SF = 0.25 x 1.0 x 1.06842
= 0.27
Net kW/SF = 0.18 /1000 x 1.0 x 1.06842
= 0.00019

A comparison to the original savings value is shown in Table 14.

Table 14. Attic/Ceiling/Roof Insulation Savings Estimate Comparison

Measure	Heating Fuel Type	Original Estimate	Recommended Revised Estimate	Comments
Attic/Ceiling/Roof Insulation (Space Cooling Only)	Electric	0.03	0.27	Assumes buildings are cooled by central or room AC
Attic/Ceiling/Roof Insulation (Space Cooling Only)	Non-electric	0.03	0.27	Assumes buildings are cooled by central or room AC

Measure 11: Wall Insulation (Space Heating Only)

The original deemed savings estimates were prepared using algorithms from the Ohio Draft TRM, with a NTGR of 0.75. The program assumes an initial wall insulation R-value of R-5, which is consistent with an uninsulated wall cavity. The updated R-value is R-20. Note, the calculations assume the program assumptions on average pre and post R-values are consistent with actual installations. The Draft Ohio TRM algorithm for wall insulation is as follows:

$$\Delta kWh/SF = ((1/R_{exist} - 1/R_{new}) * HDD * 24) / 3412 / \eta_{Heat} * NTGR$$

Where:

R_{exist}	= R-value of existing attic insulation
	= 5
R_{new}	= R-value of updated attic insulation
	= 20
HDD	= heating degree days for Cincinnati
	= 3853
n_{Heat}	= heating system efficiency
	= 0.70
NTGR	= 0.75

The program deemed savings were calculated as follows:

ΔkWh	= ((1/5– 1/20) * 3853* 24) / 3412 / 0.70 * 0.75
	= 4.36 kWh/SF

The program savings calculation used a degree-day based approach, which is less rigorous than the simulation based approach described above. The R-values of the existing and upgraded wall should consider the R-value of the entire assembly, not just the insulation. It is unclear from the program documentation supplied by Duke Energy if the upgraded wall R-value includes just insulation or other wall assembly components. Also, the efficiency of electric resistance heaters is generally higher than 70%; electric resistance baseboard heaters are generally considered to be 100% efficient, neglecting a small amount of losses from the rear of the heater that don't enter the conditioned space.

The desk review used a simulation-based approach to develop simple unit energy savings across a variety of pre and post insulation R-value combinations:

ΔkWh/SF	= (ΔkWh/kSF) / 1000 * NTGR * LLF
ΔkW/SF	= (ΔkW/kSF) / 1000 * NTGR * LLF

where:

ΔkWh/SF	= electricity savings per SF of insulation
ΔkWh/kSF	= electricity savings per 1000 SF from prototypical DOE-2 models
ΔkW/SF	= peak demand savings per SF of insulation
ΔkW/kSF	= peak demand savings per 1000 SF from prototypical DOE-2 models
NTGR	= net-to-gross ratio
	= 1.0
LLF	= line loss factor
	= 1.06842

Program design calculations assumed an uninsulated wall, with a wall cavity R-value of R-5, upgraded to R-20. The calculations assume the program assumptions on average pre and post R-values are consistent with actual installations. Results from the DOE-2 simulations are shown in *Appendix B: Prototypical Simulation Model Results*. The savings values were interpolated to match the program assumptions for pre- and post-installation R-values. The measure is assumed to apply to frame walls only. Note, the R-value in the table below is for the applied insulation R-

value. An empty cavity is simulated when the insulation R-value is specified as "R-0" (indicating an uninsulated wall).

Pre R-value	Post R-value	Gross kWh/SF of insulation installed		
		Frame	Brick	Avg
0	20	2.08	0[4]	2.08

No summer peak demand savings are expected from electrically heated homes.

Net kWh/SF = 2.08 x 1.0 x 1.06842
= 2.22

A comparison to the original savings value is shown in Table 15.

Table 15. Wall Insulation (Space Heating Only) Savings Estimate Comparison

Measure	Heating Fuel Type	Original Estimate	Recommended Revised Estimate	Comments
Wall Insulation (Space Heating Only)	Electric	4.36	2.22	Electric heating only
Wall Insulation (Space Heating Only)	Non-electric	0	0	Electric heating only

Measure 12: Wall Insulation (Space Cooling Only)

The original deemed savings estimates were prepared using algorithms from the Ohio Draft TRM, with a NTGR of 0.75. The program assumes an initial wall insulation R-value of R-5, which is consistent with an uninsulated wall cavity. The updated R-value is R-20. The Draft Ohio TRM algorithm for wall insulation cooling savings is as follows:

$$\Delta kWh/SF = ((1/R_{exist} - 1/R_{new}) * CDH * DUA) / 1000 / \eta_{Cool} * NTGR$$

Where:

R_{exist} = R-value of existing wall insulation
= 5
R_{new} = R-value of updated wall insulation
= 20
CDH = cooling degree hours for Cincinnati
= 7711
DUA = deemed usage adjustment factor
= 0.75
n_{Cool} = cooling system efficiency (SEER)
= 10.5
NTGR = 0.75

[4] Due to the physical difficulty in adding insulation to a brick wall, we assume brick walls are not treated by the program.

The program deemed savings were calculated as follows:

ΔkWh = ((1/5– 1/20) * 7711* 0.75) / 1000 / 10.5 * 0.75
= 0.07 kWh/SF

The program savings calculation used a degree-hour based approach with a deemed adjustment factor, which is less rigorous than the simulation based approach described above. The R-values of the existing and upgraded wall should consider the R-value of the entire assembly, not just the insulation. The cooling system seasonal efficiency of SEER 10.5 is larger than prototype assumption of SEER 8.5.

The desk review used a simulation-based approach to develop simple unit energy savings across a variety of pre and post insulation R-value combinations:

ΔkWh/SF = (ΔkWh/kSF) / 1000 * NTGR * LLF
ΔkW/SF = (ΔkW/kSF) / 1000 * NTGR * LLF

where:

ΔkWh/SF = electricity savings per SF of insulation
ΔkWh/kSF = electricity savings per 1000 SF from prototypical DOE-2 models
ΔkW/SF = peak demand savings per SF of insulation
ΔkW/kSF = peak demand savings per 1000 SF from prototypical DOE-2 models
NTGR = net-to-gross ratio
= 1.0
LLF = line loss factor
= 1.06842

Program design calculations assumed an uninsulated wall, with a wall cavity R-value of R-5, upgraded to R-20. Results from the DOE-2 simulations are shown in *Appendix B: Prototypical Simulation Model Results*. The savings values were interpolated to match the program assumptions for pre- and post-installation R-values. The measure is assumed to apply to frame walls only.

Pre R-value	Post R-value	Gross kWh/SF of insulation installed		
		Frame	Brick	Avg
0	20	0.39	0	0.39

The weighted kW savings were very small; on the order of 0.109 kW/kSF.

Net kWh/SF = 0.39 x 1.0 x 1.06842
= 0.42
Net kW/SF = 0.109 /1000 x 1.0 x 1.06842
= 0.00012

A comparison to the original savings value is shown in Table 16.

Table 16. Wall Insulation (Space Cooling Only) Savings Estimate Comparison

Measure	Heating Fuel Type	Original Estimate	Recommended Revised Estimate	Comments
Wall Insulation (Space Cooling Only)	Electric	0.07	0.42	Assumes buildings are cooled by central or room AC
Wall Insulation (Space Cooling Only)	Non-electric	0.07	0.42	Assumes buildings are cooled by central or room AC

Measure 13: Floor Insulation (Space Heating Only)

Program design calculations for this measure relied on the Duke Deemed Savings database, since the Draft Ohio TRM does not cover this measure. The Duke Deemed Savings database relies on prototypical simulation models that represent a variety of building types and vintages. The desk review used a simulation-based approach, with a prototype developed specifically for the LI homes served by PWC.

The savings were calculated from:

$$\Delta kWh/SF = (\Delta kWh/kSF) / 1000 * NTGR * LLF$$
$$\Delta kW/SF = (\Delta kW/kSF) / 1000 * NTGR * LLF$$

where:

ΔkWh/SF = electricity savings per SF of insulation
ΔkWh/kSF = electricity savings per 1000 SF from prototypical DOE-2 models
ΔkW/SF = peak demand savings per SF of insulation
ΔkW/kSF = peak demand savings per 1000 SF from prototypical DOE-2 models
NTGR = net-to-gross ratio
= 1.0
LLF = line loss factor
= 1.06842

Program design calculations assumed an uninsulated floor, upgraded to R-19. The kWh savings results are shown below.

Pre R-value	Post R-value	Foundation Type	Gross kWh/SF of insulation installed		
			Frame	Brick	Avg
0	19	Basement	0.28	0.27	0.28
0	19	Crawlspace	1.22	1.21	1.22
		Average			0.75

No demand savings are expected from electrically heated buildings.

Net kWh/SF = 0.75 x 1.0 x 1.06842
= 0.80

A comparison to the original savings value is shown in Table 17.

Table 17. Floor Insulation (Space Heating Only) Savings Estimate Comparison

Measure	Heating Fuel Type	Original Estimate	Recommended Revised Estimate	Comments
Floor Insulation (Space Heating Only)	Electric	0.70	0.80	Electric heating only
Floor Insulation (Space Heating Only)	Non-electric	0	0	Electric heating only

Measure 14: Floor Insulation (Space Cooling Only)

This measure was assigned zero savings in for electric and non-electric heating buildings.

Measure 15: Foundation Insulation (Space Heating Only)

Program design calculations for this measure relied on the Duke Deemed Savings database, since the Draft Ohio TRM does not cover this measure. The Duke Deemed Savings database relies on prototypical simulation models that represent a variety of building types and vintages. The desk review used a simulation-based approach, with a prototype developed specifically for the LI homes served by PWC.

The savings were calculated from:

$$\Delta kWh/SF = (\Delta kWh/kSF) / 1000 * NTGR * LLF$$
$$\Delta kW/SF = (\Delta kW/kSF) / 1000 * NTGR * LLF$$

where:

ΔkWh/SF = electricity savings per SF of insulation
ΔkWh/kSF = electricity savings per 1000 SF from prototypical DOE-2 models
ΔkW/SF = peak demand savings per SF of insulation
ΔkW/kSF = peak demand savings per 1000 SF from prototypical DOE-2 models
NTGR = net-to-gross ratio
= 1.0
LLF = line loss factor
= 1.06842

Program design calculations assumed an uninsulated basement wall, upgraded to R-19. Results from the DOE-2 simulations are shown in *Appendix B: Prototypical Simulation Model Results*.

Pre R-value	Post R-value	Foundation Type	Gross kWh/SF of insulation installed		
			Frame	Brick	Avg
0	19	Basement	1.48	1.49	1.49
0	19	Crawlspace	3.81	3.85	3.83
		Average			2.66

No demand savings are expected from electrically heated buildings.

Net kWh/SF = 2.66 x 1.0 x 1.06842
= 2.84

A comparison to the original savings value is shown in Table 18.

Table 18. Foundation Insulation (Space Heating Only) Savings Estimate Comparison

Measure	Heating Fuel Type	Original Estimate	Recommended Revised Estimate	Comments
Floor Insulation (Space Heating Only)	Electric	0.90	2.84	Electric heating only
Floor Insulation (Space Heating Only)	Non-electric	0	0	Electric heating only

Measure 16: Air Sealing (Space Heating Only)

The original deemed savings estimates were prepared using algorithms from the Ohio Draft TRM, with a NTGR of 0.75. The Draft Ohio TRM algorithm for air leakage sealing is as follows:

$$\Delta kWh = (((CFM50_{Exist} - CFM50_{New}) / \text{N-factor}) * 60 * 24 * HDD * 0.018) / 3412 / \eta_{Heat} * NTGR$$

Where:

$CFM50_{Exist}$ = Blower door infiltration rate at 50Pa prior to sealing
= 1

$CFM50_{New}$ = Blower door infiltration rate at 50Pa after to sealing
= 0

N-factor = LBL factor to convert CFM50 to natural infiltration rate
= 29.4

HDD = heating degree days for Cincinnati
= 3853

n_{Heat} = heating system efficiency
= 0.70

NTGR = 0.75

ΔkWh = (((1) / 29.4) *60 * 24 * 3853 * 0.018) / 3412 / 0.7 * 0.75
= 1.07 kWh/CFM

This calculation is within 3% of the value used in the deemed savings table.

The program savings calculation used a degree-day based approach, which is less rigorous than the simulation based approach described above. The n-factor of 29.4 used in the program design calculations is appropriate for the cooling season; a lower value of 17.8 is appropriate for winter conditions. Also, the efficiency of electric resistance heaters is generally higher than 70%;

electric resistance baseboard heaters are generally considered to be 100% efficient, neglecting a small amount of losses from the rear of the heater that don't enter the conditioned space.

The desk review used a simulation-based approach to develop simple unit energy savings per CFM of natural infiltration reduction.

$\Delta kWh/CFM_{50}$ = $\Delta kWh/CFM_n$ / n-factor * NTGR * LLF

where:

$\Delta kWh/CFM_{50}$ = electricity savings per cfm of infiltration reduction at 50 Pa
$\Delta kWh/CFM_n$ = electricity savings per cfm of natural infiltration reduction
n-factor = LBL conversion factor from CFM50 to natural infiltration rate
= 17.8 (heating season)

Average kWh savings per cfm of infiltration reduction from simulations is 29.2 kWh/CFM_n. Applying the LBL n-factor, the expected gross savings per reduction in CFM_{50} is

$\Delta kWh/CFM_{50}$ = $\Delta kWh/CFM_n$ / n-factor
= 29.2 / 17.8
= 1.64 kWh/CFM_{50}.

No summer peak demand savings are expected from electrically heated buildings.

Net kWh/ CFM_{50} = 1.64 x 1.0 x 1.06842
= 1.75

A comparison to the original savings value is shown in Table 19.

Table 19. Foundation Insulation (Space Heating Only) Savings Estimate Comparison

Measure	Heating Fuel Type	Original Estimate	Recommended Revised Estimate	Comments
Air Sealing (Space Heating Only)	Electric	1.1	1.75	Electric heating only
Air Sealing (Space Heating Only)	Non-electric	0	0	Electric heating only

Measure 17: Air Sealing (Space Cooling Only)

The original deemed savings estimates were prepared using algorithms from the Ohio Draft TRM, with a NTGR of 0.75. The Draft Ohio TRM algorithm for air leakage sealing is as follows:

ΔkWh = $(((CFM_{50Exist} - CFM_{50New}) / N\text{-factor}) * 60 * CDH * DUA * 0.018) / 1000 / \eta_{Cool} * NTGR$

Where:

$CFM_{50Exist}$ = Blower door infiltration rate at 50Pa prior to sealing
= 1

CFM_{50New}	= Blower door infiltration rate at 50Pa after to sealing = 0
N-factor	= LBL factor to convert CFM50 to natural infiltration rate = 29.4
CDH	= cooling degree hours for Cincinnati = 7711
DUA	= deemed usage adjustment factor = 0.75
n_{Cool}	= cooling system efficiency (SEER) = 10.5
NTGR	= 0.75
ΔkWh	= (((1) / 29.4) *60 * 7711 * 0.75 * 0.018) / 1000 / 10.5 * 0.75 = 0.02 kWh/CFM

The program savings calculation used a degree-hour based approach with a deemed adjustment factor, which is less rigorous than the simulation based approach described above. The cooling system seasonal efficiency of SEER 10.5 is larger than prototype assumption of SEER 8.5.

The desk review used a simulation-based approach to develop simple unit energy savings per CFM of natural infiltration reduction.

ΔkWh/CFM50	= ΔkWh/CFMn / n-factor * NTGR * LLF
ΔkW/CFM50	= ΔkW/CFMn / n-factor * NTGR * LLF

where:

$\Delta kWh/CFM_{50}$	= electricity savings per cfm of infiltration reduction at 50 Pa
$\Delta kWh/CFM_n$	= electricity savings per cfm of natural infiltration reduction
n-factor	= LBL conversion factor from CFM50 to natural infiltration rate = 29.4 (cooling season)
$\Delta kW/CFM_{50}$	= summer demand savings per cfm of infiltration reduction at 50 Pa
$\Delta kW/CFM_n$	= summer demand savings per cfm of natural infiltration reduction
NTGR	= net-to-gross ratio = 1.0
LLF	= line loss factor = 1.06842

Average kWh savings per cfm of infiltration reduction from simulations is 3.5 kWh/CFM_n. Average kW savings per cfm is 0.007 kW/CFM_n. Applying the LBL n-factor, the expected gross savings per reduction in CFM50 is

ΔkWh/CFM50	= ΔkWh/CFMn / n-factor = 3.7 / 29.4 = 0.12 kWh/CFM_{50}

ΔkW/CFM50 = ΔkW/CFMn / n-factor
= 0.007 / 29.4
= 0.00023 kW/CFM_{50}.

Net kWh/ CFM_{50} = 0.12 x 1.0 x 1.06842
= 0.13
Net kW/ CFM_{50} = 0.00023 x 1.0 x 1.06842
= 0.00025

A comparison to the original savings value is shown in Table 20.

Table 20. Air Sealing (Space Cooling Only) Savings Estimate Comparison

Measure	Heating Fuel Type	Original Estimate	Recommended Revised Estimate	Comments
Air Sealing (Space Heating Only)	Electric	0.02	0.13	Assumes buildings are cooled by central or room AC
Air Sealing (Space Heating Only)	Non-electric	0.02	0.13	Assumes buildings are cooled by central or room AC

Summary of Recommended Changes

The following table shows the recommended changes in unit energy savings values.

Table 21. Recommended Changes to Unit Energy Savings Values

Measure	Measure Net Savings Per Unit in PWC Contract	Recommended Net Value
Electrically Heated Homes		
Refrigerator Replacement	1263.0	896
CFL	38.9	40.5
Faucet Aerator (1.5 GPM assumed)	18.7	26.7
Energy Efficient Shower Head (1.625 GPM Assumed)	157.7	288
Water Heater Tank Wrap	59.3	138
Water Heater Pipe Insulation	99.8	327
Water Heater Replacement (Electric)	117.2	133
Water Heater Replacement (Gas)	0.0	0.0
Attic/Ceiling/Roof Insulation (Space Heating Only)	2.14	1.36
Attic/Ceiling/Roof Insulation (Space Cooling Only)	0.03	0.27
Wall Insulation (Space Heating Only)	4.36	2.22
Wall Insulation (Space Cooling Only)	0.07	0.42
Floor Insulation (Space Heating Only)	0.7	0.80
Floor Insulation (Space Cooling Only)	0.0	0.0
Foundation Insulation (Space Heating Only)	0.9	2.84
Air Sealing (Space Heating Only)	1.1	1.75
Air Sealing (Space Cooling Only)	0.02	0.13
Non-Electrically Heated Homes		
Refrigerator Replacement	1263.0	1,364
CFL	38.9	59.0
Faucet Aerator (1.5 GPM assumed)	18.7	26.7
Energy Efficient Shower Head (1.625 GPM Assumed)	157.7	288
Water Heater Tank Wrap	59.3	138
Water Heater Pipe Insulation	99.8	327
Water Heater Replacement (Electric)	117.2	133
Water Heater Replacement (Gas)	0.0	0.0
Attic/Ceiling/Roof Insulation (Space Heating Only)	0.0	0.0
Attic/Ceiling/Roof Insulation (Space Cooling Only)	0.03	0.27
Wall Insulation (Space Heating Only)	0.0	0.0
Wall Insulation (Space Cooling Only)	0.07	0.42
Floor Insulation (Space Heating Only)	0.0	0.0
Floor Insulation (Space Cooling Only)	0.0	0.0
Foundation Insulation (Space Heating Only)	0.0	0.0
Air Sealing (Space Heating Only)	0.0	0.0
Air Sealing (Space Cooling Only)	0.02	0.13

Appendix A: Residential Prototype Model Description

This analysis is based on DOE-2.2 simulations of a set of prototypical single family residential buildings. The prototypical simulation models were derived from the residential building prototypes used in the California Database for Energy Efficiency Resources (DEER) study, with adjustments made for local building practices and climate. The prototype "model" in fact contains four separate residential buildings; 2 one-story and 2 two-story buildings. Each version of the 1 story and 2 story buildings are identical except for the orientation, which is shifted by 90 degrees. The selection of these four buildings is designed to give a reasonable average response of buildings of different design and orientation to the impact of energy efficiency measures.

Two separate models were created to represent general designs of buildings:

1. Frame construction typical of rural areas
2. Brick construction typical of urban areas.

A sketch of the residential prototype buildings is shown in Figure 1.

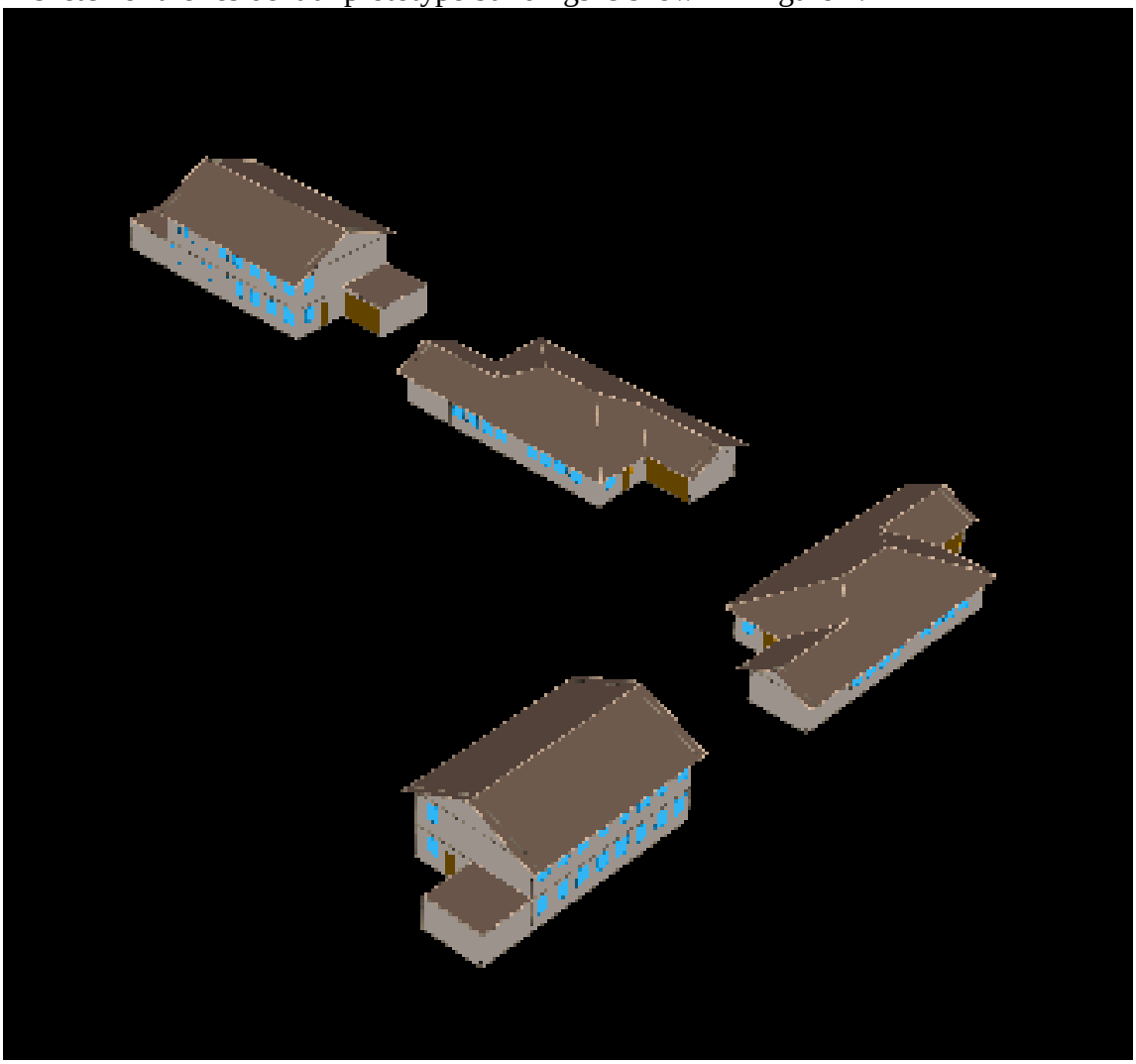

Figure 1. Computer Rendering of Residential Building Prototypical DOE-2 Model

The base prototype includes an unconditioned basement. A separate crawlspace model was developed to analyze floor and crawlspace wall insulation. The general characteristics of the residential building prototype model are summarized in Table 22.

Table 22. Residential Building Prototype Description

Characteristic	Value
Conditioned floor area	1 story house: 1465 SF (not including basement) 2 story house: 2930 SF (not including basement)
Wall construction and R-value	Two wall types: wood frame with siding and solid brick. Walls uninsulated in both cases.
Roof construction and R-value	Wood frame with asphalt shingles, R-10 insulation
Glazing type	Single pane
Infiltration rate	3 ACH
Lighting and appliance power density	0.51 W/SF average
HVAC system type	Central split system AC with gas furnace Central split system AC with electric furnace Central split system heat pump Electric furnace only Gas furnace only
HVAC system size	Based on ASHRAE design day peak load with 20% over sizing.
HVAC system efficiency	Baseline SEER = 6.8
Thermostat setpoints	Heating: 65°F with setback to 50°F Cooling: 72°F with setup to 75°F
Duct location	Buildings without basement: attic Buildings with basement: basement
Duct surface area	Single story house: 390 SF supply, 72 SF return Two story house: 505 SF supply, 290 SF return
Duct insulation	Uninsulated
Duct leakage	20% of fan flow total leakage, evenly split between supply and return.
Natural ventilation	Allowed during cooling season when cooling setpoint exceeded and outdoor temperature < 65°F.

Appendix B: Prototypical Simulation Model Results

Building: Single Family Frame Construction			City: Cincinnati		HVAC: Electric Heat, no AC					Measure: Roof Insulation
Base →	0		11		19		30		38	
Measure	kWh/ kSF	kW/ kSF	kWh/ kSF	kW/ kSF	kWh/ kSF	kW/ kSF	kWh/ kSF	kW/ kSF	kWh/ kSF	kW/ kSF
11	3753.9	0.000								
19	4323.9	0.000	570.0	0.000						
30	4599.5	0.000	845.6	0.000	275.6	0.000				
38	4707.3	0.000	953.4	0.000	383.4	0.000	107.8	0.000		
49	4802.4	0.000	1048.5	0.000	478.5	0.000	202.9	0.000	95.1	0.000
60	4863.1	0.000	1109.2	0.000	539.2	0.000	263.7	0.000	155.8	0.000
Building: Single Family Brick Construction			City: Cincinnati		HVAC: Electric Heat, no AC					Measure: Roof Insulation
Base →	0		11		19		30		38	
Measure	kWh/ kSF	kW/ kSF	kWh/ kSF	kW/ kSF	kWh/ kSF	kW/ kSF	kWh/ kSF	kW/ kSF	kWh/ kSF	kW/ kSF
11	3657.2	0.000								
19	4205.8	0.000	548.6	0.000						
30	4469.8	0.000	812.6	0.000	264.0	0.000				
38	4573.7	0.000	916.6	0.000	367.9	0.000	103.9	0.000		
49	4663.7	0.000	1006.5	0.000	457.8	0.000	193.9	0.000	89.9	0.000
60	4723.0	0.000	1065.9	0.000	517.2	0.000	253.2	0.000	149.3	0.000

Building: Single Family Frame Construction			City: Cincinnati		HVAC: AC with Gas Heat					Measure: Roof Insulation
Base →	0		11		19		30		38	
Measure	kWh/ kSF	kW/ kSF	kWh/ kSF	kW/ kSF	kWh/ kSF	kW/ kSF	kWh/ kSF	kW/ kSF	kWh/ kSF	kW/ kSF
11	747.8	0.290								
19	864.3	0.375	116.6	0.085						
30	913.8	0.410	166.0	0.119	49.5	0.034				
38	936.7	0.410	188.9	0.119	72.4	0.034	22.9	0.000		
49	965.4	0.427	217.6	0.137	101.0	0.051	51.5	0.017	28.7	0.017
60	976.8	0.444	229.0	0.154	112.5	0.068	63.0	0.034	40.1	0.034

Building: Single Family Brick Construction			City: Cincinnati		HVAC: AC with Gas Heat					Measure: Roof Insulation
Base →	0		11		19		30		38	
Measure	kWh/ kSF	kW/ kSF	kWh/ kSF	kW/ kSF	kWh/ kSF	kW/ kSF	kWh/ kSF	kW/ kSF	kWh/ kSF	kW/ kSF
11	702.2	0.444								
19	812.5	0.546	110.2	0.102						
30	862.5	0.597	160.2	0.154	50.0	0.051				
38	880.7	0.614	178.5	0.171	68.3	0.068	18.3	0.017		
49	898.3	0.631	196.1	0.188	85.8	0.085	35.8	0.034	17.6	0.017
60	909.2	0.648	207.0	0.205	96.8	0.102	46.8	0.051	28.5	0.034

Building: Single Family Frame Construction			City: Cincinnati		HVAC: Electric Heat, no AC					Measure: Wall Insulation
Base →	0		11		13		17		19	
Measure	kWh/ kSF	kW/ kSF	kWh/ kSF	kW/ kSF	kWh/ kSF	kW/ kSF	kWh/ kSF	kW/ kSF	kWh/ kSF	kW/ kSF
11	1544.0	0.000								
13	1713.5	0.000	169.5	0.000						
17	1952.9	0.000	408.9	0.000	239.5	0.000				
19	2039.5	0.000	495.5	0.000	326.0	0.000	86.5	0.000		
21	2112.4	0.000	568.4	0.000	398.9	0.000	159.5	0.000	72.9	0.000
25	2226.5	0.000	682.5	0.000	513.1	0.000	273.6	0.000	187.1	0.000

Building: Single Family Frame Construction			City: Cincinnati		HVAC: AC with Gas Heat					Measure: Wall Insulation
Base →	0		11		13		17		19	
Measure	kWh/ kSF	kW/ kSF	kWh/ kSF	kW/ kSF	kWh/ kSF	kW/ kSF	kWh/ kSF	kW/ kSF	kWh/ kSF	kW/ kSF
11	297.6	0.091								
13	329.1	0.109	31.5	0.018						
17	372.0	0.109	74.4	0.018	42.9	0.000				
19	389.1	0.109	91.5	0.018	60.0	0.000	17.1	0.000		
21	400.2	0.109	102.5	0.018	71.1	0.000	28.2	0.000	11.1	0.000
25	422.4	0.109	124.7	0.018	93.3	0.000	50.4	0.000	33.3	0.000

APPENDIX F-

My Home Energy Report Evaluation

REPORT

Nexant
Reimagine tomorrow.

My Home Energy Report Program Evaluation

Submitted to Duke Energy Ohio
September 30, 2015

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1 Executive Summary

1.1 Program Summary

Duke Energy offers the My Home Energy Report (MyHER) to Duke Energy residential customers who live in single-metered, single family homes with thirteen months of usage history throughout Ohio. 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.[1] MyHER motivates customers to reduce their energy consumption by:

- Comparing their household electricity consumption to that of similar homes
- Suggesting tips for reducing energy use by changing their behavior or installing energy efficient equipment
- Educating them about the energy savings benefits of Duke Energy's demand side management (DSM) programs
- Encouraging active management of their home's energy consumption

1.2 Evaluation Objectives and High Level Findings

This report presents the result of Nexant's evaluation activities. The evaluation estimates the annual energy impacts associated with MyHER and measures customer satisfaction and engagement relative to baseline. The MyHER program operates as a randomized, controlled trial and customers are randomly assigned to either "treatment" or "control", for program evaluation purposes. Treatment customers are MyHER recipients or 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 MyHER program are presented below in Table 1-1. The 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. Additional information concerning the evaluation period is shown in Table 1-2.

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

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

	Energy (kWh)	Confidence and Precision
Claimed Impacts	220	N/A
Evaluated Impacts	256	90/14

*MyHER is an opt-out program. As such, all impacts are considered net impacts; nevertheless, Nexant 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*	March 2014	February 2015
Customer Survey Period	May 14, 2015	June 16, 2015

*The MyHER impact analysis provides census estimates for the most recent twelve months prior to the analysis.

1.3 Evaluation Recommendations

The Ohio MyHER program is achieving its goal of delivering cost-effective energy savings. The program is implemented as a randomized, controlled trial (RCT). This program design is a robust method for isolating and measuring the energy savings impacts attributable to the program. Nexant's overarching recommendation to Duke Energy Ohio is to preserve the integrity of the randomized, controlled trial as the program evolves and grows.

Substantial planning and coordination is required to deliver MyHER to approximately 300,000 Duke Energy 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. This process is currently functioning well, but additional efficiencies may be achieved by establishing a "MyHER messaging plan" in advance. Furthermore, Duke Energy may capitalize on MyHER's customer engagement and awareness stimuli by continuing to develop and offer products, data, and services that inform customer choices about energy consumption.

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

- ***Maintain the integrity of the RCT design with consistent, simultaneous assignment of newly-eligible customers to either treatment or control group***
- ***Reduce the size of the control group established by the 2010 program pilot to achieve better balance between the DEO MyHER treatment and control groups***
- ***Revise the Operations Playbook to reflect full-scale deployment of MyHER and incorporate lessons learned.*** The Playbook is a valuable source document for key components of managing the MyHER program, but should be updated to reflect changes that may have occurred as the program reached full scale, particularly how households

become ineligible and/or are re-clustered.

- ***Ensure that any content that can be developed ahead of the monthly production schedule is reviewed and finalized before the data transfers begin.*** This primarily applies to tips and messages, which are not dependent on billing data ingestion for scheduling.
- ***Review quality control thresholds and expectations.*** A full quality assurance process was implemented in 2014 and allows Duke Energy to review all customer data before reports are mailed. Tracking the nature and magnitude of quality assurance issues will help Duke monitor program quality and balance the time required to correct issues against the affected portion of the treatment population.
- ***Expand information options for MyHER recipients seeking more detail about the energy use in their homes.*** This could include inviting recipients to receive on-site audits, establishing a mechanism for short-term lending of in-home displays, further promotion of the web-portal, “ask an expert” web/chat space, or any number of other options for households that are ready to dive deeper into understanding the factors behind their energy consumption.
- ***Leverage the perceived utility of MyHER information.*** Continue to emphasize the trend chart and the comparison bar chart, the most useful components of MyHER and use the communication opportunity to encourage treatment households to follow through on their intentions.

2 Introduction and Program Description

This section presents a brief description of the MyHER program as it operated in Duke Energy Ohio territory from March 2014 to February 2015. It is informed by document review, in-depth interviews with staff and the understanding of program nuance developed through regular communication during the evaluation process.

2.1 Program Description

The My Home Energy Report program ("MyHER") is a Duke Energy Ohio ("Duke" or "DEO") 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. 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 and homes that are considered energy efficient. Reports also include seasonal and household-appropriate energy savings tips, as well as information on energy efficiency programs, offered by Duke Energy, from which the household might benefit. Many tips include low- or no-cost suggestions such as behavioral changes. Duke contracts with Tendril Inc. for the management and delivery of its MyHER product.

Customers occupying single-family homes with an individual electric meter and at least thirteen months of electricity consumption history are eligible to receive a MyHER. A portion of eligible customers are placed into a control groups to satisfy evaluation, measurement, and verification (EM&V) requirements. Customers assigned to the control group are not eligible to participate in the MyHER program. The program is an opt-out program – that is, customers can notify Duke Energy that they no longer wish to receive a MyHER and will be subsequently removed from the program.

Duke has several objectives for supporting 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
3. Providing an opportunity to promote other energy efficiency program options to residential customers.

2.2 Implementation

MyHER is implemented by Tendril Inc., an analytics contractor that prepares and mails the MyHER reports according to a pre-determined annual calendar. Tendril and Duke Energy Ohio

coordinate closely on the data transfer and cleaning required to successfully manage the MyHER program, and they make adjustments as needed to provide customized tips and messages expected to reflect the attributes of specific homes. A more detailed discussion of the roles and responsibilities of both organizations is contained in Chapter 4.

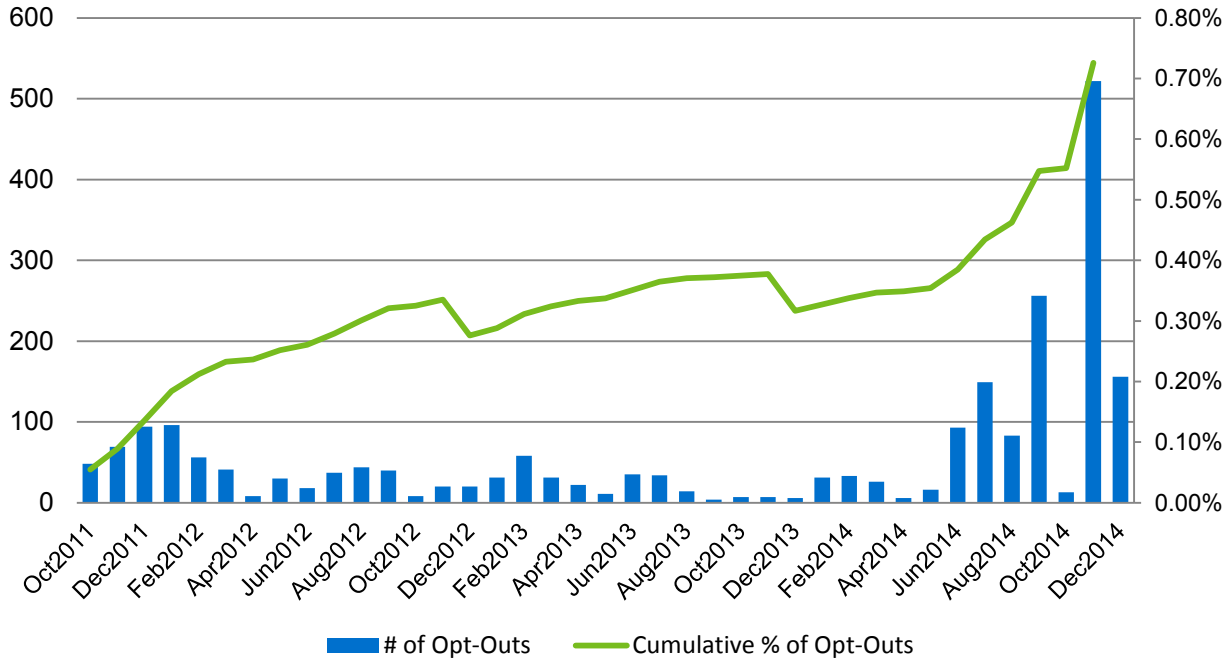
Eligibility

MyHER targets residential customers living in single family, single meter, non-commercial homes with at least thirteen months of electricity consumption history. Other variables could lead an account to be excluded, including: assignment to the control group, different mailing and service addresses, and customers enrolled in payment plans based on income (although budget bill customers are eligible). Approximately 340,000[2] Duke Energy residential customers currently meet these requirements. 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 approximately 7% 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); details are discussed in section 3.1.2.

Figure 2-1 presents the opt-out rate for Duke Energy's MyHER program. The opt-out rate has remained below 1%, even as Duke Energy began promoting the HoM program at the end of 2014. Customers enrolled in that program are removed from MyHER and categorized as an opt-out.

[2] This population number includes 300,000 treatment participants and 40,000 control group customers.

Figure 2-1: Opt-out Rate October 2011-December 2014



2.3 Key Research Objectives

The section describes key research objectives and associated evaluation activities.

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. Are the sample sizes of control groups used by the various entities optimal and if not, how should they be modified to be brought into line with reasonable precision targets (e.g., plus or minus 1% precision with 90% confidence).
3. What is the impact of MyHER on the uptake of other Duke programs (downstream and upstream) in the market?
4. What were net energy savings attributed solely to MyHERs after removing double counting of savings from other DEO energy efficiency programs?

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 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'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

This introductory section is followed by three additional sections: a chapter presenting the results of the impact analysis, a chapter presenting the results of the process evaluation activities, including the customer surveys, and a final chapter presenting conclusions and recommendations.

3 Impact Evaluation

3.1 Methods

A key objective of the MyHER impact evaluation is to measure the change in electric energy consumption (kWh) resulting from exposure to the normative comparisons and conservation messaging presented in Duke'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 control 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 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 to quantify 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 February 2015. 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 Experian 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 in 2014, and the associated reason for omission.

- **Participation Tracking Data for Other Duke EE 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. The participant list dataset included 462,614 distinct accounts; 406,129 accounts were assigned to the treatment group and 56,492 accounts assigned to the control group. The billing history dataset included 27,681,635 monthly billing records from 462,621 accounts.

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

- Seven accounts with billing data that were not designated as members of either the treatment or control group
- 27 accounts without a full year of pre-assignment usage history (10 control, 17 treatment)
- 2,653 records (<0.01%) where the number of days in the billing cycle was equal to zero
- 1,477 records with a negative value for billed kWh
- 145 records with unrealistically high usage. The criteria used for this determination was any month with greater than 6 times the 99th percentile value for daily kWh usage, or approximately 900 kWh per day
- 1,910 records having a meter read date more than 100 days before or after the 15th of the bill month to which the usage was assigned
- Records associated with 2,845 treatment group homes and 4,316 control group homes that were assigned to MyHER in January 2015. Based on the dates Tendril sent MyHERs to the printer for the treatment homes, these homes could not have received their first MyHER mailer until the final days of the last bill month in the period of interest for this evaluation (March 2014 through February 2015). Including these homes in the analysis would add noise to the data without providing any additional information about the magnitude of the MyHER treatment effect.

Like most electric utilities, Duke does not bill its customers for usage within a standard calendar month interval. Instead, billing cycles are a function of meter read dates and vary across accounts. Duke "calendarizes" billing records in its data warehouse in a field called "bill month". A record with bill month = 201501 corresponds to a home's first (of 12) bills for 2015. Typically this will reflect energy captured by a meter read during one of the approximately 20 weekdays in a given month. The electric usage associated with bill month 201501 includes a mix of December and January days depending on the meter read schedule of the account.

Nexant's analysis of MyHER impacts is based on the bill month designation. Meter read patterns are distributed similarly across the month within the treatment and control group, so

using the bill month categorization does not introduce bias to the impact estimates. It is important to remember that when monthly impact estimates are presented in this report that the bill month lags the calendar month by an average of two weeks.

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:

- **Postal Hygiene** – 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 mailer.
- **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.
- **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 mailer.
- **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.

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. Nexant was able to reproduce these participation counts within ± 2% for each month in the analysis period based on the data requested for the evaluation. Access to additional data such as pending disconnects and other operational data prevented Nexant from replicating monthly participation totals identically. 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 3-1 for the study period. The average proportion treated was 93.5%.

Table 3-1: Calculation of Treatment Percentage by Bill Month

Bill Month	Number of Treatment Homes Analyzed	DEO Participant Count[3]	Proportion of Homes Treated
2014 03	317,959	297,659	93.6%
2014 04	317,879	297,659	93.6%
2014 05	318,299	300,073	94.3%
2014 06	320,922	296,114	92.3%
2014 07	321,379	304,596	94.8%
2014 08	320,197	299,805	93.6%
2014 09	317,250	299,805	94.5%
2014 10	318,047	298,786	93.9%
2014 11	321,272	298,786	93.0%
2014 12	321,846	295,816	91.9%
2015 01	323,013	299,022	92.6%
2015 02	321,146	299,812	93.4%
Twelve Month Average Proportion			**93.5%**

The monthly participation counts shown in Table 3-1 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 due to the program. The 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:

3 The DEO participation counts used in this calculation are moved back one month because of the way participation is counted. For example, the February 2015 (201502) participation count is actually the number of homes that have received a report showing usage for the 201501 bill month.

- MyHER saves an average of 256 kWh per home, ± 35.2 kWh.
- Homes in the MyHER treatment group reduced electric consumption by an average of 1.9%, ± 0.26%.

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 is 256 kWh with a relative precision of ±13.8%. In this case ±13.8% is determined by dividing the absolute margin of error by the impact estimate. 35.2÷256 = 0.138 = 13.8%.

All of the precision estimates in this report are presented at the 90% confidence level and assume a two-tailed distribution.

3.1.4 Equivalence Testing

Unequivocal, 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 3-1 shows the result of this simple difference in means calculation performed for MyHER accounts who had been assigned to a group prior to each bill month in 2013 and 2014. Unfortunately, this simple diagnostic reveals a troublesome pattern. During winter months the treatment group's electricity use is significantly lower than the control group, but during summer months the treatment group actually uses more electricity than the control group on average. One would not anticipate exposure to MyHER leads to a reduction in winter consumption, accompanied by an increase in electricity consumption during the summer. This result suggests there is a difference in how treatment and control customers use electricity in summer and winter.

Given the differences in seasonal energy consumption for treatment and control groups described in Figure 3-1 Nexant chose to estimate the program treatment effects with a linear fixed effects regression model.

Figure 3-1: Difference in Average kWh Usage by Month (2013-2014)

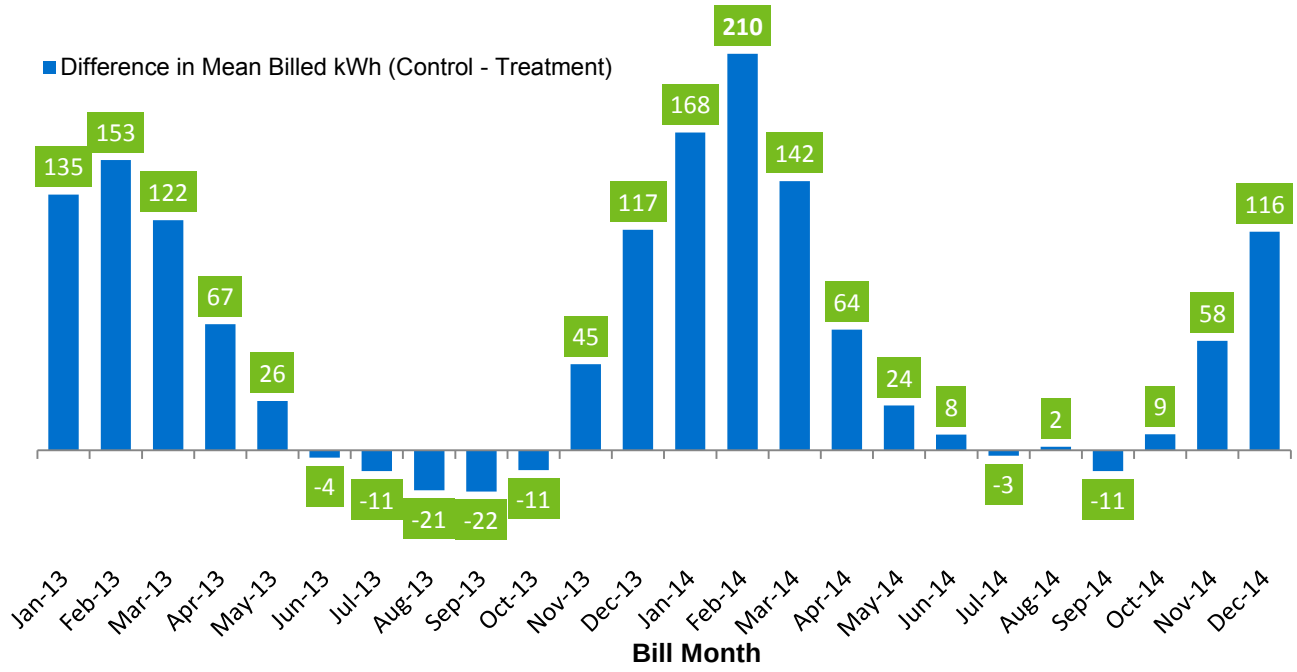
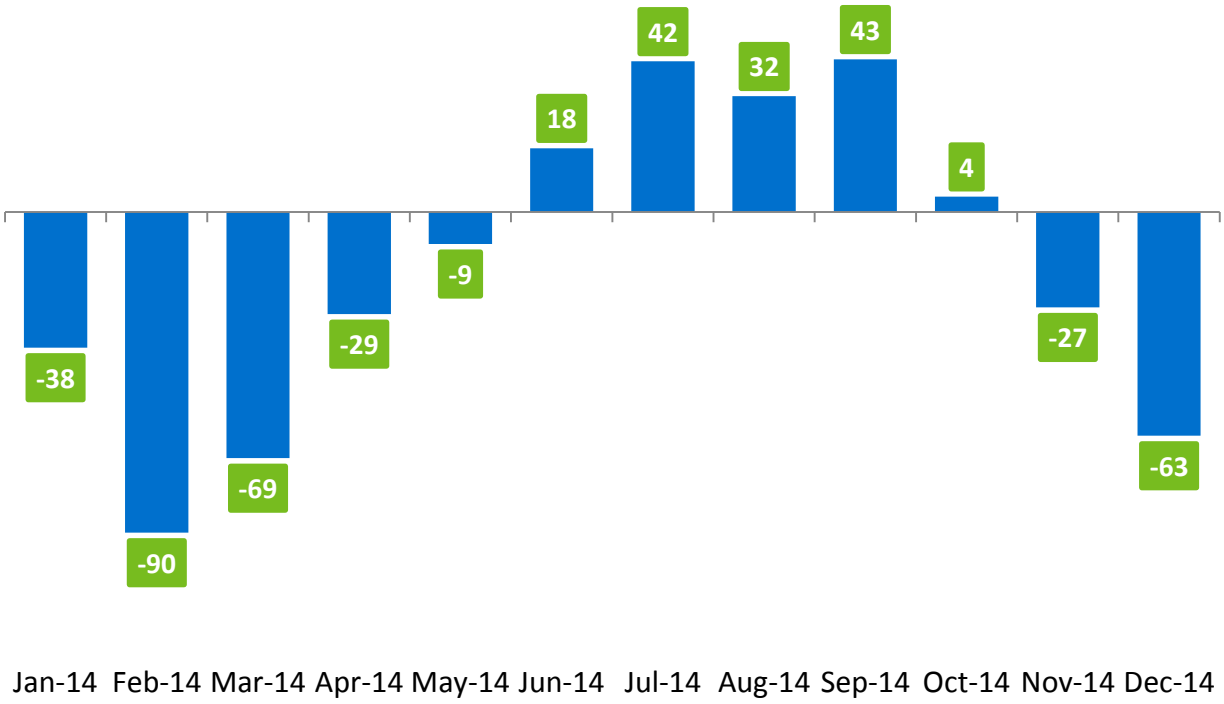


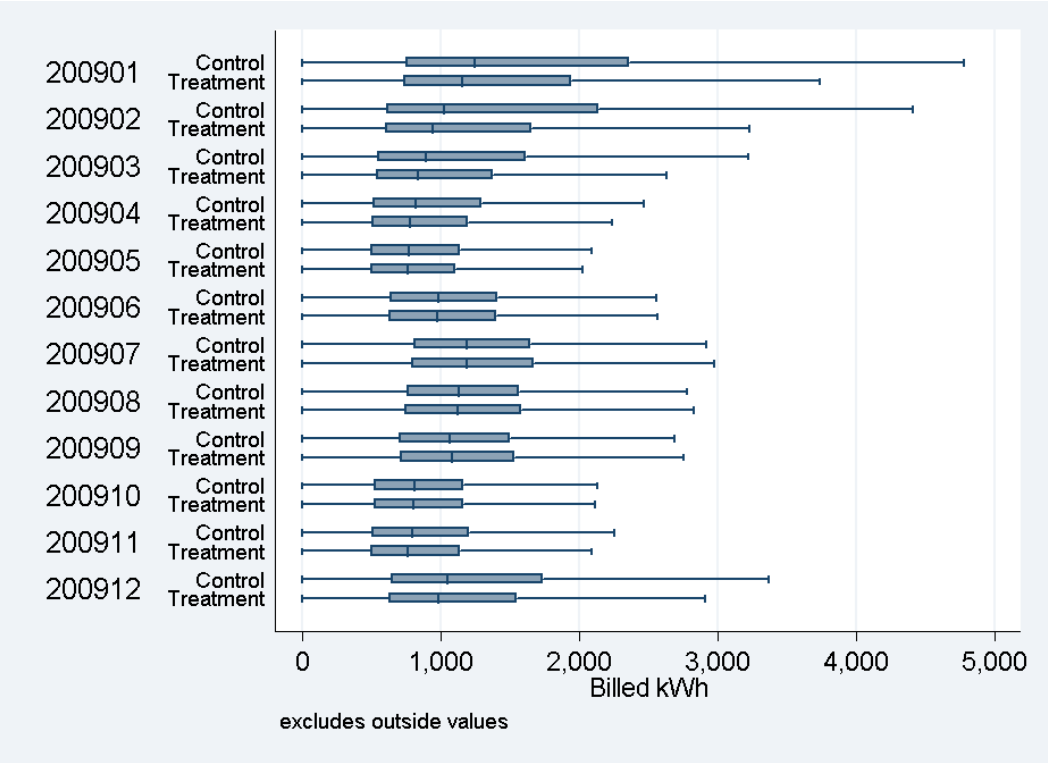
Figure 3-2 shows estimates of the MyHER impacts for each bill month in 2014 using linear fixed-effects regression for the entire MyHER Ohio treatment and control group. These results further indicate seasonal differences in electricity consumption patterns between the groups. While the annual savings estimate of 184 kWh per home produced by this approach is plausible, the distribution of impacts across the year is counterintuitive and suggests the annual impact estimate may be unreliable due to influence from preexisting differences between the two groups.

Figure 3-2: 2014 Monthly Impact Estimates (kWh), via Pooled Regression



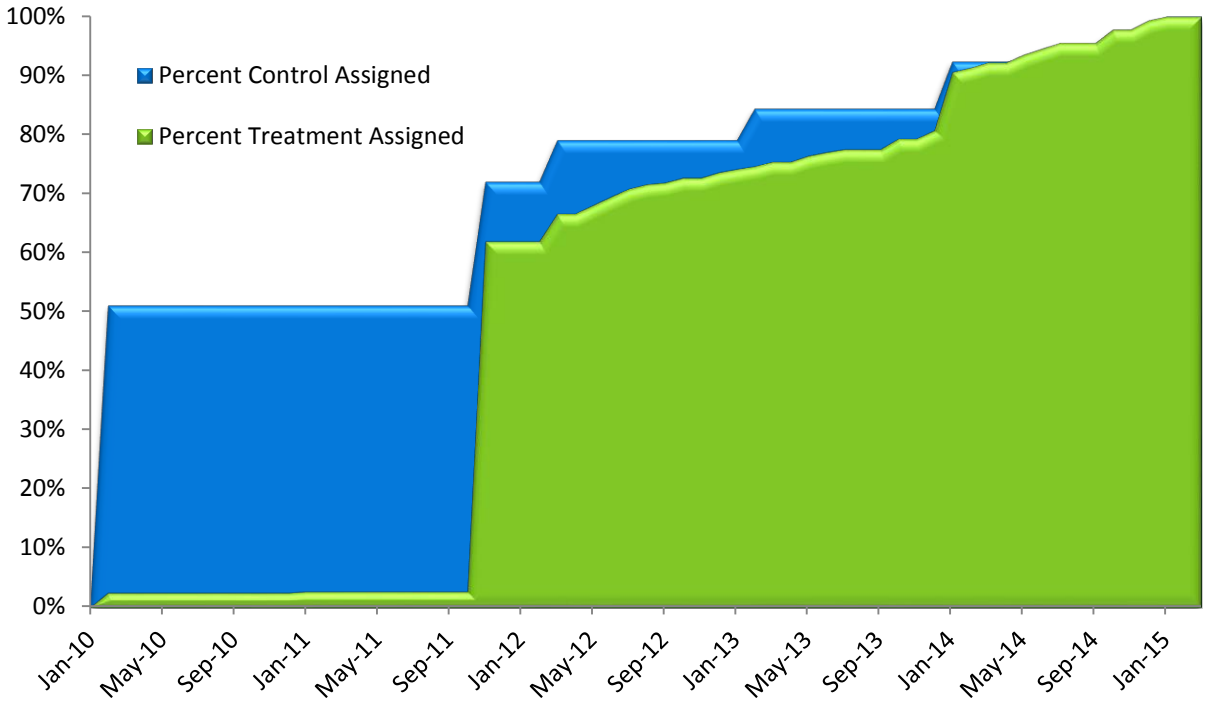
Given the results of these initial diagnostics, Nexant analyzed the consumption patterns of the MyHER treatment and control groups prior to assignment. Figure 3-3 displays a boxplot comparing the 2009 billed kWh usage of MyHER accounts that would later be assigned to the treatment and control groups. No customer had yet received a MyHER during 2009. The blue box in the middle of each plot marks the 25th to 75th percentile of monthly usage (the interquartile range). The dark line in the middle of this box is the median value. The 'whiskers' on either end of the box extend 1.5 times the length of the interquartile range, or to the most extreme observations. This graph indicates that the accounts who would later be assigned to the control group used more electricity in the winter months than the accounts who would later be assigned to the treatment group.

Figure 3-3: Boxplot of 2009 Monthly Consumption by Group



Nexant believes this seasonal difference between the treatment and control group arose through assignment of customers to both groups at different periods of time. This pattern of assignment introduces temporal variation which is likely confounded by changes to program eligibility rules and the difficulty of enforcing program eligibility rules with available demographic data. Figure 3-4 shows a timeline of assignment to the MyHER treatment and control group since program inception in 2010. The area under the curve represents the cumulative percentage of the total number of homes that have been assigned to the program by a given month. What is so striking about Figure 3-4 is how different the curves look for the treatment and control group. Over half of the homes assigned to the MyHER control group to date were added in February 2010 as part of the original pilot. The majority of the treatment group was added approximately 18 months later. While assignments to treatment and control at any single point in time were random, the disproportionate assignment of customers to one group or the other over time may have resulted in time-dependent differences in consumption patterns between the two groups.

Figure 3-4: Timeline of Assignments to Treatment and Control



These differences make analysis via a pooled model that combines all treatment and control group homes problematic, as evidenced by the results shown in Figure 3-2. Nexant concluded that the best approach to develop reliable estimates of the MyHER treatment effect was to parse the MyHER population into a series of subgroups, or cohorts, that were assigned at similar times and consider the impacts of each cohort separately.

If we define a cohort as a group of accounts that are added to the program (either to treatment or control) at a given time, the MyHER Ohio program would have many cohorts as new batches of homes have been assigned almost every month since 2012. At times homes were even assigned to treatment without a corresponding assignment to control. This is a practice which should be strictly avoided in any future assignment. It is impossible to statistically analyze the differences between so many groups. Treatment and control groups should be assigned annually or semi-annually, and each assignment should contain both treatment and control group customers. Ideally, MyHER participants would be assigned in annual waves with sufficient control group customers to measure the treatment effect in each wave.

Nexant mapped the MyHER population into five cohorts on a temporal basis that generally follows the major periods when customers were assigned to treatment and control groups. Budget Bill accounts, which became eligible for MyHER in January 2014, were treated as a standalone cohort (i.e., were not treated as part of the 2013-2014 cohort).

This cohort has the highest average electric usage so its disproportionate representation in the two groups is one of the primary reasons for the observed differences in usage patterns

between the groups. The majority of the current treatment group was assigned in November 2011 when MyHER converted from a pilot to a full-scale program in Ohio. On average, these homes use less electricity than the cohort of homes from the 2010 pilot.

Figure 3-5 shows the MyHER cohorts and compares the relative size of each cohort as of December 2014. The homes assigned as part of the 2010 MyHER pilot represent 55% of the current control group, but only 2% of the current treatment group. This cohort has the highest average electric usage so its disproportionate representation in the two groups is one of the primary reasons for the observed differences in usage patterns between the groups. The majority of the current treatment group was assigned in November 2011 when MyHER converted from a pilot to a full-scale program in Ohio. On average, these homes use less electricity than the cohort of homes from the 2010 pilot.

Figure 3-5: Comparison of Treatment and Control Group Composition by Cohort

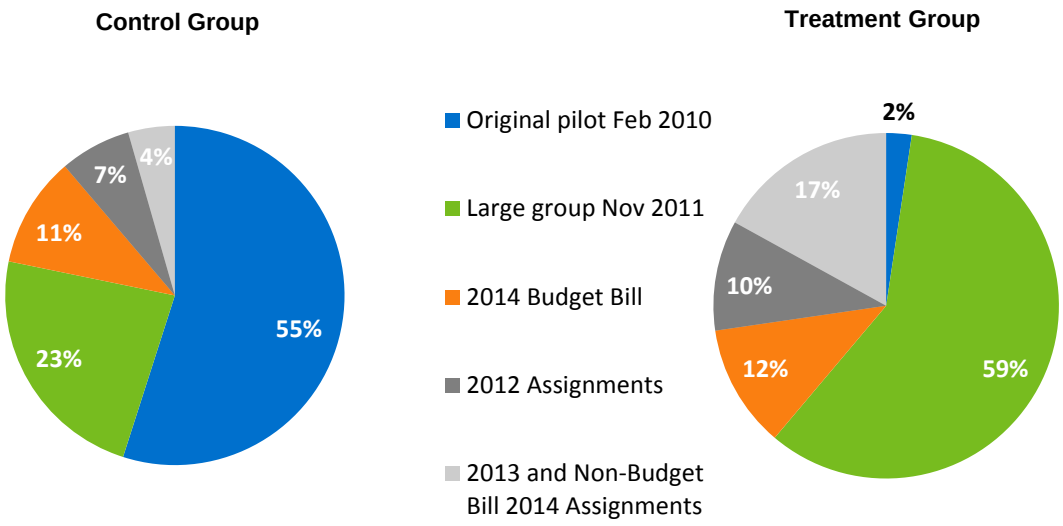


Table 3-2 provides additional summary information for each of the five cohorts. The “number of homes” columns reflect the number of active assigned customers during the December 2014 bill month without any filters applied for eligibility. Table 3-2 also compares the average annual kWh usage of each cohort’s treatment and control group for the 12 months prior to the beginning of assignment. The pre-assignment usage is relatively balanced between groups for cohorts 1, 2, and 3. Cohorts 4 and 5 show slightly higher usage for the treatment group.

Table 3-2: MyHER Cohort Summary Statistics

Cohort Number	Cohort Description	# Treatment Homes	# Control Homes	Annual kWh Pre-Assignment for Control Group	Annual kWh Pre-Assignment for Treatment Group	Pre-Period
1	Original pilot Feb. 2010	7,732	21,910	15,777	15,714	Feb-09 to Jan-10
2	Large group Nov. 2011	191,143	9,284	14,329	14,457	Nov-10 to Oct-11
3	2014 Budget Bill	37,504	4,205	13,592	13,439	Jan-13 to Dec-13
4	2012 Assignments	33,550	2,705	12,270	13,031	Mar-11 to Feb-12
5	2013 and Non-Budget Bill 2014 Assignments	55,244	1,774	11,521	12,380	Mar-12 to Feb-13

3.1.5 Regression Analysis

Separating the MyHER population into five distinct cohorts removed most of the differences in pre-assignment energy usage between the treatment and control groups. However, there are still some 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 these disparities, which were most noticeable in cohorts 4 and 5.

The basic form of the LFER model is shown in Equation 3-1. Average daily electric 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-level indicator variable:

Equation 3-1: Fixed Effects Model Specification

$$\mathrm{kWh_{ity}} = \mathrm{customer_i} * \beta_i + \sum_{t=1}^{12}\sum_{y=2009}^{2015} \mathrm{I_{ty}} * \beta_{ty} + \sum_{t=1}^{12}\sum_{y=2009}^{2015} \mathrm{I_{ty}} * \tau_{ty} * \mathrm{treatment_{ity}} + \varepsilon_{ity}$$

Table 3-3 provides additional information about the terms and coefficients in Equation 3-1.

Table 3-3: 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 five cohorts of MyHER accounts. Detailed regression output can be found in Appendix C. 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 bill month. Table 3-4 illustrates the calculation of monthly impact estimates from the regression model coefficients for homes assigned to treatment in the original MyHER pilot in 2010. 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 3-4: Impact Calculation Example – Cohort 1

Bill Month	Daily Treatment Coefficient (τ)	Monthly Impact (kWh)
2014 03	-0.0221659	-0.7
2014 04	-0.1577775	-4.8
2014 05	-0.7559144	-23.0
2014 06	-0.9643815	-29.4
2014 07	-0.7067365	-21.5
2014 08	-0.9874304	-30.1
2014 09	-0.2783146	-8.5
2014 10	-0.7281917	-22.2
2014 11	-1.069556	-32.6
2014 12	-1.009122	-30.7
2015 01	-1.353346	-41.2
2015 02	-1.188561	-36.2
12 Month Total Impact		**280.7**

Impact estimates from the five 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 3-1, 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 DEO energy efficiency offerings at a greater rate than control group homes. The primary purpose of the dual participation analysis is to quantify annual kWh 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 assumes the role of a trusted energy advisor with its customer base.

Although the energy savings from the incremental energy efficiency participation are netted out of the MyHER savings to prevent double-counting, this increased uptake is desirable for the company and should be leveraged as much as possible.

Duke EM&V staff provided Nexant with a table of non-MyHER program participation records for the MyHER treatment and control group homes dating back to January 2010. This dataset included nearly 600,000 records of efficient measure installations by the MyHER treatment and control group and formed the basis of Nexant's dual participation analysis. Table 3-5 shows the distribution of participation and savings across Duke's residential portfolio. CFL measures within the Smart Saver program dominated the savings distribution.

Table 3-5: EE Program Participation by MyHER Customers

Filed Program Name	Number of Records	Net MWh/year	Net kW/year
Smart Saver Residential	523,337	268,110	30,421
Residential Energy Assessments	21,366	14,417	1,820
Appliance Recycling Program	7,236	5,583	1,301
Energy Education Program for Schools	21,612	3,498	409
Low Income PWC Pilot	1,161	1,098	146
Home Energy Solutions	1,917	1,091	689
Low Income	4,951	859	232
Total	**581,580**	**294,655**	**35,018**

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

Table 3-6 shows the dual participation calculations, by bill month, for the homes assigned to MyHER in November 2011 (Cohort 2). Savings from energy efficiency measures climb steadily over time in both groups as additional efficient technologies are installed through Duke's residential energy efficiency portfolio. The treatment group's impacts increase at a slightly steeper rate, so the incremental energy savings subtracted from the MyHER treatment effect grows as a cohort's duration of exposure lengthens.

Table 3-6: Incremental Energy Efficiency Savings Calculations – Cohort 2

Bill Month	Mean Daily kWh Impact (Control)	Mean Daily kWh Impact (Treatment)	Incremental Daily kWh from EE (Treatment – Control)	Cumulative Uplift %	Incremental kWh Savings in Bill Month
201403	0.447	0.470	0.023	5.07%	0.691
201404	0.462	0.482	0.020	4.41%	0.619
201405	0.474	0.495	0.021	4.47%	0.645
201406	0.483	0.507	0.024	4.87%	0.716
201407	0.495	0.521	0.026	5.24%	0.789
201408	0.514	0.540	0.025	4.91%	0.769
201409	0.525	0.554	0.028	5.39%	0.862
201410	0.539	0.568	0.029	5.42%	0.888
201411	0.555	0.584	0.029	5.21%	0.880
201412	0.569	0.601	0.032	5.61%	0.973
201501	0.582	0.617	0.035	6.10%	1.080
201502	0.596	0.631	0.036	6.03%	1.093
12 Month Total					**10.004**

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 programs or initiatives. Duke provided Nexant with records of the exact messages received by each home in 2014 as well as primary messages for 2012 and 2013. Nexant used this information to study how the uplift in treatment group adoption of measures changed in months following promotional messaging in MyHER. Table 3-7 shows the number of homes that received each combination of messages for nine MyHER cycles.

Table 3-7: MyHER Promotional Messaging by Month

Source Month	Message1	Message2	Number of Homes
13-Dec	Appliance Recycling	Programmable Thermostat	232,567
13-Dec	Energy Vampires	Programmable Thermostat	1,852
14-Jan	Power Manager	Electric Blanket	261,680
14-Jan	Videos	Electric Blanket	24,589
14-Feb	Lighting Store	Wash Tips	284,035
14-Feb	Smart Saver	Wash Tips	2,353
14-Mar	My Select Rate	811 – Dial before you dig	71,111
14-Mar	Tune Up	811 – Dial before you dig	221,173
14-May	Giving Back	Dryer Lint	11,937
14-May	HEHC	Dryer Lint	279,293
14-Jun	Savings	Grill – Reduce heat from oven	255,026
14-Jun	Water Heater	Grill – Reduce heat from oven	31,052
14-Jul	Lighting Store	Energy Star Cooling System	187,470
14-Jul	Lighting Store	Wash tips	33,478
14-Jul	My Select Rate	Energy Star Cooling System	57,474
14-Jul	My Select Rate	Wash tips	11,663
14-Oct	Share Warmth	Thank you	283,477
14-Dec	HEHC	Doors & Windows	265,839
14-Dec	SS Ins & Seal	Doors & Windows	11,877

3.2 Impact Findings

3.2.1 Per-Home kWh and Percent Impacts

Nexant estimates the average participating MyHER home saved 256 kWh of electricity from March 2014 to February 2015. This represents a 1.9% reduction in total electric consumption, compared to the control group over the same period. These final estimates reflects 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 efficiency programs.

Table 3-8 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 3-8: MyHER Impact Estimates with ITT Adjustment

Bill Month	Treatment Homes Analyzed	DEO Participant Count	kWh impact in Assigned Homes	% Treated	kWh Impact in Treated Homes
2014 03	317,959	297,659	-25.3	93.6%	-27.0
2014 04	317,879	297,659	-20.5	93.6%	-21.9
2014 05	318,299	300,073	-17.3	94.3%	-18.3
2014 06	320,922	296,114	-12.4	92.3%	-13.4
2014 07	321,379	304,596	-10.5	94.8%	-11.1
2014 08	320,197	299,805	-15.3	93.6%	-16.3
2014 09	317,250	299,805	-14.4	94.5%	-15.2
2014 10	318,047	298,786	-22.4	93.9%	-23.8
2014 11	321,272	298,786	-24.3	93.0%	-26.2
2014 12	321,846	295,816	-21.0	91.9%	-22.8
2015 01	323,013	299,022	-27.2	92.6%	-29.4
2015 02	321,146	299,812	-37.5	93.4%	-40.1
12-Month Total			**-248.0**	**93.5%**	**-265.6**

An adjustment factor of 9.81 annual kWh per home is applied to MyHER impact estimate estimates in Table 3-8 to arrive at the final net verified program impact per home. 3.2.6 provides additional detail on the calculation of the 9.81 kWh adjustment for overlapping participation in other Duke EE programs.

Table 3-9: MyHER Impact Estimates with Adjustment for Dual Participation

kWh Savings in Treated Homes	Incremental kWh from EE Programs	Net MyHER Impact Estimate	Control Group Usage (kWh)	Percent Reduction
265.6	9.81	255.8	13,478	1.9%

The filed per-home impact for MyHER in Ohio is 220 kWh per home based on a previous evaluation study. The Nexant evaluation results amounts to a realization rate of 116%.

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 twelve month period examined by Nexant in this evaluation, MyHER participants conserved 76.4 GWh of electricity; or enough energy to power nearly 6,000 homes for an entire year. The aggregate impacts presented in Table 3-10 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 3-10: MyHER Aggregate Impacts

Bill Month	DEO Participant Count	Per Home kWh Savings	Aggregate GWh
2014 03	297,659	26.4	7.8
2014 04	297,659	21.3	6.4
2014 05	300,073	17.7	5.3
2014 06	296,114	12.7	3.8
2014 07	304,596	10.4	3.2
2014 08	299,805	15.6	4.7
2014 09	299,805	14.3	4.3
2014 10	298,786	22.9	6.8
2014 11	298,786	25.3	7.5
2014 12	295,816	21.9	6.5
2015 01	299,022	28.3	8.5
2015 02	299,812	39.1	11.7
12-Month Total		**255.8**	**76.4**

3.2.3 Precision of Findings

The margin of error of the per-home impact estimate is ± 35.2 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 3-11).

Table 3-11: 90% Confidence Intervals Associated with MyHER Impact Estimates

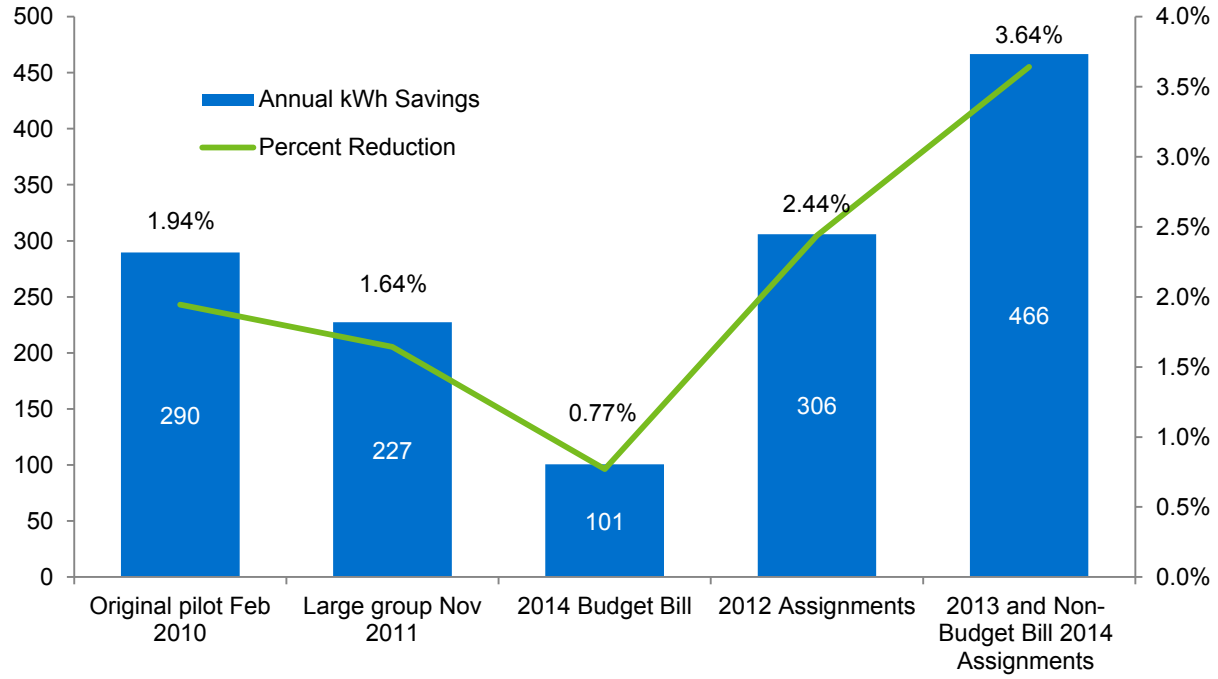
Parameter	Lower Bound (90%)	Point Estimate	Upper Bound (90%)
Annual Savings per Home	221 kWh	256 kWh	291 kWh
Percent Reduction	1.64%	1.90%	2.16%
Aggregate Impact	65.9 GWh	76.4 GWh	86.9 GWh

The absolute precision of the result is ± 0.26% and the relative precision of ± 13.8% at the 90% confidence level.

3.2.4 Impact Estimates by Cohort

The per-home impact estimates shown in Table 3-8 reflect a weighted average impact across the five cohorts of MyHER customers analyzed. The impact estimates for the individual cohorts varied significantly for the study period. Figure 3-6 shows point estimates for each cohort for the period March 2014 to February 2015 in both absolute (kWh) and percent impacts.

Figure 3-6: Annual kWh and Percent Impact Estimates by Cohort



The budget bill homes that were added to the MyHER program in January 2014 had the smallest impacts. These homes are relatively new to MyHER and will likely show increased responsiveness over time.

Cohorts 4 and 5 show the largest average impact during the study period in Figure 3-6, yet Table 3-2 shows these two cohorts also had the smallest control group sizes and the largest differences in pre-treatment usage between the treatment and control group. The small control group assignments and lack of rigid randomization since 2012 (other than the assignment of Budget Bill homes) increases uncertainty around estimates for these two cohorts. Table 3-12 shows the margin of error at the 90% confidence level for each cohort's annual impact estimate.

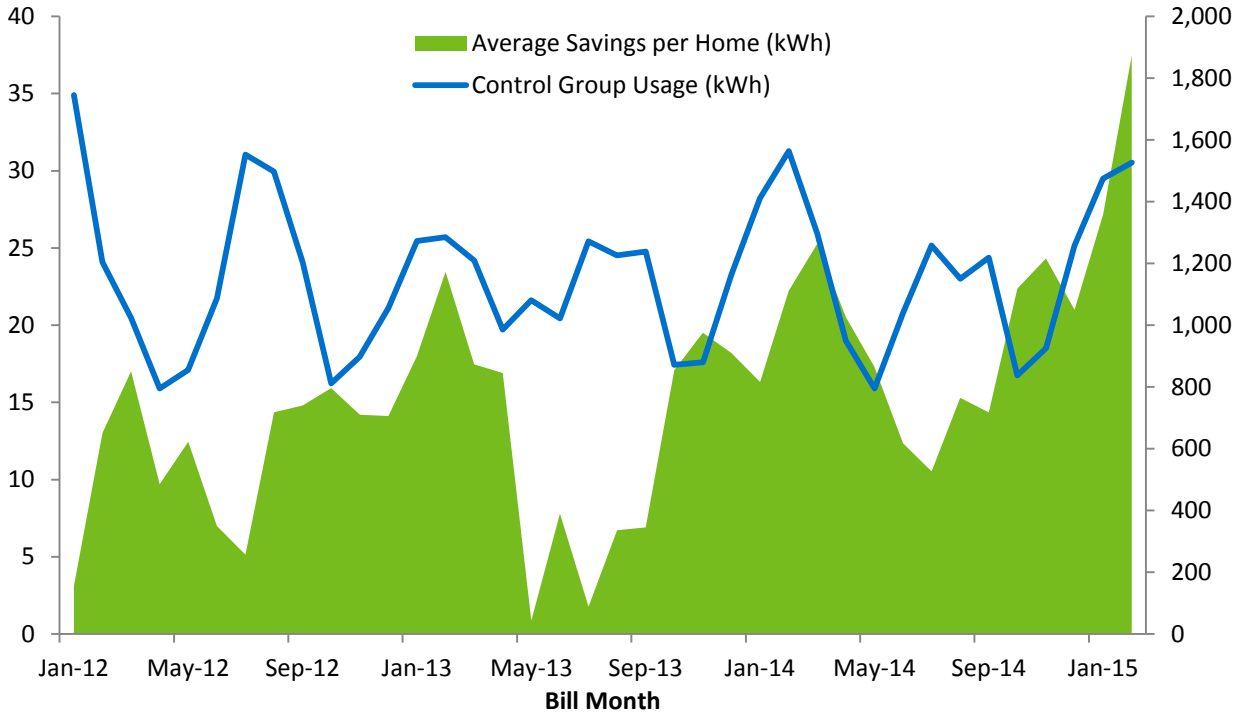
Table 3-12: 90% Confidence Intervals Associated with Cohort Estimates

Cohort Number	Cohort Description	Margin of Error in kWh at 90% Confidence Level
1	Original pilot Feb 2010	± 68
2	Large group Nov 2011	± 47
3	2014 Budget Bill	± 80
4	2012 Assignments	± 86
5	2013 and Non-Budget Bill 2014 Assignments	± 105

3.2.5 Temporal Patterns

Duke Energy currently mails MyHER to the treatment group eight times per year. These mailers target the summer and winter months and skip the shoulder months. The green series in Figure 3-7 shows the average estimated monthly treatment effect for each bill month from January 2012 to February 2015. There is a definite seasonal pattern to the MyHER savings profile, with the largest impacts occurring during winter months and the smallest impacts occurring during summer months. Figure 3-7 also depicts the average monthly consumption of the control group with a blue line that is scaled on the secondary axis on the right side of the plot.

Figure 3-7: Average kWh Savings by Month 2012-2015



Based on the observed savings trends, MyHER is actually performing quite well during shoulder months when Tendril does not mail. Even though usage is low (≈1,000 kWh per home per month), the treatment effect is still relatively strong at 15-20 kWh per home each month. Summer months are the more puzzling feature of Figure 3-7. Although consumption is high during summer months, MyHER produces the least kWh savings during these months. If Duke Energy wishes to explore the effect of changing the frequency or timing of MyHER delivery, Nexant recommends an experimental design where a portion of the treatment group is randomly selected to remain on the current delivery schedule and the remainder of the treatment homes is mailed to on an alternate schedule or frequency.

Figure 3-7 also displays a trend of gradual increases in savings. This result is consistent with many other HER evaluations across North America that have found a modest increase in savings as homes continue to receive HER messaging. Table 3-13 explores this result more explicitly for the cohorts 1 and 2. All of these homes have been treated since the beginning of

2012. The average treatment effect observed among these homes has increased noticeably each year.

Table 3-13: Increasing Effect of MyHER over Time

Year	Average Observed kWh Savings per Home	HDD (Base 65 F)	CDD (Base 65 F)
2012	110	4,199	1,439
2013	168	5,029	1,150
2014	220	5,438	1,077

Table 3-13 also provides the number of heating degree days (HDD) and cooling degree days (CDD) for each year observed in Cincinnati, Ohio. Consistent with the demonstrated increase in MyHER savings during winter months, it follows that a cold winter would achieve increased savings compared to a mild winter since the savings are correlated with consumption. Each summer in the 3-year period was milder than the year before, but since we have seen MyHER savings are smallest during the summer, this pattern likely has less of an effect on the total savings observed across the year than winter weather conditions.

3.2.6 Uplift in Other DEO 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 9.8 kWh per home, or 2.93 GWh in aggregate.

Table 3-14: Monthly Adjustment for Overlapping Participation in Other EE Programs

Bill Month	Incremental kWh from Other EE Programs
2014 03	0.64
2014 04	0.58
2014 05	0.61
2014 06	0.67
2014 07	0.76
2014 08	0.76
2014 09	0.86
2014 10	0.90
2014 11	0.89
2014 12	0.99
2015 01	1.07
2015 02	1.07
Incremental kWh from EE netted out of MyHER	**9.81**

Although these additional savings must be subtracted from the MyHER effect to prevent double-counting, the MyHER promotional messaging clearly played an important role in harvesting these savings.

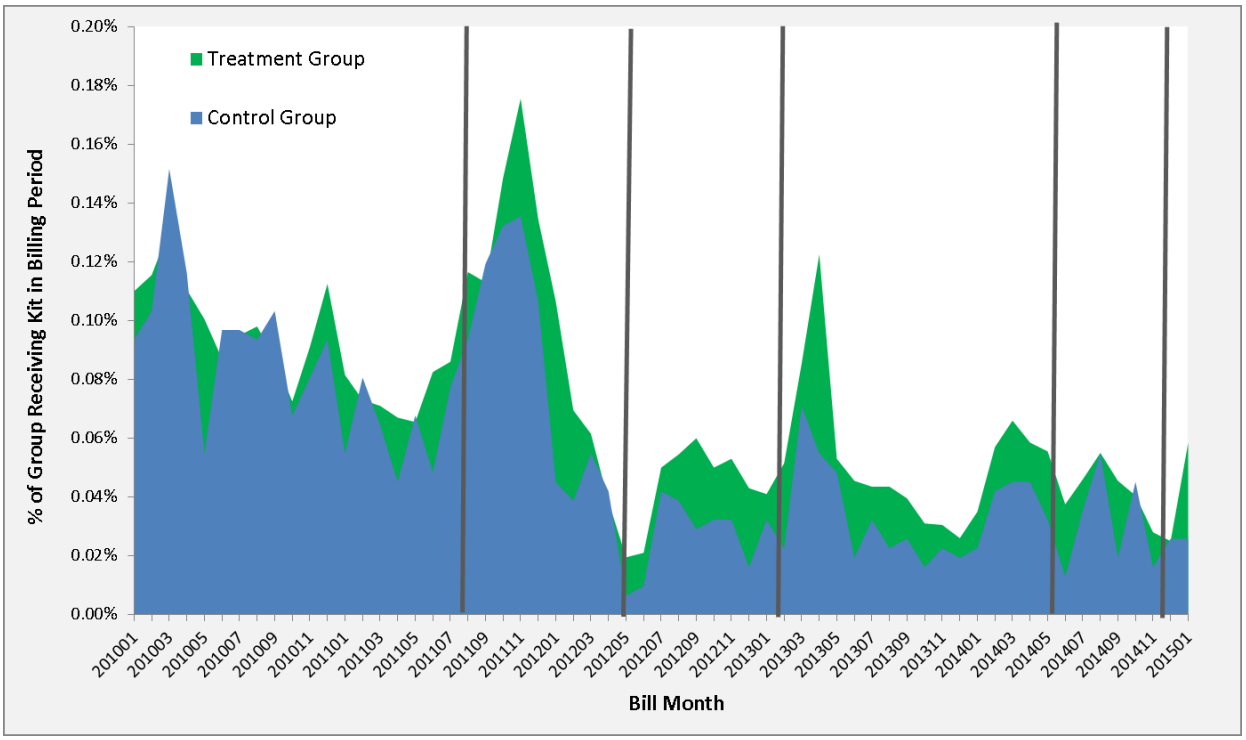
Table 3-15 shows the average daily energy savings attributable to tracked energy efficiency measures as of February 2015 by cohort and calculates an uplift percentage. In each case the treatment group showed a higher propensity to adopt measures through DEO programs than the control group. Nexant only counted savings for measures installed in the "post" period so the cohorts that have been assigned to MyHER for the longest period of time have accumulated the most savings. Cohort 1 was in the 'post' period during DEO's aggressive CFL campaign of 2010-2011 so both the treatment and control group have accumulated a significant quantity of tracked savings (≈ 700 kWh/year per home on average).

Table 3-15: Uplift Percentage by Cohort

Cohort	Cohort	Daily Net kWh Savings from EE (Treatment Group)	Daily Net kWh Savings from EE (Control Group)	Uplift Percentage
1	Original pilot Feb 2010	2.04	1.97	3.8%
2	Large group Nov 2011	0.63	0.60	6.0%
3	2014 Budget Bill	0.19	0.17	13.9%
4	2012 Assignments	0.43	0.42	2.9%
5	2013 and Non-Budget Bill 2014 Assignments	0.36	0.35	2.3%

Nexant also considered the uplift on a time-series basis to see if uplift rates were noticeably higher following the promotion of a program or measure in MyHER. Figure 3-8 shows the participation rate in the Home Energy House Call Kit measure over the last five years. Participation rate is defined as the number of homes receiving the measure divided by the total number of homes in the group. Home Energy House Call has been promoted five times in MyHER in this time period. The date of each promotional message is represented as a vertical line in the figure. There is a noticeable spike in the treatment group's adoption of the kit immediately following the inclusion of the MyHER promotion. In some cases the control group also shows increased adoption, indicating that Home Energy House Call was likely marketed via other channels as well during the same time period. However, the increased uptake in the treatment group is more pronounced.

Figure 3-8: Uplift in Home Energy House Call Participation Following MyHER Messaging



3.3 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. In fact, the average annual savings from MyHER has increased since the previous evaluation of the program in Ohio and shows consistent growth from year to year. Table 3-16 compares the Nexant evaluation result to HER evaluation findings from other utilities. DEO's MyHER program is achieving savings levels comparable to implementations of similar programs by neighboring utilities in the Midwest.

Table 3-16: Benchmarking Comparison of HER Impacts

Utility	Implementation Period	# of Treatment Customers	Annual kWh per Treated Home
Pennsylvania Power & Light	June 2012-May 2013	93,924	388
AEP Ohio*	2012	197,646	377
Puget Sound Energy	2013	40,000	325
Com-Ed	June 2010-May 2011	45,171	282
Indianapolis Power & Light Company	March 2012-February 2013	25,000	266
Duke Energy Ohio	**March 2014-February 2015**	**299,000**	**256**
Connexus Energy	March 2009-January 2010	40,000	229
Indiana Michigan Power	May 2012-December 2012	47,987	200
FirstEnergy Ohio**	2013	73,000	175
Ameren Illinois	August 2010-November 2011	198,494	159
Pacific Gas & Electric	2014	1,017,692	104
Duquesne Light	June 2012-May 2013	50,000	91

*This table is not intended as a formal comparison; a number of factors, specific to each utility, can influence the annual energy saving of Home Energy Reports (HER). For example, the AEP Ohio program targets high-use customers and the impacts reported are for the second year of the program (source: Navigant Consulting, Inc. 2013. Home Energy Reports Program, Program Year 2012 Evaluation Report. Prepared for AEP Ohio. 05/12/2013, Chicago).
**The FirstEnergy Ohio impact estimates are based on four months of performance data and extrapolated to a full year's savings. In addition, indications are that HER impacts grow over time, and this analysis was performed on the first four month of the program (source: ADM Associates. 2013. Home Performance Program Evaluation, Measurement, and Verification Report, 2013. Prepared for FirstEnergy Ohio Companies.

Although MyHER is achieving its primary target of delivering cost-effect savings to the company, and its secondary goal of promoting other DEO initiatives, Nexant provides the following conclusions and recommendations for consideration:

- ***The inconsistent assignment of homes to the MyHER treatment and control group over time has complicated the intended RCT experimental design.*** This issue complicates the impact analysis and increases uncertainty in the impact estimates for cohorts 4 and 5. In the future homes should always be assigned to the treatment group with a corresponding assignment of homes to the control group. Assignment of new accounts to the MyHER treatment and control group should be limited to once or twice per year.

- ***The cohort imbalances discussed in Section 3.1.4 result in a less precise estimate of the MyHER treatment effect than would be expected for an RCT given the DEO control group size.*** Nexant simulations indicate that with a control group of 40,000 homes like DEO currently has, the margin of error around the annual impact estimate at the 90% confidence level should be ± 24 kWh. This would equate to relative precision of 9.4% with a 256 kWh annual energy savings impact. However, the observed margin of error in Section 3.2.3 is ± 35 kWh and the relative precision of the impact estimate is ± 13.8% at the 90% confidence level.

- ***The primary reason the observed precision value was larger than the expected precision value is likely the surplus of control group homes from the 2010 pilot (Cohort 1)***. Table 3-2 showed that the ratio of control group homes to treatment homes is almost 3:1 for this cohort. Precision estimates are dominated by the size of the smaller of the two groups so having 22,000 control group homes in the cohort doesn't produce any more of an estimate than if this cohort had 8,000 control group homes, or the size of the Cohort 1 treatment group. DEO is essentially only getting the precision associated with a control group of 26,000 homes despite withholding treatment from 40,000 homes. Not exposing these 14,000 Cohort 1 control group homes to MyHER is producing no improvement in the precision of the program level estimate, so Nexant recommends releasing 2/3 of the Cohort 1 control group to treatment as the aggregate impact of the release would be an additional 3 GWh/year of savings.

4 Process Evaluation

This section presents the results of process evaluation activities including in-depth interviews with DEO 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. The process evaluation activities for MyHER sought to document program structure and operational processes and to understand the experience of those receiving MyHER mailings. MyHER is a maturing program, having been implemented in Duke Energy Ohio territory since 2011 after a successful pilot program in 2010. The evaluation team therefore focused on the customer survey, investigating the recall and influence of MyHER messages among recipients, the extent to which MyHER affects customer engagement with Duke, 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 awareness 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 (Table 4-1). In this protocol customers are first contacted by letter on Duke Energy stationary asking them to go online and complete the survey. The letter contained a two-dollar bill to assure recipients of the validity of the survey, a URL for the online survey, and a customer code that points the customer to a unique location 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. This email contained a link to the survey website at the location where they could complete it. After 10 working days customers who did not respond to the web survey received another letter, this time containing a hard copy of the survey and a return postage free envelope asking them to complete the survey by mail.

Table 4-1: Summary of Process Evaluation Activities

			Sample		Confidence/Precision	
Population	Approach	Population	Expected	Actual	Expected	Actual
Program management and implementation	In-depth interviews	~20	Up to 5	4	NA	--
Treatment households	Mixed mode; mail and web	~260,000	~189	228	90/06	90/06
Control group households	Mixed mode; mail and web	~38,000	~189	216	90/06	90/06

4.1.1.1 Interviews

Nexant conducted interviews with key contacts at Duke Energy Ohio and at Tendril. The interviews informed our understanding of the program operations and the main activities required to develop and mail the MyHER to DEO customers eight times a year.

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 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 nearly 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 efficiency options
- Inclination to seek information on managing household energy use from Duke Energy

This survey approach is consistent with the RCT design basis of the program and supports both the impact and process evaluation activities by providing additional insight into potential program effects.

Survey Dispositions

We mailed 550 letters to randomly selected residential customers in both the treatment and control groups. The survey was completed by 228 treatment households and 216 control households. Nearly identical portions of both populations completed the survey in each mode.

(Table 4-2) The response rate for the control group was 39%; for the treatment group the response rate was 42%.

Table 4-2: Survey Disposition

Mode	Treatment		Control	
	Count	Percent	Count	Percent
Completes				
Web-based Survey URL	125	55%	121	56%
Mail/Paper Survey	89	39%	82	38%
In-bound Phone	14	6%	13	6%
Total Completes	**228**	**100.00%**	**216**	**100.00%**

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

Staffing & Coordination

MyHER is managed primarily through a core team of three Duke Energy staff members: a Behavioral Program Manager with oversight of both residential and nonresidential 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 that occur at Duke and to support the contracted implementation team.

At Tendril, MyHER is supported by a team of people including an Operations Manager, a Home Energy Report Product Manager, and an Account Manager responsible for ensuring that the Duke MyHER products meet expectations for quality, timing, and customer satisfaction. Tendril staff track the number of reports sent, the quality of the reports, the timing of reports, and indications of customer satisfaction.

Staff at both organizations described continuous, close coordination to ensure that the data behind the MyHER graphs is accurate, the tips provided to specific households are appropriate, and that the HER is delivered within the relatively short timeframe between bills.

MyHERs are mailed out eight times a year, with a gap in March, May, October and December.[4] Duke Energy settled on this schedule based on experiences in prior years. When MyHER was piloted, treatment homes received reports every month, which was expensive. Quarterly reports seemed to be too few, and behavioral response impacts appeared to subside between mailings. Thus, the program settled on eight mailings a year. In spring 2015, MyHER introduced a web

[4] Based on the 2015 message calendar.

portal component. This portal provides an opportunity for participants to log in and set and track goals and access an "expert" for advice or questions. The web portal did not replace mailed reports, as concerns about persistence and effects on program impacts prevent staff from moving toward emailed reports.[5]

In 2012, Duke developed an Operations Playbook to support the management and operational success of MyHER. This document also set expectations for Tendril, who was new to the Duke program in 2012. The Operations Playbook continues to serve as a basic reference for major activities and responsibilities associated with MyHER. The document outlines substantial data handling tasks required to successfully develop and deliver customized and timely reports to approximately 300,000 Ohio customers.

Staff at both organizations report program operations had largely stabilized by 2014, after several years working together. Home Energy Report programs inherently involve data tracking and cleaning tasks, and the scale of Duke Energy's MyHER program requires extensive data handling infrastructure. When issues arise they tend to involve data errors or outliers that must be identified and resolved prior to mailing. Occasionally, issues with data will require adjustments by Tendril on the back-end. As these accumulate over time, the resulting process can become increasingly complicated. Staff at both organizations acknowledged that on-going tweaks and changes to the program can create challenges given the tight production schedule involved and the potential for process changes to have broad implications.

4.2.1.1 Data Cleaning and Transfer

Data transfer and cleaning activities are a major component of the MyHER program. These tasks generate report content and enable timely delivery. Tendril obtains data nightly via secure electronic transfer. These transfers include information on all residential customers based on bill end date, regardless of eligibility status. Ineligible homes (including control group homes) are filtered out by Tendril using a variety of flags provided by Duke and through their own mailing quality control process.

Clustering

Clustering describes the series of steps used to create the comparison "neighborhoods" on which comparison graphs are built. Prior evaluations of the MyHER program included recommendations to review this process and stabilize clusters so that the cluster sizes did not vary substantially month-to-month. Duke and Tendril worked to reduce the dynamic nature of cluster size. Alternative approaches to stabilizing clusters are being considered by Duke and Tendril; nevertheless, no major changes had been implemented as of June 2015.

The clustering mechanism is an important component of the program. When Tendril clusters accounts, it establishes an appropriate set of comparison homes using known pieces of household information, such as: bill date, home size, home age, fuel type, and location.

[5] Note that the web portal component was outside the scope of this process evaluation review.

Observed electricity consumption data for each home in a cluster is used to calculate an average value for each cluster as a whole. This value is then used to create comparison bar charts for individual homes—a central component of the MyHER norming effect. This calculation is used to assign households to efficient, average, or above average usage categories.

Cluster sizes can change as people move or become ineligible. The most common reason for a household to become ineligible is when updated information is obtained about a home. Updated information can come from residents who call to correct errors on their report and from refreshed data obtained from a third party data provider that results in reassignment of a home to an ineligible category (typically multifamily). Prior to 2014, Tendril procured refreshed home characteristic information annually, which would result in widespread re-clustering at a single point in time each year. In 2014 Tendril moved to a rolling process that procures updated information throughout the year, which means that while the clusters are re-adjusted regularly, the effect of each re-adjustment is smaller.

The number and size of these neighborhood clusters changes each month, reflecting the dynamic calculations and reclassification of residential customers. In 2014, Ohio had an average of 596 clusters per month, with an average of 497 homes in each cluster. The primary concern that emerges from re-clustering is the potential to create small neighborhoods: "odd duck" homes that appear to have few valid comparisons. MyHER implementation staff adjusted K-means, ranges of square footage, and sizes of homes trying to get rid of small neighborhoods, but found that these strategies created other issues in comparisons (for example, an age range that is too large to be comparable, or distance between average and efficient homes that appeared unattainable). Ultimately, program staff decided to lower the cluster threshold to 10, and withhold mailing MyHER to homes in clusters with fewer than 10 homes.

Other Accounts Not Mailed

While refreshing eligibility and status in a small "neighborhood" are common reasons a household in the treatment group might not receive a report, other accounts can be excluded from a given month's mailing. The reasons for exclusion include the following:

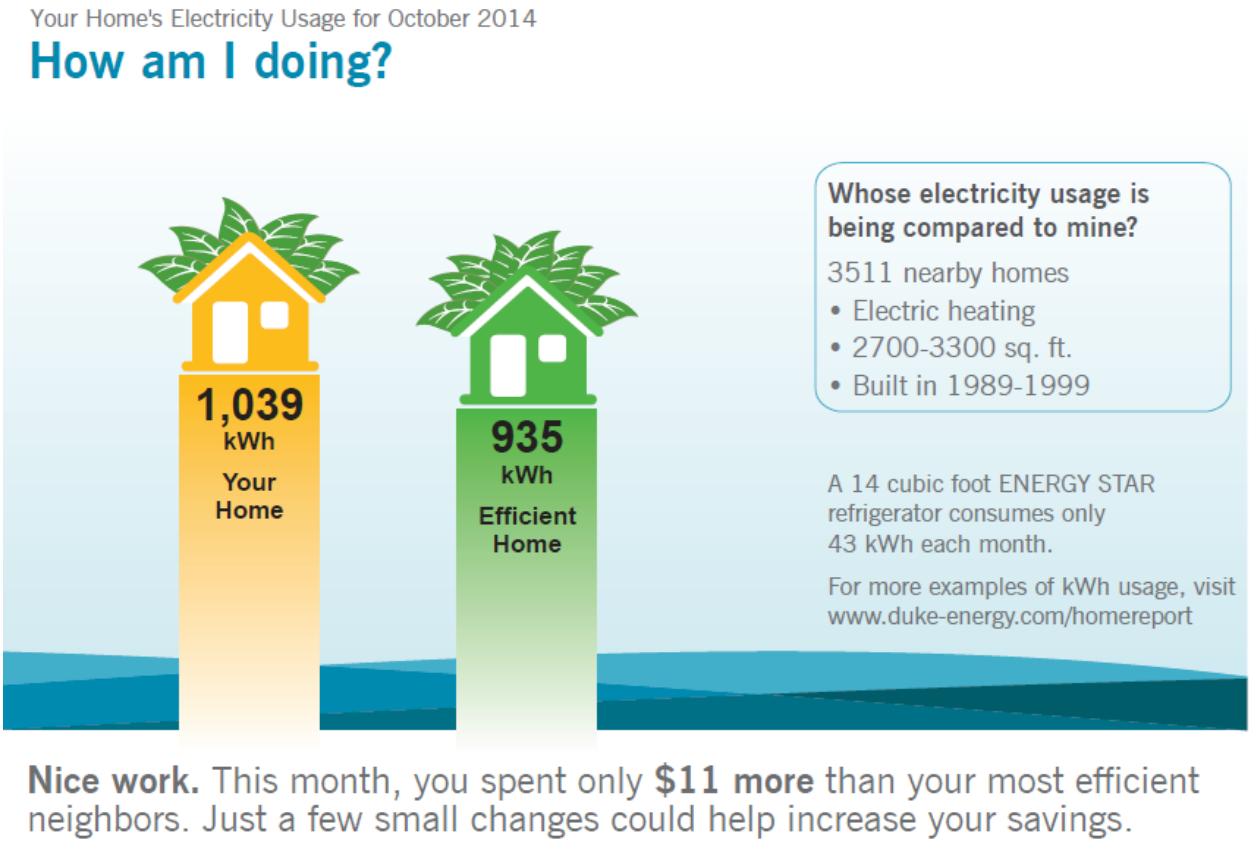
- Missing postal information. As part of the printing process, letters receive quality control scrutiny to ensure "postal hygiene." Letters without return addresses, with an error in the address, or with other missing information are pulled from the mailing.
- Missing or late billing data (including those missing billing dates). For a variety of reasons, billing data may not be available for every account in time to support the MyHER production and mailing schedule. Accounts without billing dates are excluded because Tendril cannot confirm if the home received their bill, if the bill was a few days late, or if the missing data is a simple processing error. Idiosyncrasies associated with billing cycles and how those cycles tie to the production schedule can also affect the number of accounts in "small neighborhoods" as those that had not received their bill at the point the HER is developed are excluded (potentially affecting the cluster size of the remaining accounts).

- Implausible bills. Bills indicating usage under 150 kWh or greater than 10,000 kWh are considered implausible, and likely to reflect an error. These homes are excluded from cluster calculations and do not receive a report.

4.2.1.2 Components of the MyHER

MyHER reports include several key elements that change each month: the bar chart, tips, trend chart, and messages. The front page includes a graph comparing the subject home to the average and most efficient homes for an assigned cluster or "neighborhood." Previously, 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 shifted to using kWh as the unit of measurement. Duke 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).

Figure 4-1: MyHER Electricity Usage Comparison Bar Chart

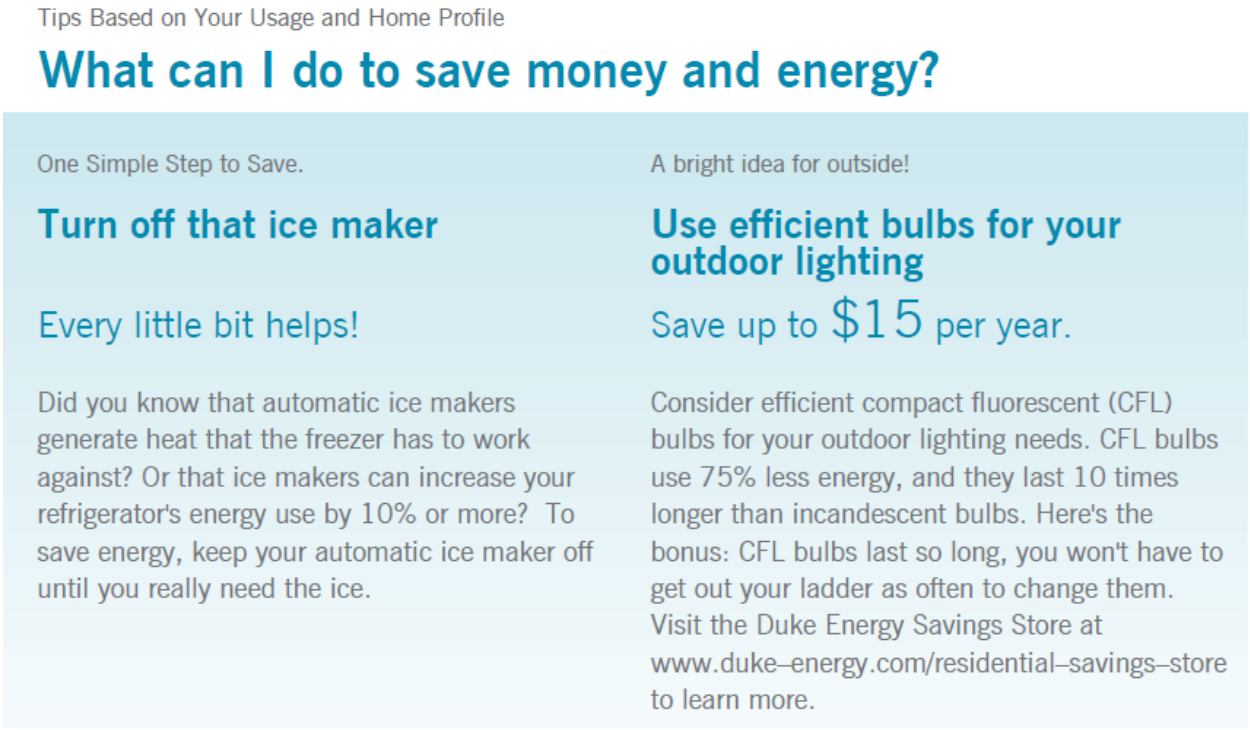


A small box next to the graph provides the size of the group of comparison homes, the assumed heating type, the approximate square footage, and the approximate age of similar homes. According to MyHER staff, a common reason for customer phone calls about MyHER is simply correcting assumed information about a given home. For example, the MyHER could indicate that Duke assumes a home has electric heat when it does not, or have a home in 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.

In addition to the comparison graph, each MyHER includes a set of customized tips under the heading “What can I do to save money and energy?” (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.

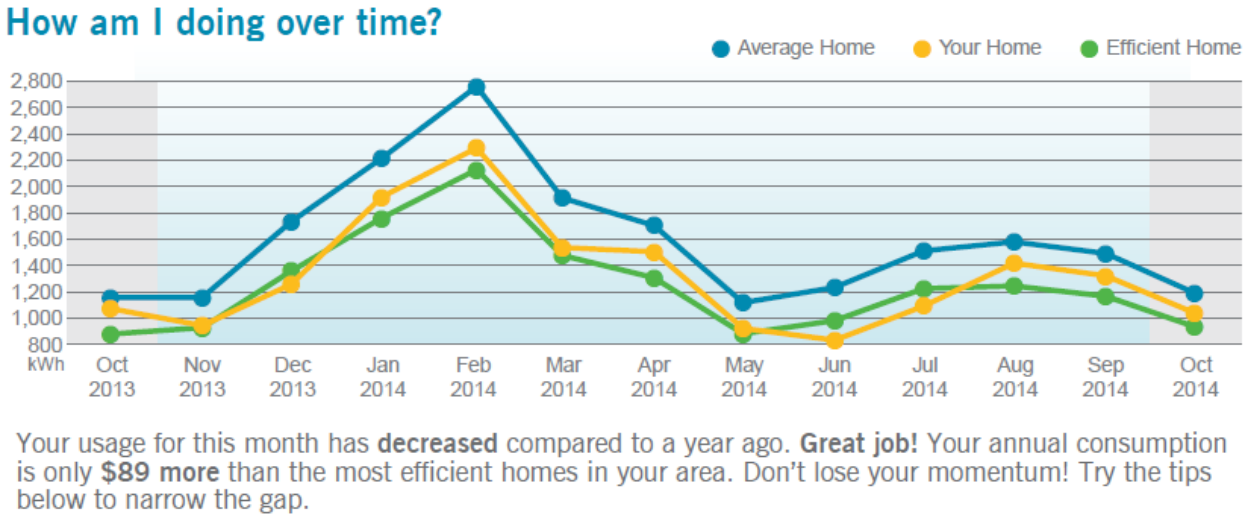
Figure 4-2: MyHER Tips on Saving Money and Energy



The left margin on the front page of each report contains elements consistent for all recipients: information about what the report does, why Duke is sending them to customers, and contact information (web and phone). Customers occasionally call with questions or concerns and, rarely, to opt-out. Program planning assumed opt-out rates would remain below 2%, in practice the opt-out rate has remained below 1% (Figure 2-1).

In addition, each MyHER includes 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



4.2.1.3 Messages: Free Form Text

Tendril's Home Energy Report product provides space on the back page for utility sponsors to include seasonal and programmatic messaging that reflects specific communication objectives for the utility as a whole. Ensuring that these messages are relevant and do not conflict with the actions or tips provided by Tendril on the front page is a continuous challenge. Occasionally the action text on the front page will be disabled to accommodate the free form text. These messages are developed annually in cooperation with the marketing and communications group. The schedule is maintained in a campaign calendar, which consists of a large spreadsheet organized by jurisdiction with primary and alternate messages for two content boxes. Duke Energy staff work 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).

According to one contact close to the process, the message calendar can be difficult to manage because of periodic changes to program promotions and incentive levels. A contact at Tendril confirmed this, noting 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. These changes can range from minor wording edits to wholesale content changes. Everyone involved recognized that this space is considered valuable real estate to Duke Energy and can require negotiations among program managers seeking to use it.

Message Targeting

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. 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.

4.2.2 Production Schedule

MyHER is guided by a report production calendar, a rolling thirteen month view of the expected production schedule, but the main focus is on meeting the program's monthly production schedule. Program contacts all mentioned the challenges associated with balancing a production schedule of approximately 20 days with the desire to ensure the best possible customer experience—specifically that customers receive a MyHER that reflects their most recent bill and avoids recommending an action/upgrade they have already done. MyHER incorporates the most recent and up-to-date information on customer electricity consumption and must be developed and delivered prior to customer receipt of a new bill—thus the production schedule pressures apply even to months following a break.

Table 4-3 presents a simplified process flow table illustrating the major steps involved and the expected timeframe. It is important to keep in mind the scale and volume at which this program operates. Tendril manages MyHER for four Duke Energy jurisdictions in five states with every batch. In 2014 this represented approximately 1.2 million customers every mailing, as the program ramped up further in 2015 this increased to approximately 2.2 million customers. Because the data transfers include ineligible and control group households, Tendril processes the energy usage data for nearly three million customers each mailing month.

Compression occurs in the production schedule due in part to the way the US Postal Service treats bulk mail delivery. Bulk mail does not have a guaranteed delivery date and can take up to 9 or 10 days to reach individual households. The delivery timeframe, combined with the time required for printing and postage, can take up to three calendar weeks, excluding the time required for quality assurance, data ingest, and filtering. This production schedule drives most of the day-to-day activities of Tendril's production and operations staff—unexpected delays in content approval, access to billing data, or quality assurance problems in printing or postal preparation can put the delivery schedule in jeopardy. Program staff look for ways to minimize the effects of potential delays, particularly for items that affect a small portion of the total MyHER treatment population.

Table 4-3: Production Process Flow and Timeframe[6]

Step #	Component	Time required	Description
1	Utility Data Transmission	~24 hours	Duke sends data files via secure file transfer that include: 1. Customer information 2. Historical billing information 3. Segmentation data
2	File Ingest and Customer Filtering	~24 hours	Files are ingested, customer records are filtered on documented eligibility criteria to refine the number of customers expected to receive HER.
3	Ingest into HER Platform	~5 hours	Filtered list of customers ingested into platform
4	3rd Party Data Append	~56 hours	Customer files are extracted and sent via secure file transfer to vendors providing segmentation and postal hygiene services and then ingested back into HER platform.
5	Additional Filtering and Customization	~60 hours	Records are further filtered by specified eligibility criteria to support customized messaging. When complete, print-ready PDFs are zipped and transmitted via secure file transfer to printing vendor
6	HER Proof Generation and Submission	~24 hours	Vendor pulls print ready PDF HER files from secure file transfer site and verifies the number of files. Applies barcodes preps for mailing. Provides digital print proofs for review and approval.
7	Proof Review and Approval		Digital print proofs are reviewed and approved.
8	Print Production	~48 hours (longer for batches over 250,000)	Upon approval, printing vendor releases print job into production that includes print, folding, and inserting into envelopes. HERs are provided to the USPS.
9	Delivery to Customer	2-9 days	HER reports are sent via USPS standard bulk.

4.2.3 Customer Surveys

The customer surveys included a section of questions focused specifically on the experience of and satisfaction with the information provided in MyHERs—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

[6] As reported in the My Home Energy Report Operations Playbook, September 2012.

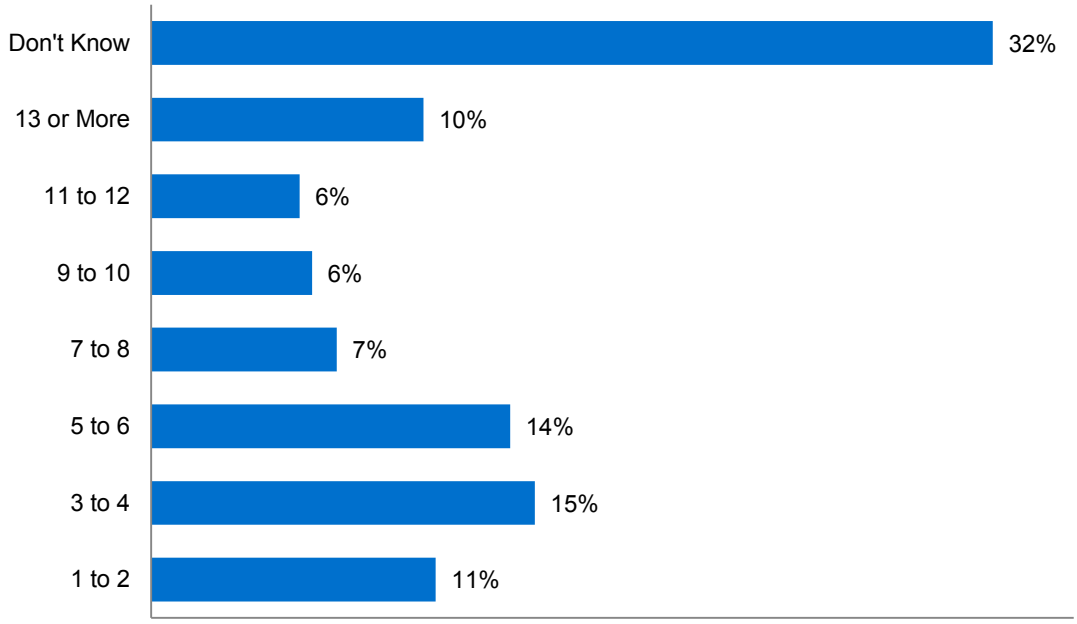
- Levels of awareness of and interest in household energy use; motivations and perceived importance
- Reported behavioral or equipment-based upgrades

4.2.3.1 Treatment Households: Experience and Satisfaction with MyHER

Nearly all of the treatment household respondents (93%) recalled receiving at least one of the MyHER reports.

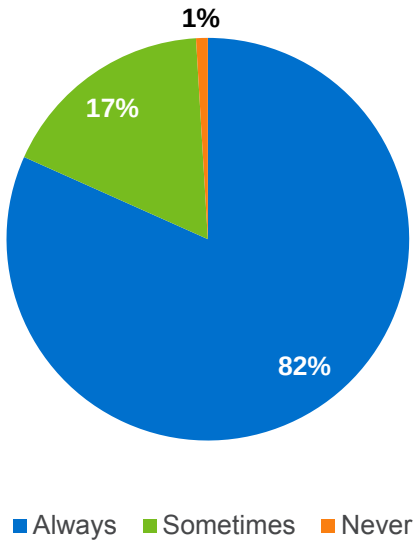
The survey asked MyHER recipients if they could recall how many individual MyHER reports they had received since January 2014 (Figure 4-4). The timing of survey deployment means that most recipients would have received 8-11 MyHER reports since January 2014. The distribution of responses related to recall 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 Since January 2014



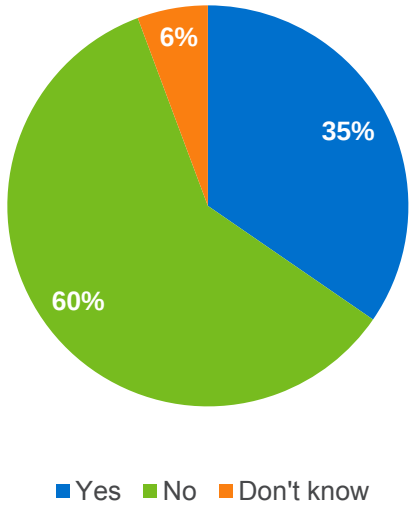
Survey respondents indicated high interest in the MyHER reports. As shown in Figure 4-5, when asked how often they read the reports, 82% of respondents indicated, “always,” while 17% indicated they “sometimes,” read the reports. Only three respondents indicated they do not read the reports.

Figure 4-5: How often customers report reading the MyHER (n=213)



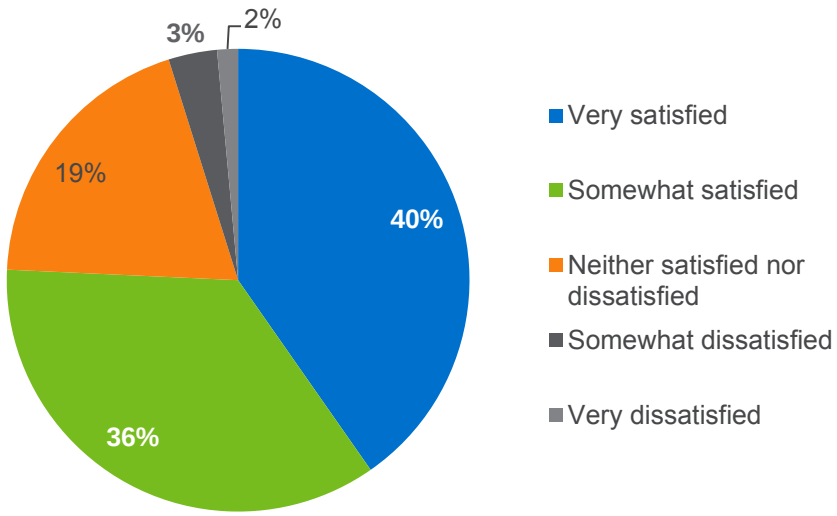
Despite this high "open rate" for MyHER reports, only 32% of survey respondents recalled specific tips from MyHER (Figure 4-6). The survey asked these 73 respondents to then provide an open-ended description of the specific tips they could recall. Despite a low overall tip recall, the recall rate of different messages is higher. The 73 respondents were able to recall 119 separate instances of MyHER tips. Nexant coded the open-ended responses and found that the most common tips customer remember include tips concerning high efficiency lighting, HVAC set points, switching off electricity-consuming products when not being used, sealing/insulating to reduce infiltration, upgrading to more efficient appliance/equipment, and unplugging devices when not in use.

Figure 4-6: Portion that recall specific tips or information (n=211)



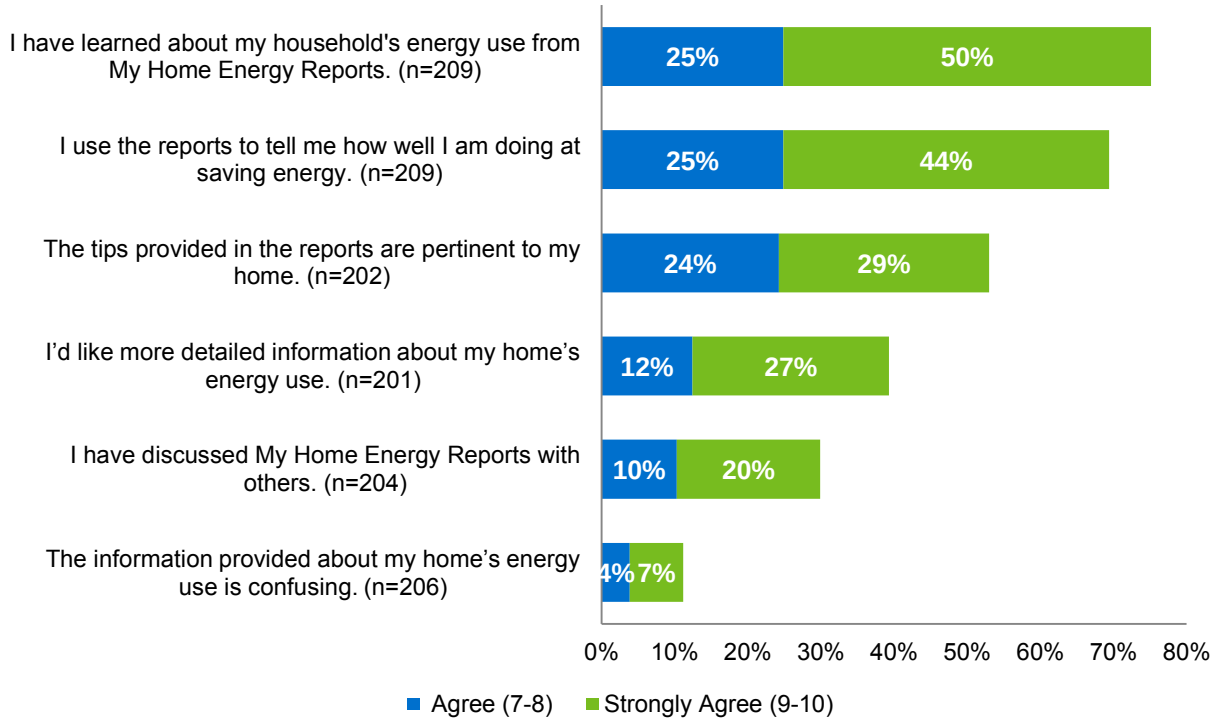
When asked to rate their satisfaction with the MyHER reports, 74% of those surveyed reported being “somewhat” or “very” satisfied with the information contained in the reports. The results of this question are reported in Figure 4-7.

Figure 4-7: Satisfaction with the information in MyHER reports (n=206)



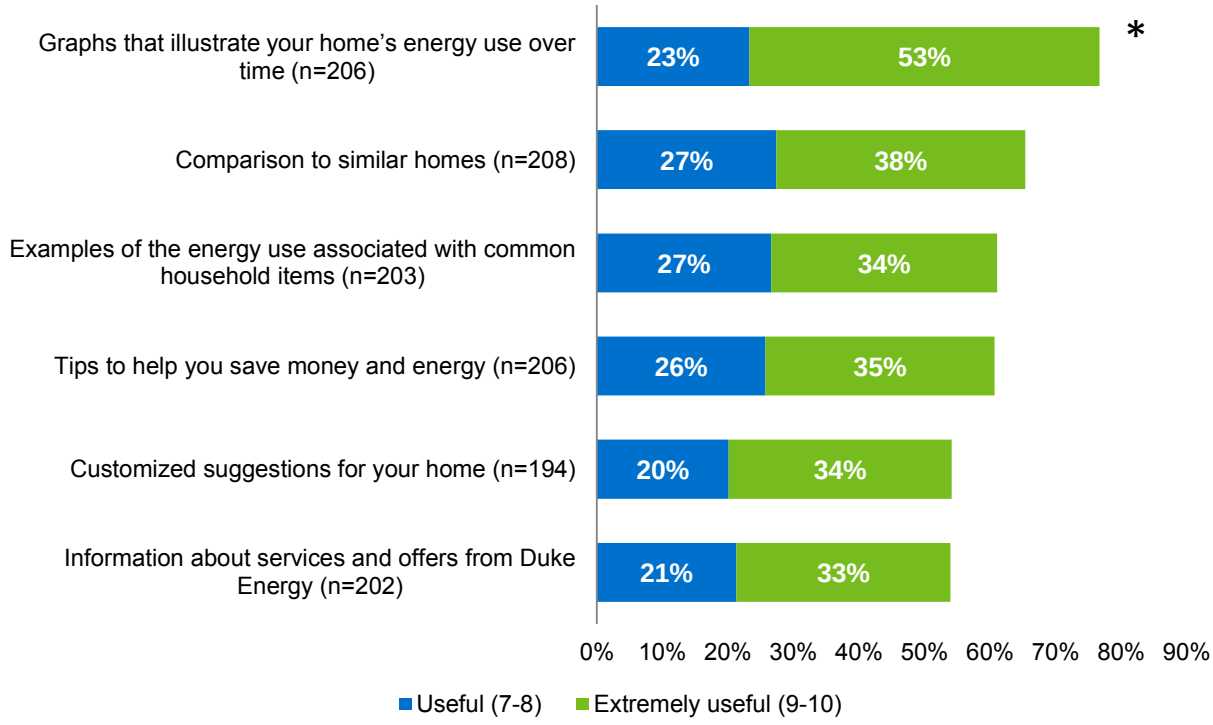
When asked to rate their agreement with a series of statements about MyHER on a scale of 0 to 10, recipients agreed strongly that the reports helped them understand their home’s energy use and that they use the report to gauge how successful they are at saving energy (Figure 4-8). Respondents indicated weak agreement that the tips provided in the reports suit their home, yet expressed only moderate desire for more detailed information about their home. The majority of survey respondents do not often discuss the MyHER report with others, nor do they believe the information contained in the reports is confusing.

Figure 4-8: Level of agreement with statements about MyHER (0-10 scale)



The results shown in Figure 4-9 illustrates that 76% of respondents rated the time series graphs of home energy consumption a seven or higher on a 0-10 point scale, indicating that treatment households found this feature highly useful, followed by 65% rating comparisons to similar homes as highly useful. Statistical comparisons of responses to this statement against the others indicates a high probability that respondents value the time series graphs over the other MyHER components, as indicated in Figure 4-9. Customized suggestions about how to save energy and information about Duke Energy services were rated lowest, receiving a seven or higher score from only 54%.

Figure 4-9: Please rate how useful each feature is to you.



*On a scale of 1-10 respondents rate the usefulness of time series graphs significantly more highly than comparison graphs, but both are highly rated.

The survey provided an open-ended question to elicit suggestions about potential improvements to MyHER. Among those that did not offer specific suggestions for improvement, 20 respondents took the opportunity to specifically mention enjoying the reports as they are and appreciating the information they receive. Only 20% of respondents offered suggestions for improvement. The most common request, mentioned by 19 of the 46 that offered 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 how that energy use changes hourly. The priming effect of receiving more detailed energy consumption information in graphical displays can be seen in requests that included:

- *"[Help me] understand the sources of energy consumption."*
- *"Break the graph down in to electric and gas components."*
- *"Include more daily detail and hourly data."*
- *"Possibly suggest reasons why my bill and usage is more than others around me, based on my model and year of my home."*

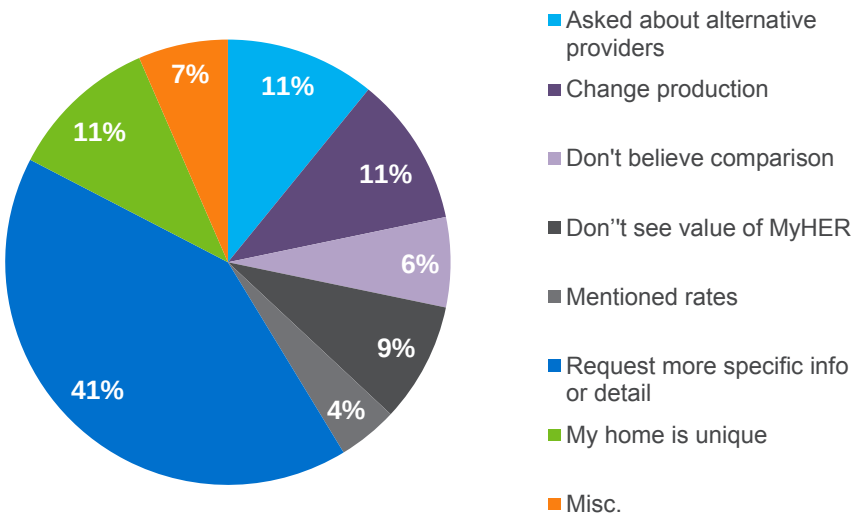
- *"Tell me what in my house is using the most energy."*
- *"Why is my house not closer to normal?"*
- *"I guess I need an energy audit.*

Other comments centered on unique features or occupancy patterns at respondent homes, disbelief in the relevance of comparison homes, and a few respondents that simply did not see the value. Responses coded as recommending production changes included a variety of different suggestions, including:

- *"What they put in it seems pretty useful to me. If they want to send it every two months just put with regular bill."*
- *"Maybe have a show on tv!"*
- *"Please stop printing in color! This is such a waste."*
- *"Shorter information the better"*
- *"I'm not color blind, but for someone who is -- there are different colors, yellow line, blue line -- someone who's color blind might not see it."*

Five respondents requested information on alternative energy providers and asked for help figuring out if these providers would save them money. Two mentioned rates and asked that they be lower. Nexant categorized these suggestions on the basis of their content; the results are presented in Figure 4-10.

Figure 4-10: Suggestions for Making MyHER more Useful



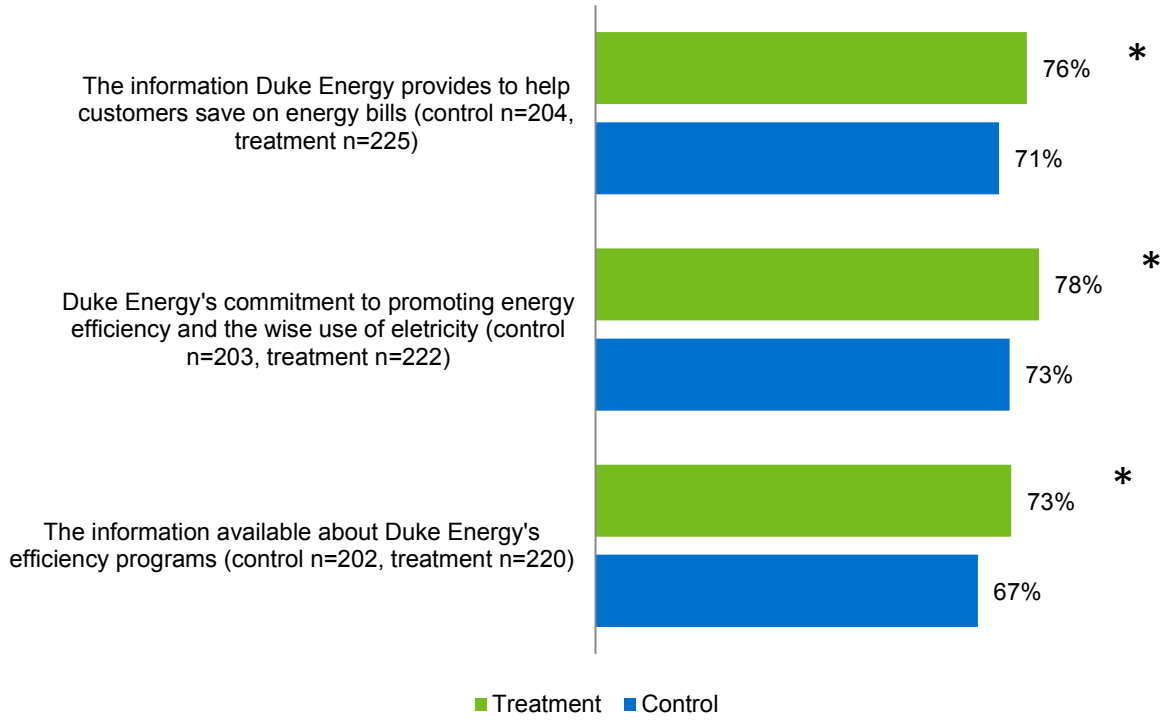
4.3 Comparing Treatment & Control Responses

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.

4.3.1 Perception of Duke Energy

The treatment group indicates that they are more satisfied with DEO energy efficiency efforts than the control group (Figure 4-11). Eighty percent of treatment customers are either somewhat or very satisfied with the information Duke Energy provides to help customers save on energy bills, compared to only 71% of control customers. Similarly, 83% of treatment customers are satisfied with Duke Energy's commitment to promoting energy efficiency while only 73% of control customers are satisfied in the same category. Seventy-nine percent of treatment customers and 67% of control customers are satisfied with the information available about Duke's Energy's efficiency programs.

Figure 4-11: Please rate your overall satisfaction with each of the following

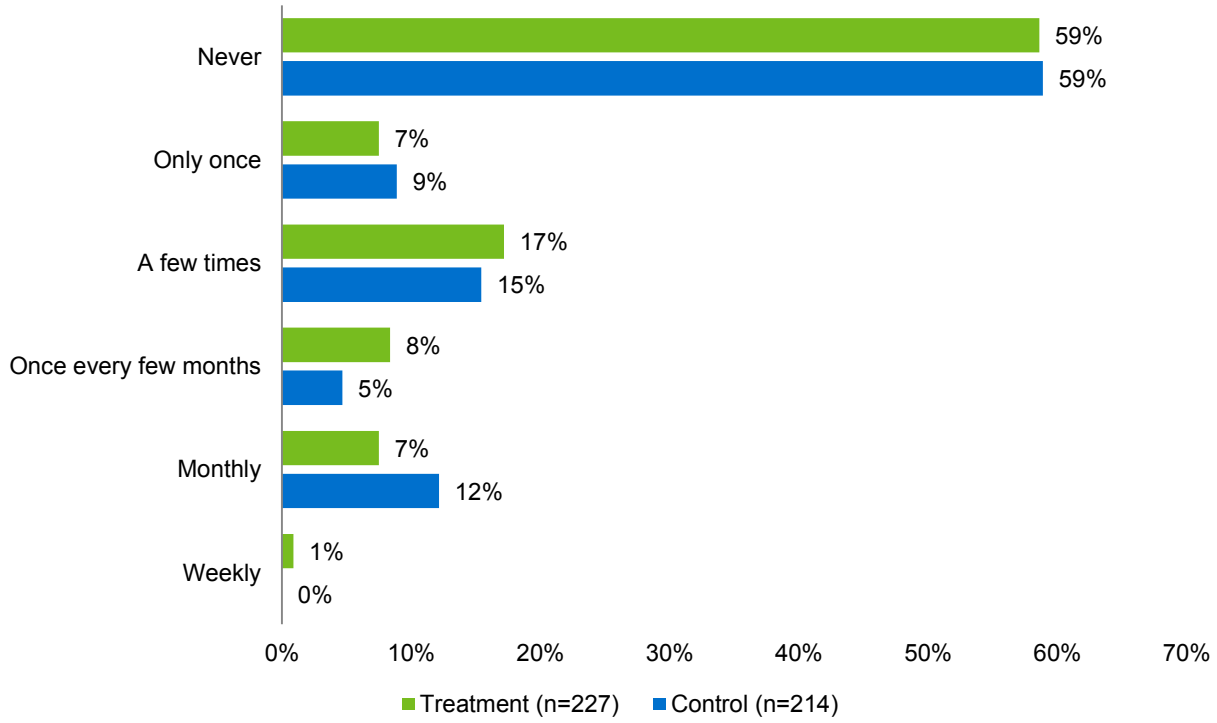


* The difference in reported satisfaction for the treatment and control groups is statistically significant (that is, very unlikely to have occurred by chance). P-value is < 0.01.

4.3.2 Engagement with Duke Energy Website

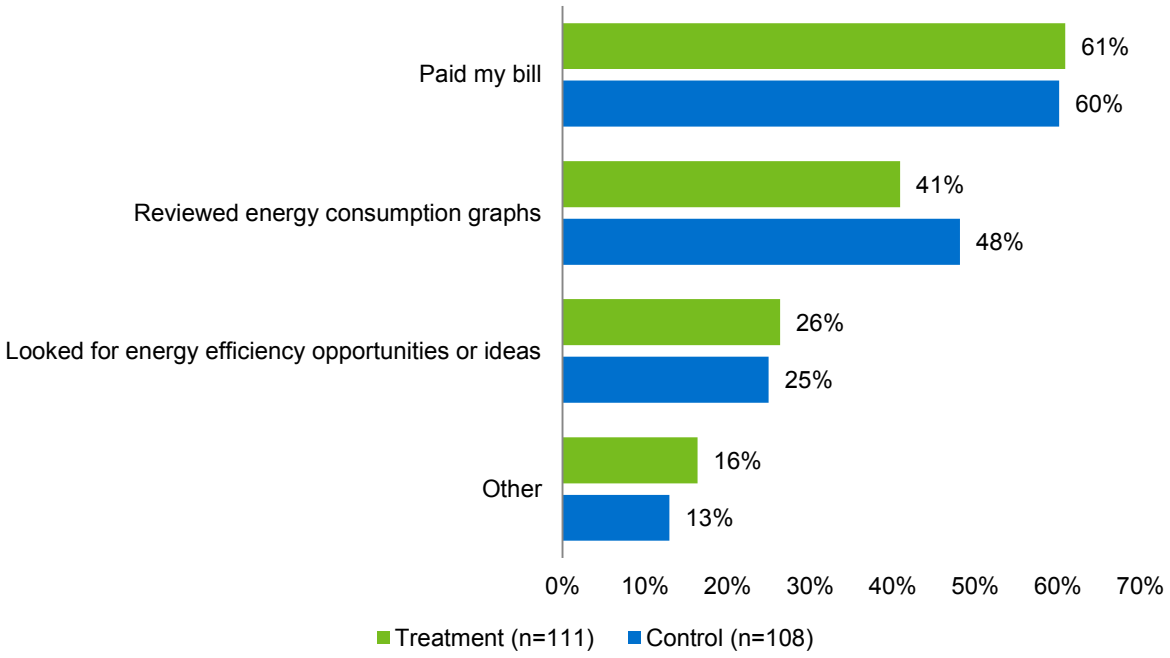
Treatment and control households rarely visit the DEO website to search for information. Results from a question concerning use of the Duke Energy website are presented below in Figure 4-12. Fifty-nine percent of respondents report that they have not visited the website in the past year, and an additional 7% of treatment and 9% of control customers report visiting only once.

Figure 4-12: Since January of 2014, about how often have you visited the Duke Energy website to search for information?



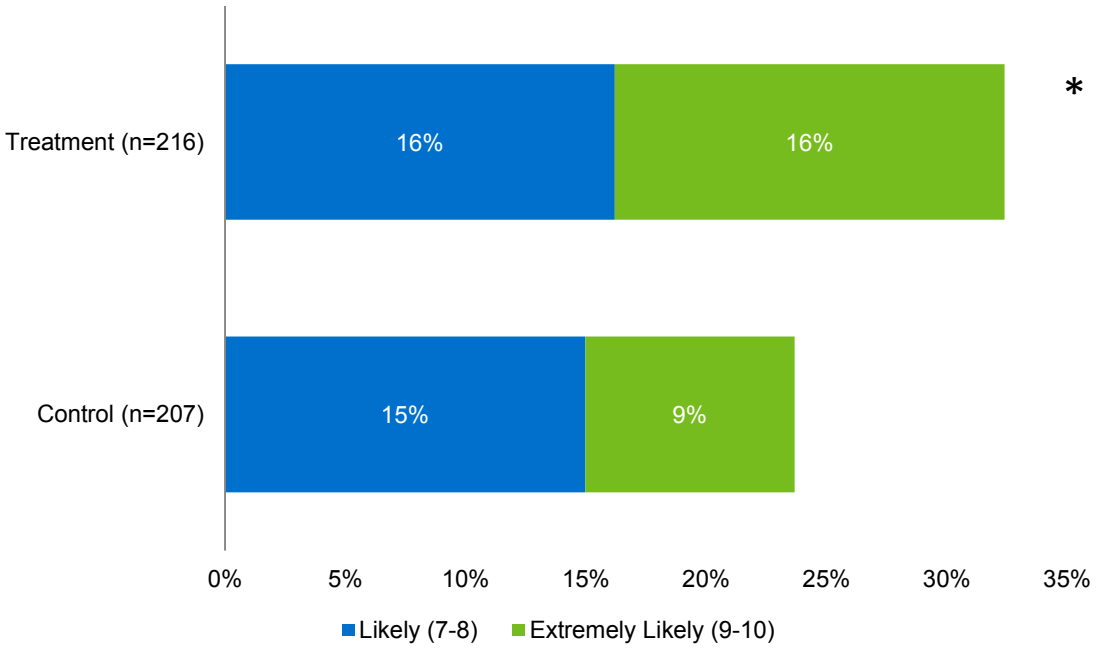
Further questions about online activity were asked of those customers indicating they visit the Duke Energy website, as shown below in Figure 4-13. Control customers were slightly more likely to report reviewing graphs of their energy consumption online. This could imply that treatment customers are already getting this information, perhaps from their MyHERs. Approximately 60% of both treatment and control customers indicated that they log on to their account to pay their bills.

Figure 4-13 When you logged into your Duke Energy online account, which of the following have you done?



The treatment group is significantly more likely to check the DEO website if they are considering energy efficiency improvements. As shown below in Figure 4-14, only 24% of control customers indicated that they were likely or extremely likely to visit the website under these circumstances, compared to 32% of treatment customers.

Figure 4-14: Likelihood of Checking DEO Website for Information about Energy Efficient Solutions or Incentives prior to Purchasing Major Household Equipment

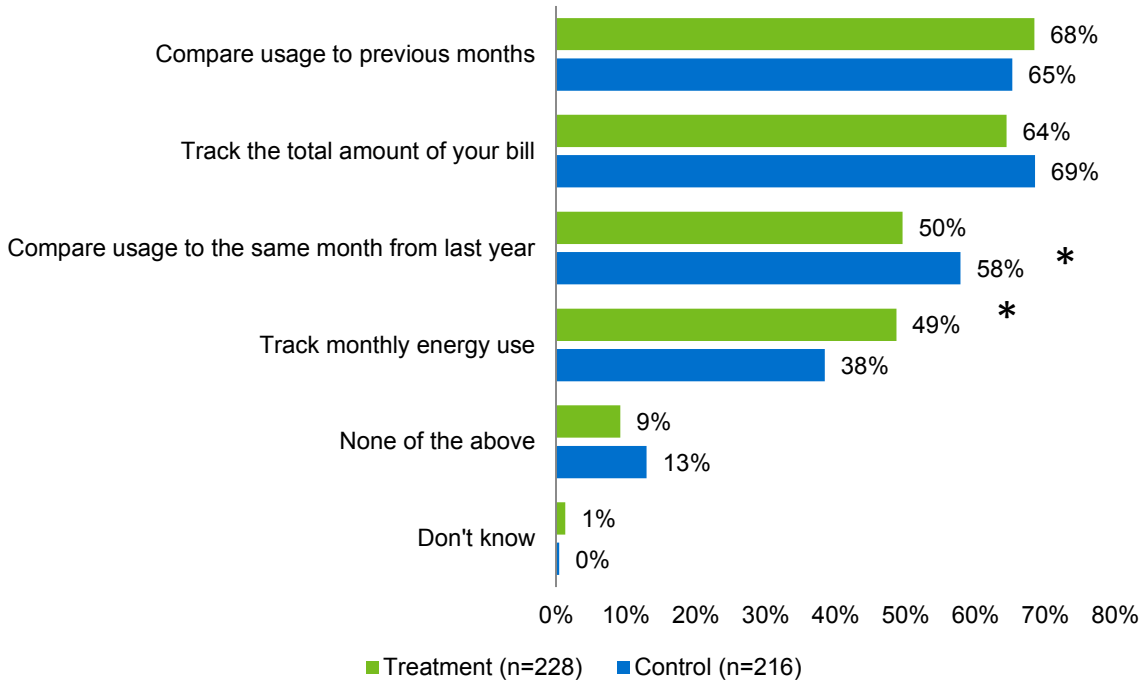


* P-value is 0.04 using test of proportions, indicating that the treatment group is significantly more likely to visit the website under these circumstances.

4.3.3 Reported Energy Saving Behaviors

Both groups of respondents report similar strategies for tracking household energy use. The treatment group was significantly more likely to track monthly energy use, but the control group was much more likely to compare a monthly bill to the same month from the previous year. Figure 4-15 depicts these results.

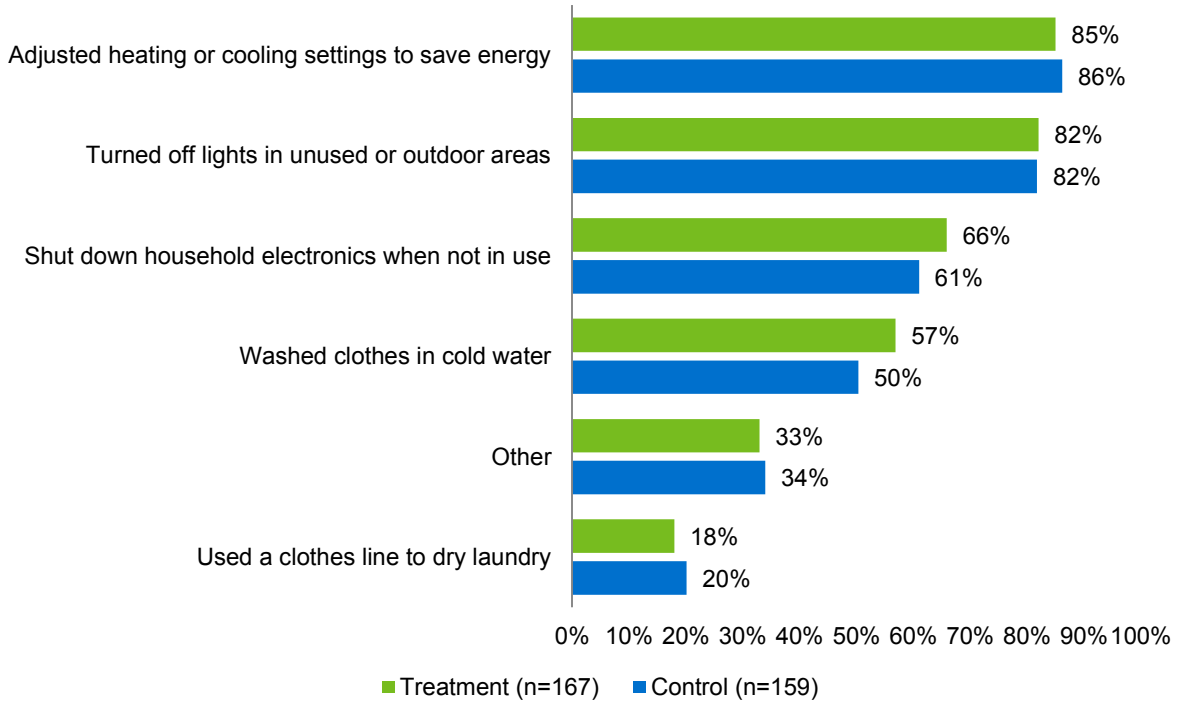
Figure 4-15: Which of the following do you do with regard to your household's energy use?



* P-values are 0.07 and 0.03 for the two actions highlighted above, indicating a significant difference between treatment and control.

Both groups reported similar levels of energy saving behaviors, as shown in Figure 4-16. The treatment group was only slightly more likely to shut down electronics when not in use and wash their clothes in cold water. Control customers were slightly more likely to adjust their thermostats to save energy.

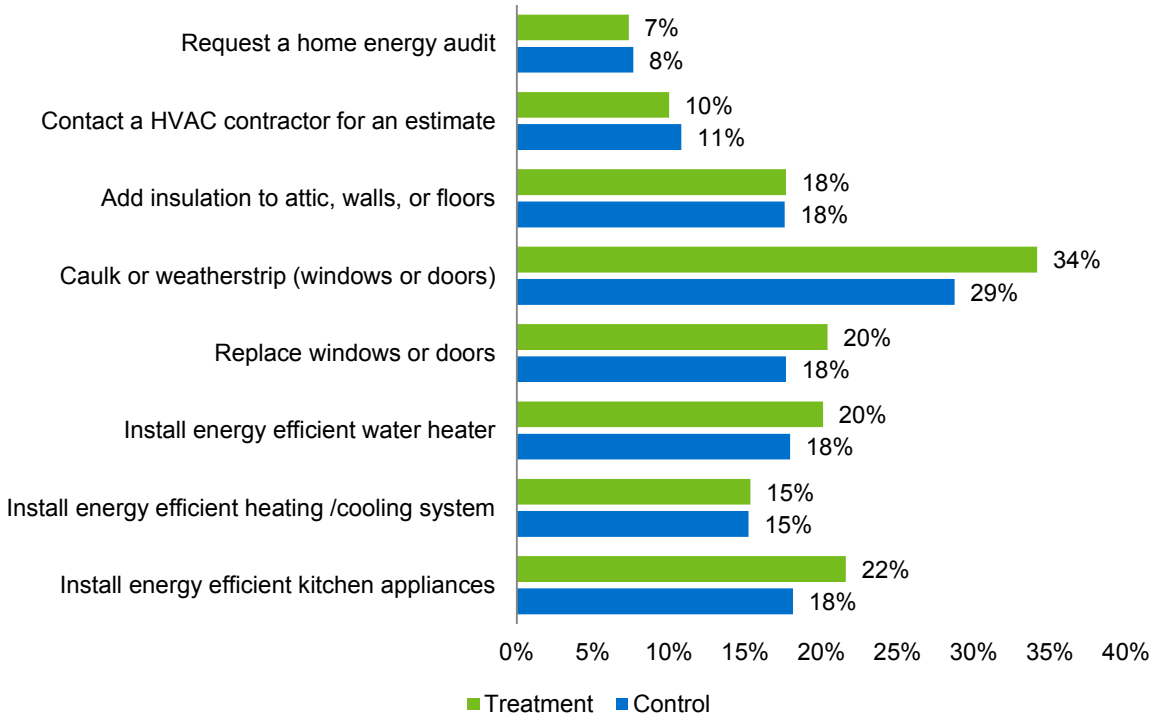
Figure 4-16: Reported Energy Saving Behaviors



4.3.4 Equipment Purchases: Past and Future Intention

The treatment group is more likely to report planned upgrades to their homes, but the differences in the two groups are not significant. The most likely upgrade amongst both groups is one that homeowners are most likely to be able to complete without help from a professional: caulking or weather-stripping windows and doors. This was followed by obtaining energy efficient kitchen appliances. The results from this question are shown in Figure 4-17.

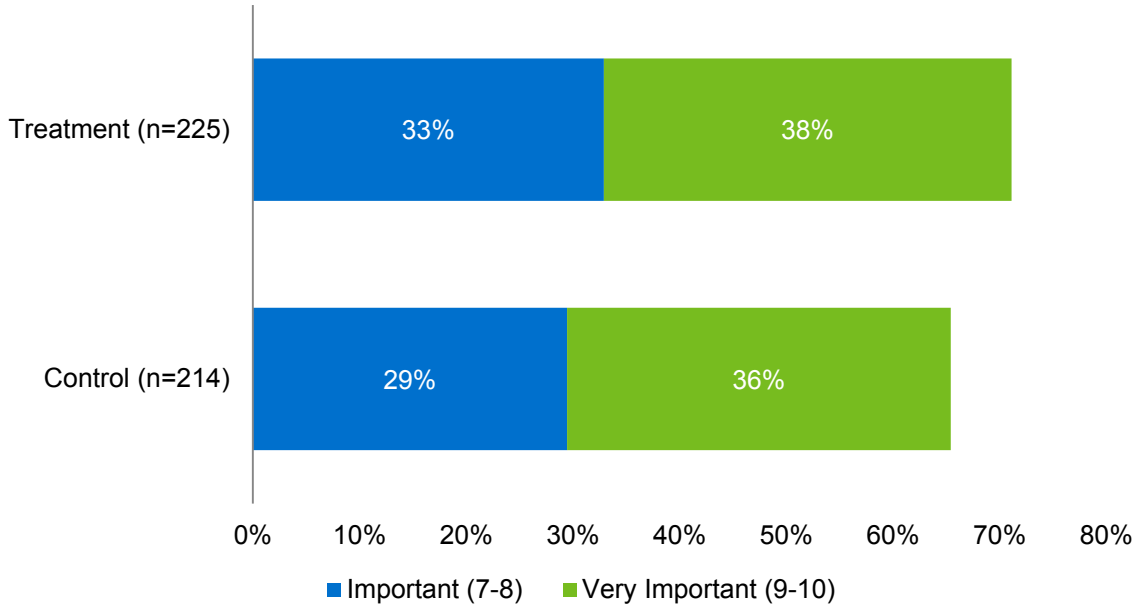
Figure 4-17: Upgrades expected in the next 12 months



4.3.5 Customer Motivation and Awareness

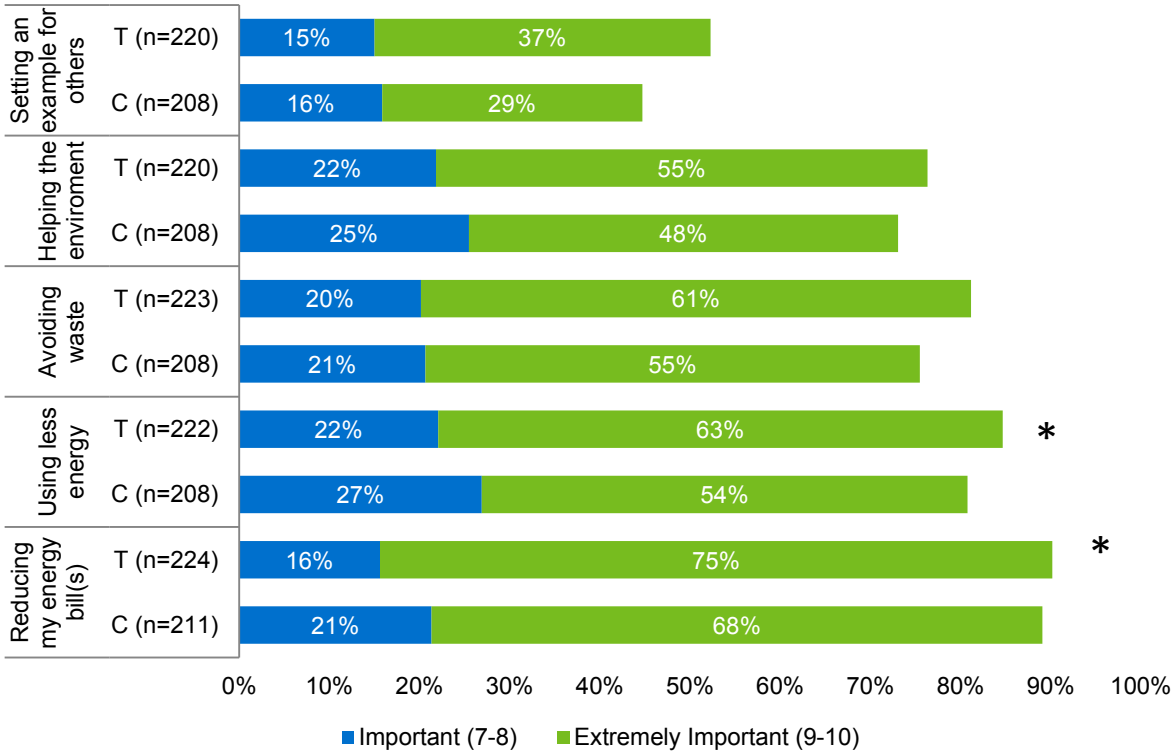
The treatment group is slightly more motivated than the control group to save energy. Seventy-one percent of treatment customers indicated that knowing they are using energy wisely is important or very important, compared to 65% of control customers (Figure 4-18).

Figure 4-18: How important is it for you know if your household is using energy wisely?



Customers were asked to rate the importance of various reasons they might try to reduce their home's energy use. The strongest motivation for both groups is saving money on their energy bills, but the treatment group rated the importance significantly higher. The treatment group also rated using less energy as significantly more important when compared to the responses of the control group. Only a small proportion of treatment and control customers find setting an example for others as important. Figure 4-19 contains the frequency of responses to this question, shown as a percentage for both the treatment and control groups.

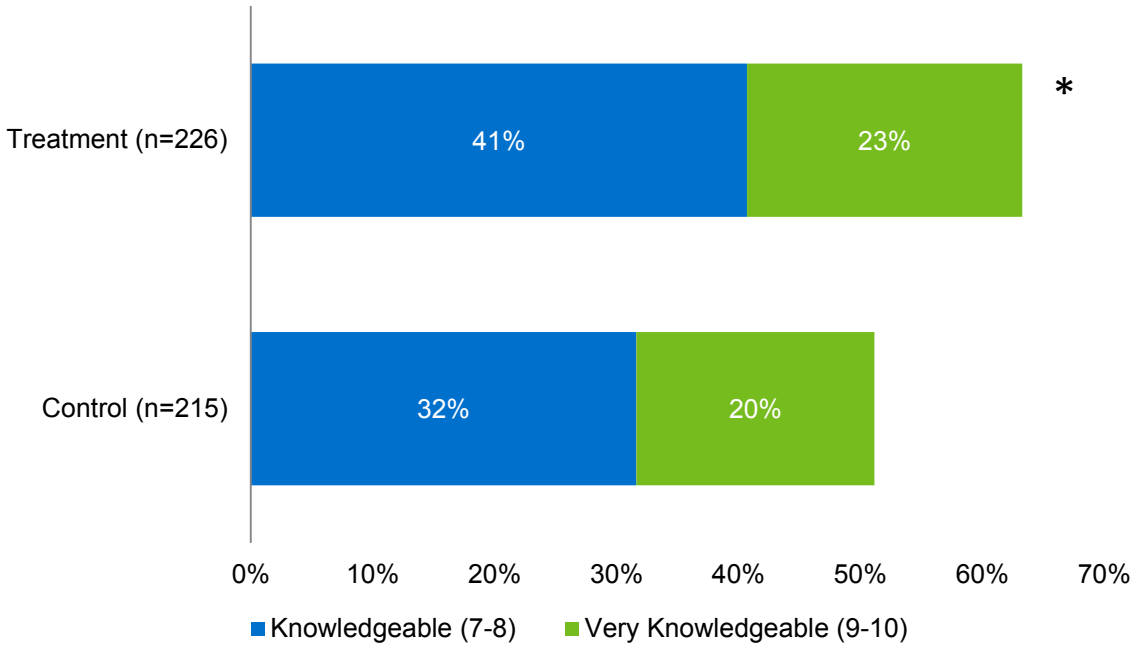
Figure 4-19: Please indicate how important each statement is to you.



* P-values are 0.06 and 0.08 for the two highlighted motivations, indicating that the treatment group finds using less energy and reducing their bills more important than the control group does.

As indicated by Figure 4-20, the treatment group was also significantly more likely to rate themselves as knowledgeable about saving energy in the home. Within the group of treatment customers, 64% rate themselves above a seven on a 0-10 point scale. Only 52% of control group customers rated themselves this way.

Figure 4-20: How would you rate your knowledge of the different ways you can save energy in your home?

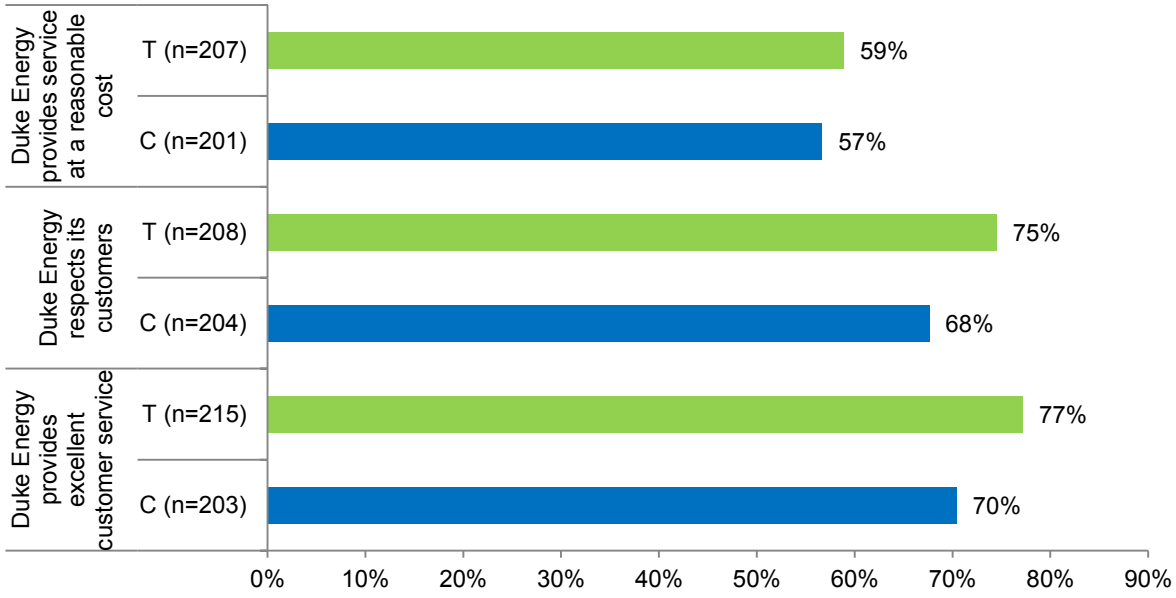


*P-value is less than 0.01, indicating that the treatment group feels significantly more knowledgeable than the treatment group feels.

4.3.6 Satisfaction with Duke Energy

Treatment customers are more satisfied with Duke Energy in general, with 75% indicating that they believe Duke Energy respects its customers, and 77% indicating that they believe Duke Energy provides excellent customer service. Only 59% of treatment customers and 57% of control customers agree that Duke Energy provides service at a reasonable cost (Figure 4-21).

Figure 4-21: Evidence of Overall Satisfaction with Duke Energy



4.3.7 Evidence of MyHER Effects

While formal statistical testing found some differences among treatment and control households (as noted in the discussion above) 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.

Each of the 45 questions survey questions provides an opportunity to observe differences between treatment and control households. If no pattern of MyHER influence existed, we would expect the treatment group would randomly score higher on about half the questions. This is akin to a series of coin flips, where the number of heads and tails is expected to be equal or near equal, on average. Indeed, for some topic areas we found no meaningful difference (Table 4-4). As a whole, however, we found that treatment group customers respond more favorably on 30 of 45 items, including all of the items associated with perceptions of Duke Energy's public stance on energy efficiency and overall satisfaction with Duke Energy. The probability of this many successes, assuming that MyHER does not influence customers at all, is less than 1%. This 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

- Note any item for which the treatment group outperformed the control group
- Calculate the probability that the difference in response patterns is due to chance, rather than an underlying difference in populations: approximately 1% (p=.0098).

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, then there is a 50/50 chance that they will "outperform" the control group as many times as not. Statistical testing is deployed to determine whether any differences are significant. For a more detailed description of the index framework, see Appendix D.

Table 4-4: Survey Response Pattern Index

Question Category	Count of Ques where T>C	Number of Ques in topic area	Portion of Ques where T>C higher
Duke Energy's Public Stance on Energy Efficiency	3	3	100%
Customer Engagement with Duke Energy Website	3	6	50%
Customers' Reported Energy-saving Behaviors	3	6	50%
Customers' Past & Future Equipment Purchases	9	16	56%
Customer Motivation, Engagement & Awareness of Energy Efficiency	9	11	82%
Customer Satisfaction with Duke Energy	3	3	100%
Total	**30**	**45**	**67%**

The pattern of responses displayed in Table 4-4 indicates that MyHER is likely affecting the treatment group's perception of Duke Energy, the availability of energy efficiency, and overall engagement with and awareness of energy efficiency.

4.3.8 Respondent Demographics

Nearly all respondents live in single family detached homes, 95% of which are owner-occupied.

Table 4-5: Distribution of Housing Type

Residence Type	Control (n=215)	Treatment (n=223)
Single family detached home*	92%	93%
Multi-family attached residence	3%	4%
Other	3%	1%
Row house	0%	1%
Apartment (more than four units)	1%	--
Single family manufactured, modular, or mobile home	1%	--

*95% owner-occupied

More than half of households surveyed have two or fewer residents, but about a quarter of treatment households have four or more. Approximately three quarters of the households surveyed do not have any children under 18 years old. While there are no apparent, systematic differences in the age of homes assigned to treatment and control, Figure 4-22 provides some indication that treatment customers appear to live in slightly newer homes than control customers.

Figure 4-22: In what year was your home built?

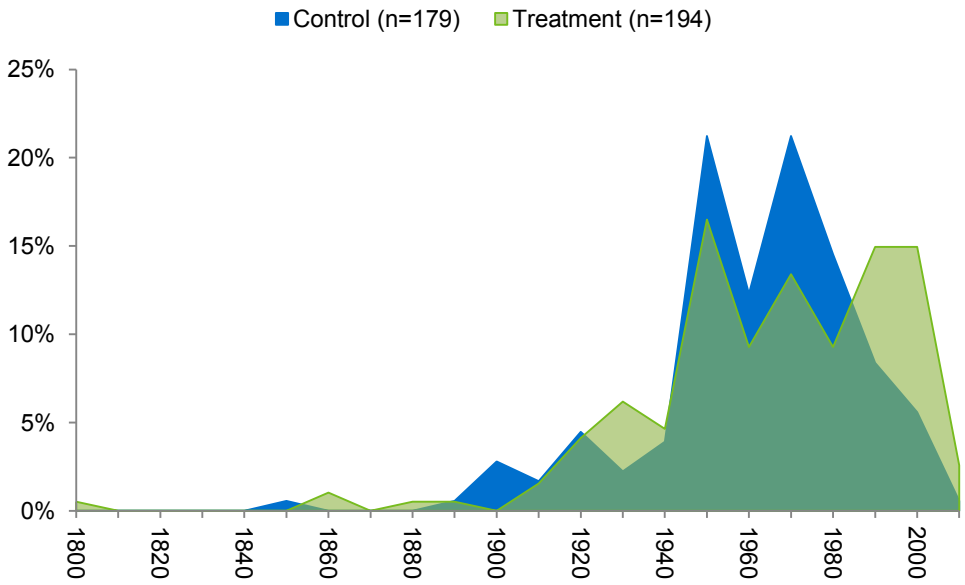
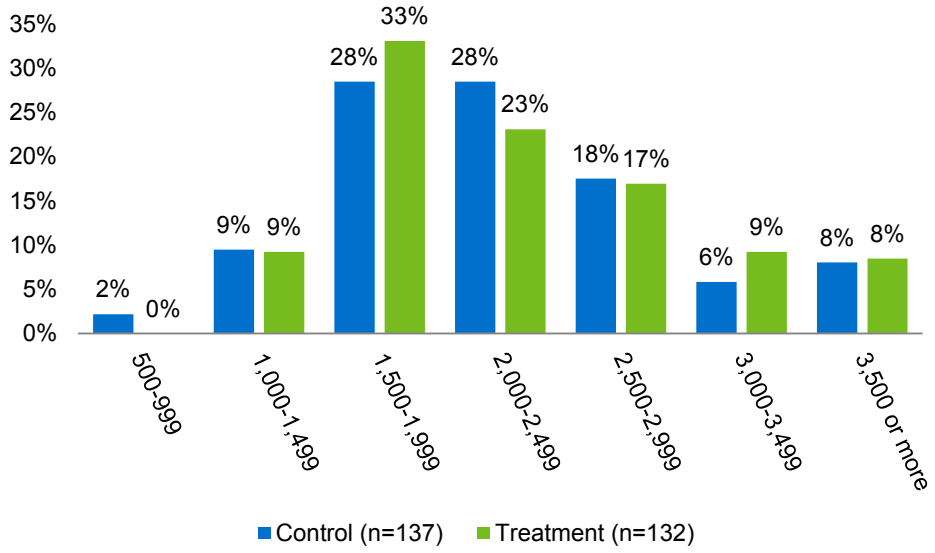


Figure 4-23 shows distribution of home square footage is similar between control and treatment households, although control households report slightly smaller homes on average. The average square footage above ground is 1,856 for control households and 2,096 for treatment households.

Figure 4-23: How many square feet is above-ground living space?



Respondent samples are relatively close to census. The lowest age category (18-25) 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. The average age of control and treatment group respondents was 59 and 60 respectively (see Table 4-6).

Table 4-6: Respondent Age Relative to OH Census

Age	Treatment (n=193)	Control (n=184)	OH Census
18-25	6%	5%	17%
26-35	14%	15%	17%
36-45	16%	19%	19%
46-55	24%	25%	20%
56-65	21%	18%	14%
Over 65	19%	18%	13%

4.4 Summary of Process Evaluation Findings

Interviews with key program staff revealed no major process findings, as the MyHER processes have stabilized with full implementation. However, as the program expands and includes more than two million households each mailing, the remaining sources of delay and on-going program adjustments could interfere with the production schedule. While access to billing data and the calendar constraints are not changeable, any MyHER elements that can be finalized before the

data cleaning and ingestion process begins will protect the production schedule and time required for on-going quality assurance.

Among treatment households, survey results indicate a high level of familiarity with and awareness of MyHER mailings: 82% report “always” reading their MyHER and 74% were satisfied with the information provided. Only 11% found the information confusing and 75% agreed they had learned about their household energy use from MyHER.

The time series graphs and comparisons to similar homes earned the highest scores for usefulness among treatment households. Eighty percent of respondents had no suggestions for improvement or offered compliments to the MyHER product. Among those that offered suggestions for improvement were a substantial number that requested additional or more detailed information about their energy use, indicating that the information in MyHER may have a priming effect.

Question by question comparisons between treatment and control households revealed mixed findings; treatment households scored Duke significantly higher on communication about and promotion of energy efficiency and were significantly more likely to say they would check the Duke website before purchasing major energy using equipment or completing energy performance improvements. Treatment households also provided significantly higher assessments of their knowledge on different ways to save energy and on the importance on “using less energy” and “reducing energy bills.” On many other items, treatment households did not differ significantly from control households.

An index designed to account for overall survey-wide differences in response patterns found that the more positive response pattern in simple frequencies was unlikely due to chance. Rather, we conclude that exposure to MyHER is affecting customer attitudes, particularly on factors associated with engagement and motivation.

4.4.1 Recommendations

Revise the Operations Playbook to reflect full-scale deployment of MyHER and incorporate lessons learned. The Playbook is a valuable source document for key components of managing the MyHER program, but should be updated to reflect changes that may have occurred as the program reached full scale, particularly how households become ineligible and/or are re-clustered.

Ensure that any content that can be developed ahead of the monthly production schedule is reviewed and finalized before the data transfers begin. This primarily applies to tips and messages, which are not dependent on billing data ingestion for scheduling.

Review quality control thresholds and expectations. A full quality assurance process was implemented in 2014 and allows Duke Energy to review all customer data before reports are mailed. Tracking the nature of quality assurance issues and the order of magnitude will help Duke monitor program quality and balance the time required with the portion of the treatment population affected.

Expand information options for MyHER recipients seeking more detail about the energy use in their homes. This could include inviting recipients to receive on-site audits, establishing a mechanism for short-term lending of in-home displays, further promotion of the web-portal, "ask an expert" web/chat space, or any number of other options for households that are ready to dive deeper into understanding the factors behind their energy consumption.

Leverage the perceived utility of MyHER information. Continue to emphasize the trend chart and the comparison bar chart, the most useful components of MyHER and use the communication opportunity to encourage treatment households to follow through on their intentions.

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 saving 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's Ohio customers and Nexant recommends that Duke Energy continue to focus on program processes and operations to further increase the efficiency of program delivery.

5.1 Impact Findings

Nexant's impact findings result in an effective realization rate of 116%. This estimate increases the previously filed participant impact from 220 kWh to 256 kWh annually. Impact estimates account for the fact that MyHER increases uptake of other Duke Energy programs. This finding subtracts 9.8 kWh annually from the average household impact of the MyHER program. The impact estimate also employs an *Intention to Treat* approach to account for the fact that program production timelines occasionally result in some homes temporarily not receiving a report. The time period of evaluated impacts is from March 2014 to February 2015. Nexant estimates the MyHER program saved a total of 76.4 GWh during this time period. The confidence and precision of this estimate is 90% and 13.8%, respectively.

5.2 Process Findings

MyHER is maturing as a program, with full implementation in Ohio. The large volume of data required to generate the MyHER and program delivery schedule is the primary driver of program activities and focus. Duke Energy and its implementation contactor, Tendril Inc., are successfully managing this process and providing Duke Energy Ohio customers valuable information for managing home energy consumption.

The clustering algorithm used by Tendril Inc. to generate the MyHER is a fundamental feature of the program. Clustering establishes the set of homes to which MyHER participants are compared and is critical to the MyHER norming effect. The method of clustering is a topic of continual discussion between Duke Energy and Tendril, and is likely to remain so as the program evolves and homes become more efficient.

Overall, the MyHER is successful in achieving its goal of enhancing customer motivation, awareness, and attention to saving energy. MyHER participants report a higher level of knowledge about ways to save energy and greatly appreciate the information Duke Energy provides to inform their decisions about household energy consumption.

5.3 Conclusions and Recommendations

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

- Maintain the integrity of the RCT design with consistent, simultaneous assignment of newly-eligible customers to either treatment or control
- Reduce the size of the control group from the 2010 program pilot in order to achieve better balance between the DEO MyHER treatment and control groups
- Update internal Duke Energy MyHER program documentation to reflect the full-scale deployment of MyHER and lessons learned since the program's inception
- Establish a process to develop, review, and finalize MyHER content ahead of the monthly MyHER production schedule
- Continue updating and monitoring quality control metrics to identify program performance issues or confirm program performance expectations
- Take advantage of customer engagement with MyHER to offer customers additional, detailed energy consumption intelligence
- Leverage customers' engagement with specific MyHER components to encourage follow-through and uptake of energy efficiency measures

Appendix A Survey Instruments

A.1 Treatment Households

Q1. We would 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.	☐	☐	☐	☐	☐

Q2. Since January of 2014, about how often have you visited the Duke Energy website to search for information? Select only one.

☐ Weekly
☐ Monthly
☐ Once every few months
☐ A few times
☐ Only once
☐ Never

Q3. When you logged in to your Duke Energy online account, which of the following have you done? Check all that apply.

☐ I do not have a Duke Energy online account
☐ Paid my bill
☐ Reviewed energy consumption graphs
☐ Looked for energy efficiency opportunities or ideas
☐ Other, please specify: _____

Q4. 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

Q5. Over the past 12 months, have you taken any actions to reduce your household energy use?

☐ Yes ☐ No – **Skip to Q7**

Q6. What actions have you taken? Check all that apply.

☐ Adjusted heating or cooling settings to save energy
☐ Washed clothes in cold water
☐ Shut down household electronics when not in use
☐ Turned off lights in unused or outdoor areas
☐ Used a clothes line to dry laundry
☐ Other, please specify: _____
☐ Other, please specify: _____
☐ Other, please specify: _____
☐ Other, please specify: _____

Q7. In the next 12 months, how likely are you to make each of the following energy efficiency improvements? Scale: 0 = Not at all Likely; 10 = Extremely Likely. If you have already made that improvement, please write the year in which you made it.

For instance, if you purchased an energy efficient refrigerator in 2012 and it is extremely likely that you would purchase another one in the next 12 months, you would write "2012" and circle "10".

	Did it in (year)	Not at all Likely										Extremely Likely
Install energy-efficient kitchen appliances		0	1	2	3	4	5	6	7	8	9	10
Install energy-efficient heating/cooling system		0	1	2	3	4	5	6	7	8	9	10
Install energy-efficient water heater		0	1	2	3	4	5	6	7	8	9	10
Replace windows or doors		0	1	2	3	4	5	6	7	8	9	10
Caulk or weatherstrip (windows or doors)		0	1	2	3	4	5	6	7	8	9	10
Add insulation to attic, walls, or floors		0	1	2	3	4	5	6	7	8	9	10
Contact a HVAC contractor for an estimate		0	1	2	3	4	5	6	7	8	9	10
Request a home energy audit		0	1	2	3	4	5	6	7	8	9	10

Q8. 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

Q9. 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

Q10. 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

Q11. 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**

Q12. Since January 2014, about how many *My Home Energy Reports* have you received?

_____ **If zero, skip to Q20**

Q13. How often do you read the *My Home Energy Reports*?

☐ Always ☐ Sometimes ☐ Never – **Skip to Q20**

Q14. 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
I'd like more detailed information about 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

Q15. 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.

Q16. Do you recall any specific tips or information from the *My Home Energy Reports*?

☐ Yes ☐ No – **Skip to Q18**

Q17. What specific tips or information do you recall?

Q18. 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

Q19. Please rate your satisfaction with the information in the *My Home Energy Reports* you've received.

- ☐ Very Satisfied
- ☐ Somewhat Satisfied
- ☐ Neither Satisfied nor Dissatisfied
- ☐ Somewhat Dissatisfied
- ☐ Very Dissatisfied

Q19a. Why do you say that? _____

_____

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

- ☐ Single family detached home
- ☐ Single family manufactured, modular, or mobile home
- ☐ Row house
- ☐ Multi-family attached residence
- ☐ Apartment (more than four units)
- ☐ Other, please specify: _____

Q23. Do you own or rent this residence? ☐ Own ☐ Rent

Q24. Including yourself, how many people live in your home? _____

Q24a. Of the number of people specified above, how many are under 18? _____

Q25. In what year was your home built? _____

Q26. How many square feet is the above-ground living space? _____

Q27. Including any walkout basements, how many square feet below-ground do you heat and/or cool? _____

Q28. In what year were you born? _____

A.2 Control Households

Q1. We would 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.	☐	☐	☐	☐	☐

Q2. Since January of 2014, about how often have you visited the Duke Energy website to search for information? Select only one.

☐ Weekly
☐ Monthly
☐ Once every few months
☐ A few times
☐ Only once
☐ Never

Q3. When you logged in to your Duke Energy online account, which of the following have you done? Check all that apply.

☐ I do not have a Duke Energy online account
☐ Paid my bill
☐ Reviewed energy consumption graphs
☐ Looked for energy efficiency opportunities or ideas
☐ Other, please specify: _____

Q4. 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

Q5. Over the past 12 months, have you taken any actions to reduce your household energy use?

☐ Yes ☐ No – **Skip to Q7**

Q6. What actions have you taken? Check all that apply.

☐ Adjusted heating or cooling settings to save energy
☐ Washed clothes in cold water
☐ Shut down household electronics when not in use
☐ Turned off lights in unused or outdoor areas
☐ Used a clothes line to dry laundry
☐ Other, please specify: _____
☐ Other, please specify: _____
☐ Other, please specify: _____
☐ Other, please specify: _____

Q7. In the next 12 months, how likely are you to make each of the following energy efficiency improvements? Scale: 0 = Not at all Likely; 10 = Extremely Likely. If you have already made that improvement, please write the year in which you made it.

For instance, if you purchased an energy efficient refrigerator in 2012 and it is extremely likely that you would purchase another one in the next 12 months, you would write "2012" and circle "10".

	Did it in (year)	Not at all Likely										Extremely Likely
Install energy-efficient kitchen appliances		0	1	2	3	4	5	6	7	8	9	10
Install energy-efficient heating/cooling system		0	1	2	3	4	5	6	7	8	9	10
Install energy-efficient water heater		0	1	2	3	4	5	6	7	8	9	10
Replace windows or doors		0	1	2	3	4	5	6	7	8	9	10
Caulk or weatherstrip (windows or doors)		0	1	2	3	4	5	6	7	8	9	10
Add insulation to attic, walls, or floors		0	1	2	3	4	5	6	7	8	9	10
Contact a HVAC contractor for an estimate		0	1	2	3	4	5	6	7	8	9	10
Request a home energy audit		0	1	2	3	4	5	6	7	8	9	10

Q8. 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

Q9. 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

Q10. 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

Q11. 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

Q12. 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

Q13. 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	☐	☐	☐	☐	☐

Q14. Which of the following best describes your home/residence?

- ☐ Single family detached home
- ☐ Single family manufactured, modular, or mobile home
- ☐ Row house
- ☐ Multi-family attached residence
- ☐ Apartment (more than four units)
- ☐ Other, please specify: _____

Q15. Do you own or rent this residence? ☐ Own ☐ Rent

Q16. Including yourself, how many people live in your home? _____

Q16a. Of the number of people specified above, how many are under 18? _____

Q17. In what year was your home built? _____

Q18. How many square feet is the above-ground living space? _____

Q19. Including any walkout basements, how many square feet below-ground do you heat and/or cool? _____

Q20. In what year were you born? _____

Thank you! Please return your completed survey using the enclosed envelope.

Appendix B Survey Frequencies

Q1 We would 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.

Q1_r1 The information available about Duke Energy's efficiency programs

Group	Very Satisfied	Somewhat Satisfied	Neither	Somewhat Dissatisfied	Very Dissatisfied	Don't know	Total
Control	70	66	58	6	2	14	216
Percent	**32.41%**	**30.56%**	**26.85%**	**2.78%**	**0.93%**	**6.48%**	**100%**
Treatment	98	75	39	3	5	8	228
Percent	**42.98%**	**32.89%**	**17.11%**	**1.32%**	**2.19%**	**3.51%**	**100%**
Total	168	141	97	9	7	22	444
Percent	**37.84%**	**31.76%**	**21.85%**	**2.03%**	**1.58%**	**4.95%**	**100%**

Q1_r2 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	80	68	42	10	3	13	216
Percent	**37.04%**	**31.48%**	**19.44%**	**4.63%**	**1.39%**	**6.02%**	**100%**
Treatment	108	76	31	4	3	6	228
Percent	**47.37%**	**33.33%**	**13.60%**	**1.75%**	**1.32%**	**2.63%**	**100%**
Total	188	144	73	14	6	19	444
Percent	**42.34%**	**32.43%**	**16.44%**	**3.15%**	**1.35%**	**4.28%**	**100%**

Q1_r3 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	74	71	41	10	8	12	216
Percent	**34.26%**	**32.87%**	**18.98%**	**4.63%**	**3.70%**	**5.56%**	**100%**
Treatment	104	77	30	10	4	3	228
Percent	**45.61%**	**33.77%**	**13.16%**	**4.39%**	**1.75%**	**1.32%**	**100%**
Total	178	148	71	20	12	15	444
Percent	**40.09%**	**33.33%**	**15.99%**	**4.50%**	**2.70%**	**3.38%**	**100%**

Q2 Since January of 2014, about how often have you visited the Duke Energy website to search for information?

Group	Weekly	Monthly	Once every few months	A few times	Only once	Never	Don't know	Total
Control	0	26	10	33	19	126	2	216
Percent	**0**	**12.04**	**4.63**	**15.28**	**8.8**	**58.33**	**0.93**	**100**
Treatment	2	17	19	39	17	133	1	228
Percent	**0.88**	**7.46**	**8.33**	**17.11**	**7.46**	**58.33**	**0.44**	**100**
Total	2	43	29	72	36	259	3	444
Percent	**0.45**	**9.68**	**6.53**	**16.22**	**8.11**	**58.33**	**0.68**	**100**

Q3_1 When you logged in to your Duke Energy online account, which of the following have you done? Check all that apply.

Q3_1 I don't have a Duke Energy online account

Group	I have	I don't have	Total
Control (n=216)	108	108	216
Percent	**50**	**50**	**100**
Treatment (n=228)	110	118	228
Percent	**48.25**	**51.75**	**100**
Total	218	226	444
Percent	**49.1**	**50.9**	**100**

Q3_2 Paid my bill

Group	No	Yes	Total
Control	151	65	216
Percent	**69.91**	**30.09**	**100**
Treatment	161	67	228
Percent	**70.61**	**29.39**	**100**
Total	312	132	444
Percent	**70.27**	**29.73**	**100**

Q3_3 Reviewed energy consumption graphs

Group	No	Yes	Total
Control	164	52	216
Percent	**75.93**	**24.07**	**100**
Treatment	183	45	228
Percent	**80.26**	**19.74**	**100**
Total	347	97	444
Percent	**78.15**	**21.85**	**100**

Q3_4 Looked for energy efficiency opportunities or ideas

Group	No	Yes	Total
Control	189	27	216
Percent	**87.5**	**12.5**	**100**
Treatment	199	29	228
Percent	**87.28**	**12.72**	**100**
Total	388	56	444
Percent	**87.39**	**12.61**	**100**

Q3_5 Other

group	No	Yes	Total
C	202	14	216
percent	**93.52**	**6.48**	**100**
T	210	18	228
percent	**92.11**	**7.89**	**100**
Total	412	32	444
percent	**92.79**	**7.21**	**100**

Q3_6 Don't know

Group	Know	Don't know	Total
Control	204	12	216
Percent	**94.44**	**5.56**	**100.00**
Treatment	218	10	228
Percent	**95.61**	**4.39**	**100.00**
Total	422	22	444
Percent	**95.05**	**4.95**	**100.00**

Q4 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?

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	67	17	20	13	6	23	12	17	14	4	14	9	216
Percent	**31.02**	**7.87**	**9.26**	**6.02**	**2.78**	**10.65**	**5.56**	**7.87**	**6.48**	**1.85**	**6.48**	**4.17**	**100**
Treatment	55	25	12	21	8	20	5	22	13	14	21	12	228
Percent	**24.12**	**10.96**	**5.26**	**9.21**	**3.51**	**8.77**	**2.19**	**9.65**	**5.7**	**6.14**	**9.21**	**5.26**	**100**
Total	122	42	32	34	14	43	17	39	27	18	35	21	444
Percent	**27.48**	**9.46**	**7.21**	**7.66**	**3.15**	**9.68**	**3.83**	**8.78**	**6.08**	**4.05**	**7.88**	**4.73**	**100**

Q5 Over the past 12 months, have you taken any actions to reduce your household energy use?

Group	No	Yes	Don't know	Total
Control	47	159	10	216
Percent	**21.76**	**73.61**	**4.63**	**100**
Treatment	54	167	7	228
Percent	**23.68**	**73.25**	**3.07**	**100**
Total	101	326	17	444
Percent	**22.75**	**73.42**	**3.83**	**100**

Q6 What actions have you taken?

Q6_1 Adjusted heating or cooling settings to save energy

Group	No	Yes	Missing	Total
Control	22	137	57	216
Percent	**10.19**	**63.43**	**26.39**	**100**
Treatment	25	142	61	228
Percent	**10.96**	**62.28**	**26.75**	**100**
Total	47	279	118	444
Percent	**10.59**	**62.84**	**26.58**	**100**

Q6_2 Washed clothes in cold water

Group	No	Yes	Missing	Total
Control	79	80	57	216
Percent	**36.57**	**37.04**	**26.39**	**100**
Treatment	72	95	61	228
Percent	**31.58**	**41.67**	**26.75**	**100**
Total	151	175	118	444
Percent	**34.01**	**39.41**	**26.58**	**100**

Q6_3 Shut down household electronics when not in use

Group	No	Yes	Missing	Total
Control	62	97	57	216
Percent	**28.7**	**44.91**	**26.39**	**100**
Treatment	57	110	61	228
Percent	**25**	**48.25**	**26.75**	**100**
Total	119	207	118	444
Percent	**26.8**	**46.62**	**26.58**	**100**

Q6_4 Turned off lights in unused or outdoor areas

Group	No	Yes	Missing	Total
Control	29	130	57	216
Percent	**13.43**	**60.19**	**26.39**	**100**
Treatment	30	137	61	228
Percent	**13.16**	**60.09**	**26.75**	**100**
Total	59	267	118	444
Percent	**13.29**	**60.14**	**26.58**	**100**

Q6_5 Used a clothes line to dry laundry

Group	No	Yes	Missing	Total
Control	127	32	57	216
Percent	**58.8**	**14.81**	**26.39**	**100**
Treatment	137	30	61	228
Percent	**60.09**	**13.16**	**26.75**	**100**
Total	264	62	118	444
Percent	**59.46**	**13.96**	**26.58**	**100**

Q6_6 Other

Group	No	Yes	Missing	Total
Control	105	54	57	216
Percent	**48.61**	**25**	**26.39**	**100**
Treatment	112	55	61	228
Percent	**49.12**	**24.12**	**26.75**	**100**
Total	217	109	118	444
Percent	**48.87**	**24.55**	**26.58**	**100**

Q6_7 Other

Group	No	Yes	Missing	Total
Control	143	16	57	216
Percent	**66.2**	**7.41**	**26.39**	**100**
Treatment	148	19	61	228
Percent	**64.91**	**8.33**	**26.75**	**100**
Total	291	35	118	444
Percent	**65.54**	**7.88**	**26.58**	**100**

Q6_8 Other

Group	No	Yes	Missing	Total
Control	152	7	57	216
Percent	**70.37**	**3.24**	**26.39**	**100**
Treatment	159	8	61	228
Percent	**69.74**	**3.51**	**26.75**	**100**
Total	311	15	118	444
Percent	**70.05**	**3.38**	**26.58**	**100**

Q6_9 Other

Group	No	Yes	Missing	Total
Control	157	2	57	216
Percent	**72.69**	**0.93**	**26.39**	**100**
Treatment	164	3	61	228
Percent	**71.93**	**1.32**	**26.75**	**100**
Total	321	5	118	444
Percent	**72.3**	**1.13**	**26.58**	**100**

Q6_10 Don't know

group	Know	Don't know	Missing	Total
Control	159	0	57	216
Percent	**73.61**	**0**	**26.39**	**100**
Treatment	165	2	61	228
Percent	**72.37**	**0.88**	**26.75**	**100**
Total	324	2	118	444
Percent	**72.97**	**0.45**	**26.58**	**100**

Q7 In the next 12 months, how likely are you to make each of the following energy efficiency improvements?

Q7_r1 Install energy efficient kitchen appliances

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	103	10	9	5	4	15	3	8	6	4	15	34	216
Percent	**47.69**	**4.63**	**4.17**	**2.31**	**1.85**	**6.94**	**1.39**	**3.7**	**2.78**	**1.85**	**6.94**	**15.74**	**100**
Treatment	105	7	7	6	7	18	6	7	5	5	26	29	228
Percent	**46.05**	**3.07**	**3.07**	**2.63**	**3.07**	**7.89**	**2.63**	**3.07**	**2.19**	**2.19**	**11.4**	**12.72**	**100**
Total	208	17	16	11	11	33	9	15	11	9	41	63	444
Percent	**46.85**	**3.83**	**3.6**	**2.48**	**2.48**	**7.43**	**2.03**	**3.38**	**2.48**	**2.03**	**9.23**	**14.19**	**100**

Q7_r2 Install energy efficient heating/cooling system

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	113	11	12	2	2	16	0	2	7	3	16	32	216
Percent	**52.31**	**5.09**	**5.56**	**0.93**	**0.93**	**7.41**	**0**	**0.93**	**3.24**	**1.39**	**7.41**	**14.81**	**100**
Treatment	112	12	10	12	7	14	4	4	4	3	20	26	228
Percent	**49.12**	**5.26**	**4.39**	**5.26**	**3.07**	**6.14**	**1.75**	**1.75**	**1.75**	**1.32**	**8.77**	**11.4**	**100**
Total	225	23	22	14	9	30	4	6	11	6	36	58	444
Percent	**50.68**	**5.18**	**4.95**	**3.15**	**2.03**	**6.76**	**0.9**	**1.35**	**2.48**	**1.35**	**8.11**	**13.06**	**100**

Q7_r3 Install energy efficient water heater

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	102	10	11	5	5	16	2	4	6	6	17	32	216
Percent	**47.22**	**4.63**	**5.09**	**2.31**	**2.31**	**7.41**	**0.93**	**1.85**	**2.78**	**2.78**	**7.87**	**14.81**	**100**
Treatment	102	10	13	12	4	15	3	7	3	2	28	29	228
Percent	**44.74**	**4.39**	**5.7**	**5.26**	**1.75**	**6.58**	**1.32**	**3.07**	**1.32**	**0.88**	**12.28**	**12.72**	**100**
Total	204	20	24	17	9	31	5	11	9	8	45	61	444
Percent	**45.95**	**4.5**	**5.41**	**3.83**	**2.03**	**6.98**	**1.13**	**2.48**	**2.03**	**1.8**	**10.14**	**13.74**	**100**

Q7_r4 Replace windows or doors

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	106	11	7	3	7	11	4	9	4	4	15	35	216
Percent	**49.0**	**5.09**	**3.24**	**1.39**	**3.2**	**5.1**	**1.8**	**4.1**	**1.85**	**1.85**	**6.94**	**16.2**	**100**
Treatment	109	11	8	12	5	10	1	4	6	3	27	32	228
Percent	**47.8**	**4.82**	**3.51**	**5.26**	**2.2**	**4.39**	**0.44**	**1.7**	**2.6**	**1.3**	**11.8**	**14.04**	**100**
Total	215	22	15	15	12	21	5	13	10	7	42	67	444
Percent	**48.4**	**4.9**	**3.4**	**3.38**	**2.7**	**4.73**	**1.13**	**2.93**	**2.25**	**1.58**	**9.46**	**15.09**	**100**

Q7_r5 Caulk or weather strip (windows or doors)

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	73	10	8	8	7	9	9	13	9	7	21	42	216
Percent	**33.8**	**4.63**	**3.7**	**3.7**	**3.24**	**4.17**	**4.17**	**6.02**	**4.17**	**3.24**	**9.72**	**19.44**	**100**
Treatment	75	8	8	7	4	23	8	13	13	6	37	26	228
Percent	**32.9**	**3.51**	**3.51**	**3.07**	**1.75**	**10.09**	**3.51**	**5.7**	**5.7**	**2.63**	**16.23**	**11.4**	**100**
Total	148	18	16	15	11	32	17	26	22	13	58	68	444
percent	**33.33**	**4.05**	**3.6**	**3.38**	**2.48**	**7.21**	**3.83**	**5.86**	**4.95**	**2.93**	**13.06**	**15.32**	**100**

Q7_r6 Add insulation to attic, walls, or floors

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	100	17	7	8	3	9	6	7	7	8	10	34	216
Percent	**46.3**	**7.87**	**3.24**	**3.7**	**1.39**	**4.17**	**2.78**	**3.24**	**3.24**	**3.7**	**4.63**	**15.74**	**100**
Treatment	118	16	10	8	2	6	3	5	3	3	24	30	228
Percent	**51.75**	**7.02**	**4.39**	**3.51**	**0.88**	**2.63**	**1.32**	**2.19**	**1.32**	**1.32**	**10.53**	**13.16**	**100**
Total	218	33	17	16	5	15	9	12	10	11	34	64	444
Percent	**49.1**	**7.43**	**3.83**	**3.6**	**1.13**	**3.38**	**2.03**	**2.7**	**2.25**	**2.48**	**7.66**	**14.41**	**100**

Q7_r7 Contact a HVAC contractor for an estimate

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	123	17	9	4	3	7	2	6	6	2	6	31	216
Percent	**56.94**	**7.87**	**4.17**	**1.85**	**1.39**	**3.24**	**0.93**	**2.78**	**2.78**	**0.93**	**2.78**	**14.35**	**100**
Treatment	127	19	6	9	6	8	5	1	4	4	11	28	228
Percent	**55.7**	**8.33**	**2.63**	**3.95**	**2.63**	**3.51**	**2.19**	**0.44**	**1.75**	**1.75**	**4.82**	**12.28**	**100**
Total	250	36	15	13	9	15	7	7	10	6	17	59	444
Percent	**56.3**	**8.11**	**3.38**	**2.93**	**2.03**	**3.38**	**1.58**	**1.58**	**2.25**	**1.35**	**3.83**	**13.29**	**100**

Q7_r8 Request a home energy audit

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	117	17	10	4	3	16	2	3	5	4	2	33	216
Percent	**54.17**	**7.87**	**4.63**	**1.85**	**1.39**	**7.41**	**0.93**	**1.39**	**2.31**	**1.85**	**0.93**	**15.28**	**100**
Treatment	133	18	8	8	5	15	2	4	4	2	5	24	228
Percent	**58.33**	**7.89**	**3.51**	**3.51**	**2.19**	**6.58**	**0.88**	**1.75**	**1.75**	**0.88**	**2.19**	**10.53**	**100**
Total	250	35	18	12	8	31	4	7	9	6	7	57	444
Percent	**56.31**	**7.88**	**4.05**	**2.7**	**1.8**	**6.98**	**0.9**	**1.58**	**2.03**	**1.35**	**1.58**	**12.84**	**100**

Q8 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	10	4	3	4	3	36	14	30	33	12	65	2	216
Percent	**4.6**	**1.85**	**1.39**	**1.85**	**1.39**	**16.7**	**6.48**	**13.9**	**15.3**	**5.56**	**30.1**	**0.93**	**100**
Treatment	3	3	2	7	2	32	16	32	42	24	62	3	228
Percent	**1.3**	**1.32**	**0.88**	**3.07**	**0.88**	**14.**	**7.0**	**14.0**	**18.4**	**10.5**	**27.2**	**1.32**	**100**
Total	13	7	5	11	5	68	30	62	75	36	127	5	444
Percent	**2.9**	**1.58**	**1.13**	**2.48**	**1.13**	**15.3**	**6.76**	**14**	**16.9**	**8.11**	**28.6**	**1.13**	**100**

Q9 Which of the following do you do with regard to your household's energy use? Check all that apply.

Q9_1 Track monthly energy use

group	No	Yes	Total
Control	133	83	216
Percent	**61.57**	**38.43**	**100**
Treatment	117	111	228
Percent	**51.32**	**48.68**	**100**
Total	250	194	444
Percent	**56.31**	**43.69**	**100**

Q9_2 Track the total amount of your bill

group	No	Yes	Total
Control	68	148	216
Percent	**31.48**	**68.52**	**100**
Treatment	81	147	228
Percent	**35.53**	**64.47**	**100**
Total	149	295	444
Percent	**33.56**	**66.44**	**100**

Q9_3 Compare usage to previous months

Group	No	Yes	Total
Control	75	141	216
Percent	**34.72**	**65.28**	**100**
Treatment	72	156	228
Percent	**31.58**	**68.42**	**100**
Total	147	297	444
Percent	**33.11**	**66.89**	**100**

Q9_4 Compare usage to the same month from last year

Group	No	Yes	Total
Control	91	125	216
Percent	**42.13**	**57.87**	**100**
Treatment	115	113	228
Percent	**50.44**	**49.56**	**100**
Total	206	238	444
Percent	**46.4**	**53.6**	**100**

Q9_5 None of the above

Group	No	Yes	Total
Control	188	28	216
Percent	**87.04**	**12.96**	**100**
Treatment	207	21	228
Percent	**90.79**	**9.21**	**100**
Total	395	49	444
Percent	**88.96**	**11.04**	**100**

Q9_6 Don't know

group	Know	Don't know	Total
Control	215	1	216
Percent	**99.54**	**0.46**	**100**
Treatment	225	3	228
Percent	**98.68**	**1.32**	**100**
Total	440	4	444
Percent	**99.1**	**0.9**	**100**

Q10 How would you rate your knowledge of the different ways you can save energy in your home?

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	4	4	5	16	13	44	19	30	38	19	23	1	216
Percent	**1.85**	**1.85**	**2.31**	**7.41**	**6.02**	**20.37**	**8.8**	**13.9**	**17.6**	**8.8**	**10.65**	**0.46**	**100**
Treat	2	4	3	7	4	32	31	51	41	24	27	2	228
Percent	**0.88**	**1.75**	**1.32**	**3.07**	**1.75**	**14.04**	**13.6**	**22.37**	**17.98**	**10.53**	**11.84**	**0.88**	**100**
Total	6	8	8	23	17	76	50	81	79	43	50	3	444
Percent	**1.35**	**1.8**	**1.8**	**5.18**	**3.83**	**17.12**	**11.26**	**18.24**	**17.79**	**9.68**	**11.26**	**0.68**	**100**

Q11 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? (Asked of treatment group only.)

Group	Yes	No	Don't know	Missing	Total
Treatment	213	11	4	0	228
Percent	**93.42**	**4.82**	**1.75**	**0**	**100**

Q12 Since January 2014, about how many My Home Energy Reports have you received?

Group	1	2	3	4	5	6	7	8	9	10	11	12	14	15	16	17	19	44	DK	Missing	Total
Treatment	7	16	12	19	12	17	5	10	1	12	1	11	2	6	9	3	1	1	68	15	228
Percent	3.07	7.02	5.26	8.3	5.26	7.5	2.2	4.4	0.44	5.26	0.44	4.82	0.9	2.63	3.95	1.32	0.44	0.44	29.82	6.58	100

Q13 How often do you read the My Home Energy Reports?

Group	Always	Sometimes	Never	Missing	Total
Treatment	174	37	2	15	228
percent	76.32	16.23	0.88	6.58	100

Q14 Please indicate how much you agree or disagree with the following statements about My Home Energy Reports.

Q14_r1 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	DK	Missing	Total
Treatment	8	2	1	4	3	21	13	21	31	16	89	2	17	228
Percent	3.5	0.9	0.44	1.75	1.3	9.21	5.7	9.2	13.6	7	39.04	0.88	7.46	100

Q14_r2 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	DK	Missing	Total
Treatment	9	5	1	10	5	21	13	24	28	16	77	2	17	228
Percent	3.95	2.19	0.44	4.39	2.19	9.21	5.7	10.53	12.28	7.02	33.77	0.88	7.46	100

Q14_r3 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	11	5	11	15	13	22	18	22	27	18	40	9	17	228
Percent	4.82	2.19	4.82	6.58	5.7	9.65	7.89	9.65	11.84	7.89	17.54	3.95	7.46	100

Q14_r4 I'd like more detailed information about my home's energy use

Group	0	1	2	3	4	5	6	7	8	9	10	DK	Missing	Total
Treatment	30	10	7	12	7	42	14	10	15	15	39	10	17	228
Percent	13.16	4.39	3.07	5.26	3.07	18.42	6.14	4.39	6.58	6.58	17.11	4.4	7.46	100

Q14_r5 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	59	25	17	7	7	13	15	8	13	9	31	7	17	228
Percent	25.88	10.96	7.46	3.07	3.07	5.7	6.58	3.51	5.7	3.95	13.6	3.07	7.5	100

Q14_r6 The information provided about my home's energy use is confusing

Group	0	1	2	3	4	5	6	7	8	9	10	DK	Missing	Total
Treatment	97	25	24	10	8	17	2	4	4	4	11	5	17	228
Percent	42.54	11	10.53	4.39	3.5	7.46	0.88	1.75	1.75	1.75	4.82	2.2	7.46	100

Q16 Do you recall any specific tips or information from the My Home Energy Reports?

Group	Yes	No	Don't know	Missing	Total
Treatment	73	126	12	17	228
Percent	32.02	55.26	5.26	7.46	100

Q18 Below is a list of My Home Energy Report features. Please rate how useful each feature is to you.

Q18_r1 Comparison to similar homes

Group	0	1	2	3	4	5	6	7	8	9	10	DK	Missing	Total
Treatment	24	4	6	6	5	18	9	24	33	18	61	3	17	228
Percent	10.53	1.75	2.63	2.63	2.2	7.89	3.95	10.53	14.47	7.89	26.75	1.3	7.46	100

Q18_r2 Tips to help you save money and energy

Group	0	1	2	3	4	5	6	7	8	9	10	DK	Missing	Total
Treatment	9	2	6	5	8	33	18	26	27	23	49	5	17	228
Percent	3.95	0.88	2.63	2.19	3.51	14.47	7.89	11.4	11.84	10.09	21.49	2.2	7.46	100

Q18_r3 Examples of the energy use associated with common household items

Group	0	1	2	3	4	5	6	7	8	9	10	DK	Missing	Total
Treatment	13	3	5	5	8	29	16	21	33	23	47	8	17	228
Percent	5.7	1.32	2.19	2.19	3.51	12.72	7.02	9.21	14.47	10.09	20.61	3.5	7.46	100

Q18_r4 Customized suggestions for your home

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Missing	Total
Treatment	17	6	7	6	13	27	13	16	23	18	48	17	17	228
Percent	7.46	2.63	3.07	2.63	5.7	11.84	5.7	7.02	10.09	7.89	21.05	7.46	7.46	100

Q18_r5 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	11	3	5	2	2	18	7	16	32	31	79	5	17	228
Percent	4.82	1.32	2.19	0.88	0.88	7.89	3.07	7.02	14.04	13.6	34.65	2.19	7.46	100

Q18_r6 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	12	5	9	7	10	30	20	15	28	20	46	9	17	228
Percent	5.26	2.19	3.95	3.07	4.39	13.16	8.77	6.58	12.28	8.77	20.18	3.95	7.46	100

Q18C 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. (Modified question – asked only of control group, not treatment.)

Q18C_r1 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	29	11	5	9	6	24	20	28	25	16	35	8	0	216
Percent	13.43	5.09	2.31	4.17	2.78	11.11	9.26	12.96	11.57	7.41	16.2	3.7	0	100

Q18C_r2 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	11	5	4	3	3	30	12	24	37	19	60	8	0	216
Percent	5.09	2.31	1.85	1.39	1.39	13.89	5.56	11.11	17.13	8.8	27.78	3.7	0	100

Q18C_r3 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	17	7	4	5	5	36	9	20	35	23	46	9	0	216
Percent	**7.87**	**3.24**	**1.85**	**2.31**	**2.31**	**16.67**	**4.17**	**9.26**	**16.2**	**10.65**	**21.3**	**4.17**	**0**	**100**

Q18C_r4 Customized suggestions for your home

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Missing	Total
Control	24	8	6	4	10	42	12	11	26	18	44	11	0	216
Percent	**11.11**	**3.7**	**2.78**	**1.85**	**4.63**	**19.44**	**5.56**	**5.09**	**12.04**	**8.33**	**20.37**	**5.09**	**0**	**100**

Q18C_r5 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	7	6	8	8	25	10	13	31	22	55	9	0	216
percent	**10.19**	**3.24**	**2.78**	**3.7**	**3.7**	**11.57**	**4.63**	**6.02**	**14.35**	**10.19**	**25.46**	**4.17**	**0**	**100**

Q18C_r6 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	18	3	6	10	7	46	13	16	24	20	45	8	0	216
Percent	**8.33**	**1.39**	**2.78**	**4.63**	**3.24**	**21.3**	**6.02**	**7.41**	**11.11**	**9.26**	**20.83**	**3.7**	**0**	**100**

Q19 Please rate your satisfaction with the information in the My Home Energy Reports you've received (Asked of treatment group only.)

Group	Very satisfied	Somewhat satisfied	Neither satisfied nor dissatisfied	Somewhat dissatisfied	Very dissatisfied	Don't know	Missing	Total
Treatment	83	73	40	7	3	5	17	228
percent	**36.4**	**32.02**	**17.54**	**3.07**	**1.32**	**2.19**	**7.46**	**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.

Q20_r1 Reducing my energy bill(s)

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	5	1	0	1	0	13	3	18	27	28	115	5	216
Percent	**2.31**	**0.46**	**0**	**0.46**	**0**	**6.02**	**1.39**	**8.33**	**12.5**	**12.96**	**53.24**	**2.31**	**100**
Treat	2	2	1	1	2	10	4	14	21	25	142	4	228
Percent	**0.88**	**0.88**	**0.44**	**0.44**	**0.88**	**4.39**	**1.75**	**6.14**	**9.21**	**10.96**	**62.28**	**1.75**	**100**
Total	7	3	1	2	2	23	7	32	48	53	257	9	444
Percent	**1.58**	**0.68**	**0.23**	**0.45**	**0.45**	**5.18**	**1.58**	**7.21**	**10.81**	**11.94**	**57.88**	**2.03**	**100**

Q20_r2 Using less energy

Group	0	1	2	3	4	5	6	7	8	9	10	DK	Total
Control	8	1	0	1	1	18	11	24	32	27	85	8	216
Percent	**3.7**	**0.46**	**0**	**0.46**	**0.46**	**8.33**	**5.09**	**11.1**	**14.8**	**12.5**	**39.35**	**3.7**	**100**
Treatment	3	2	1	2	3	16	7	21	28	28	111	6	228
percent	**1.32**	**0.88**	**0.44**	**0.88**	**1.32**	**7.02**	**3.07**	**9.21**	**12.3**	**12.3**	**48.68**	**2.63**	**100**
Total	11	3	1	3	4	34	18	45	60	55	196	14	444
percent	**2.48**	**0.68**	**0.23**	**0.68**	**0.9**	**7.66**	**4.05**	**10.1**	**13.5**	**12.4**	**44.14**	**3.2**	**100**

Q20_r3 Helping the environment

Group	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Control	11	1	3	3	2	21	15	22	31	18	81	8	216
Percent	**5.09**	**0.46**	**1.39**	**1.39**	**0.93**	**9.72**	**6.94**	**10.19**	**14.35**	**8.33**	**37.5**	**3.7**	**100**
Treat	8	3	2	7	1	26	5	25	23	28	92	8	228
Percent	**3.51**	**1.32**	**0.88**	**3.07**	**0.44**	**11.4**	**2.19**	**10.96**	**10.09**	**12.28**	**40.35**	**3.51**	**100**
Total	19	4	5	10	3	47	20	47	54	46	173	16	444
Percent	**4.28**	**0.9**	**1.13**	**2.25**	**0.68**	**10.59**	**4.5**	**10.59**	**12.16**	**10.36**	**38.96**	**3.6**	**100**

Q20_r4 Setting an example for others

Group	0	1	2	3	4	5	6	7	8	9	10	DK	Total
Control	29	7	12	13	8	31	15	20	13	9	51	8	216
Percent	**13.43**	**3.24**	**5.56**	**6.02**	**3.7**	**14.35**	**6.94**	**9.26**	**6.02**	**4.17**	**23.61**	**3.7**	**100**
Treat	28	10	8	9	5	32	13	15	18	21	61	8	228
Percent	**12.28**	**4.39**	**3.51**	**3.95**	**2.19**	**14.04**	**5.7**	**6.58**	**7.89**	**9.21**	**26.75**	**3.51**	**100**
Total	57	17	20	22	13	63	28	35	31	30	112	16	444
Percent	**12.84**	**3.83**	**4.5**	**4.95**	**2.93**	**14.19**	**6.31**	**7.88**	**6.98**	**6.76**	**25.23**	**3.6**	**100**

Q20_r5 Avoiding waste

Group	0	1	2	3	4	5	6	7	8	9	10	DK	Total
Control	10	0	0	4	5	25	7	18	25	25	89	8	216
Percent	**4.63**	**0**	**0**	**1.85**	**2.31**	**11.57**	**3.24**	**8.33**	**11.57**	**11.57**	**41.2**	**3.7**	**100**
Treatment	3	4	1	2	4	19	9	19	26	32	104	5	228
Percent	**1.32**	**1.75**	**0.44**	**0.88**	**1.75**	**8.33**	**3.95**	**8.33**	**11.4**	**14.04**	**45.61**	**2.19**	**100**
Total	13	4	1	6	9	44	16	37	51	57	193	13	444
Percent	**2.93**	**0.9**	**0.23**	**1.35**	**2.03**	**9.91**	**3.6**	**8.33**	**11.49**	**12.84**	**43.47**	**2.93**	**100**

Q21 Please Indicate your level of agreement with each of the following statements:

Q21_r1 Duke Energy provides excellent customer service

Group	Strongly disagree	Somewhat disagree	Neither	Somewhat agree	Strongly agree	Don't know	Total
Control	7	5	48	65	78	13	216
Percent	**3.24**	**2.31**	**22.22**	**30.09**	**36.11**	**6.02**	**100**
Treatment	8	10	31	69	97	13	228
Percent	**3.51**	**4.39**	**13.6**	**30.26**	**42.54**	**5.7**	**100**
Total	15	15	79	134	175	26	444
Percent	**3.38**	**3.38**	**17.79**	**30.18**	**39.41**	**5.86**	**100**

Q21_r2 Duke Energy respects its customers

Group	Strongly disagree	Somewhat disagree	Neither	Somewhat agree	Strongly agree	Don't know	Total
Control	10	11	45	58	80	12	216
Percent	**4.63**	**5.09**	**20.83**	**26.85**	**37.04**	**5.56**	**100**
Treatment	6	10	37	67	88	20	228
Percent	**2.63**	**4.39**	**16.23**	**29.39**	**38.6**	**8.77**	**100**
Total	16	21	82	125	168	32	444
Percent	**3.6**	**4.73**	**18.47**	**28.15**	**37.84**	**7.21**	**100**

Q21_r3 Duke Energy provides a service at a reasonable cost

Group	Strongly disagree	Somewhat disagree	Neither	Somewhat agree	Strongly agree	Don't know	Total
Control	12	22	53	73	41	15	216
Percent	**5.56**	**10.19**	**24.54**	**33.8**	**18.98**	**6.94**	**100**
Treatment	11	22	52	77	45	21	228
Percent	**4.82**	**9.65**	**22.81**	**33.77**	**19.74**	**9.21**	**100**
Total	23	44	105	150	86	36	444
Percent	**5.18**	**9.91**	**23.65**	**33.78**	**19.37**	**8.11**	**100**

Q22 Which of the following best describes your home/residence?

Group	Single family detached home	Single family manufactured, modular, or mobile home	Row house	Multi-family attached residence	Apartment (more than four units)	Other	Perfer not to answer	Total
Control	198	2	1	6	2	6	1	216
Percent	**91.67**	**0.93**	**0.46**	**2.78**	**0.93**	**2.78**	**0.46**	**100**
Treatment	207	1	2	9	1	3	5	228
Percent	**90.79**	**0.44**	**0.88**	**3.95**	**0.44**	**1.32**	**2.19**	**100**
Total	405	3	3	15	3	9	6	444
Percent	**91.22**	**0.68**	**0.68**	**3.38**	**0.68**	**2.03**	**1.35**	**100**

Q23 Do you own or rent this residence?

Group	Own	Rent	Prefer not to answer	Total
Control	204	11	1	216
Percent	**94.44**	**5.09**	**0.46**	**100**
Treatment	211	11	6	228
Percent	**92.54**	**4.82**	**2.63**	**100**
Total	415	22	7	444
Percent	**93.47**	**4.95**	**1.58**	**100**

Q24 Including yourself, how many people live in your home?

Group	1	2	3	4	5	6	7	10	Don't know	Prefer not to answer	Total
Control	29	106	35	19	8	5	4	0	1	9	216
Percent	**13.43**	**49.07**	**16.2**	**8.8**	**3.7**	**2.3**	**1.85**	**0**	**0.46**	**4.17**	**100**
Treatment	44	93	21	23	18	5	0	2	0	22	228
Percent	**19.3**	**40.79**	**9.21**	**10.1**	**7.89**	**2.19**	**0**	**0.88**	**0**	**9.65**	**100**
Total	73	199	56	42	26	10	4	2	1	31	444
Percent	**16.44**	**44.82**	**12.61**	**9.46**	**5.86**	**2.25**	**0.9**	**0.45**	**0.23**	**6.98**	**100**

Q24a Of the people, how many are under 18?

Group	0	1	2	3	4	5	Don't know	Prefer not to answer	Total
Control	154	18	17	5	3	3	2	14	216
Percent	**71.3**	**8.33**	**7.87**	**2.31**	**1.39**	**1.39**	**0.93**	**6.48**	**100**
Treatment	152	11	18	16	5	0	0	26	228
Percent	**66.67**	**4.82**	**7.89**	**7.02**	**2.19**	**0**	**0**	**11.4**	**100**
Total	306	29	35	21	8	3	2	40	444
Percent	**68.92**	**6.53**	**7.88**	**4.73**	**1.8**	**0.68**	**0.45**	**9.01**	**100**

Appendix C Detailed Regression Outputs/Models

Table 5-1: Regression Coefficients for Cohort 1

Linear regression, absorbing indicators

Number of obs	=	**2,566,758**
F(**136**,**2527640**)	=	**6571.65**
Prob > F	=	**0.0000**
R-squared	=	**0.6485**
Adj R-squared	=	**0.6431**
Root MSE	=	**19.7141**

dailykwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
bill_mo						
200902	-24.79145	.1412338	-175.53	0.000	-25.06826	-24.51463
200903	-38.08344	.1412118	-269.69	0.000	-38.36021	-37.80667
200904	-48.19071	.1412118	-341.27	0.000	-48.46748	-47.91394
200905	-51.88403	.1454994	-356.59	0.000	-52.1692	-51.59886
200906	-44.75884	.144674	-309.38	0.000	-45.0424	-44.47529
200907	-26.82191	.1412117	-189.94	0.000	-27.09868	-26.54514
200908	-35.04642	.1412108	-248.19	0.000	-35.32319	-34.76965
200909	-42.59644	.1412099	-301.65	0.000	-42.87321	-42.31968
200910	-50.4061	.1412109	-356.96	0.000	-50.68287	-50.12933
200911	-49.34843	.1412109	-349.47	0.000	-49.62519	-49.07166
200912	-38.69916	.1412099	-274.05	0.000	-38.97592	-38.42239
201001	.3389038	.1412236	2.40	0.016	.0621106	.6156971
201002	-25.77843	.1478373	-174.37	0.000	-26.06819	-25.48867
201003	-35.5246	.154202	-230.38	0.000	-35.82683	-35.22237
201004	-50.82198	.1544131	-329.13	0.000	-51.12462	-50.51933
201005	-52.95626	.1546336	-342.46	0.000	-53.25933	-52.65318
201006	-40.00506	.1548733	-258.31	0.000	-40.3086	-39.70151
201007	-30.11298	.1551862	-194.04	0.000	-30.41714	-29.80882
201008	-26.8305	.1554479	-172.60	0.000	-27.13518	-26.52583
201009	-37.77273	.1556554	-242.67	0.000	-38.07781	-37.46765
201010	-50.57101	.1558793	-324.42	0.000	-50.87653	-50.26549
201011	-50.71093	.1560978	-324.87	0.000	-51.01688	-50.40498
201012	-34.8108	.1563158	-222.70	0.000	-35.11717	-34.50442
201101	-25.53353	.1565075	-163.15	0.000	-25.84028	-25.22678
201102	-28.12689	.1567052	-179.49	0.000	-28.43403	-27.81976

dailykwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
201103	-40.3933	.156857	-257.52	0.000	-40.70073	-40.08587
201104	-47.69441	.1570531	-303.68	0.000	-48.00223	-47.38659
201105	-51.5173	.1572752	-327.56	0.000	-51.82555	-51.20904
201106	-41.67349	.1575237	-264.55	0.000	-41.98223	-41.36475
201107	-32.61071	.1577562	-206.72	0.000	-32.91991	-32.30151
201108	-26.37461	.1580974	-166.83	0.000	-26.68448	-26.06475
201109	-41.67209	.1583708	-263.13	0.000	-41.98249	-41.36169
201110	-53.47861	.1586079	-337.17	0.000	-53.78947	-53.16774
201111	-50.28012	.1588785	-316.47	0.000	-50.59152	-49.96873
201112	-41.35411	.1591213	-259.89	0.000	-41.66598	-41.04224
201201	-13.68635	.1593321	-85.90	0.000	-13.99864	-13.37407
201202	-35.21679	.1595404	-220.74	0.000	-35.52948	-34.90409
201203	-43.50056	.1597042	-272.38	0.000	-43.81357	-43.18754
201204	-53.30191	.1599149	-333.31	0.000	-53.61533	-52.98848
201205	-51.38956	.1601039	-320.98	0.000	-51.70336	-51.07576
201206	-43.67783	.1603251	-272.43	0.000	-43.99206	-43.3636
201207	-28.41211	.1606323	-176.88	0.000	-28.72694	-28.09728
201208	-31.60931	.1608931	-196.46	0.000	-31.92465	-31.29396
201209	-41.24501	.1610961	-256.03	0.000	-41.56076	-40.92927
201210	-53.60166	.1613527	-332.20	0.000	-53.91791	-53.28542
201211	-48.82241	.1615952	-302.13	0.000	-49.13913	-48.50569
201212	-41.94992	.1618642	-259.17	0.000	-42.26717	-41.63267
201301	-32.44683	.1620838	-200.19	0.000	-32.76451	-32.12915
201302	-31.20381	.1622802	-192.28	0.000	-31.52188	-30.88575
201303	-34.62473	.1624924	-213.09	0.000	-34.94321	-34.30625
201304	-44.76165	.1626598	-275.19	0.000	-45.08046	-44.44285
201305	-41.96365	.1628915	-257.62	0.000	-42.28291	-41.64439
201306	-46.24753	.1631461	-283.47	0.000	-46.56729	-45.92777
201307	-37.98462	.1634631	-232.37	0.000	-38.305	-37.66424
201308	-40.24308	.1637681	-245.73	0.000	-40.56406	-39.9221
201309	-39.91959	.16403	-243.37	0.000	-40.24108	-39.59809
201310	-52.35092	.1669684	-313.54	0.000	-52.67818	-52.02367
201311	-49.4715	.1645449	-300.66	0.000	-49.794	-49.14899
201312	-36.4857	.1647595	-221.45	0.000	-36.80862	-36.16278
201401	-25.85145	.1649936	-156.68	0.000	-26.17483	-25.52807
201402	-20.1828	.1651589	-122.20	0.000	-20.5065	-19.85909
201403	-32.41711	.1653571	-196.04	0.000	-32.7412	-32.09301

dailykwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
201404	-47.13923	.1655151	-284.80	0.000	-47.46364	-46.81483
201405	-53.94467	.1656993	-325.56	0.000	-54.26944	-53.61991
201406	-46.342	.1659543	-279.25	0.000	-46.66726	-46.01673
201407	-39.65235	.1662512	-238.51	0.000	-39.9782	-39.3265
201408	-43.42692	.166532	-260.77	0.000	-43.75332	-43.10053
201409	-41.67842	.1667674	-249.92	0.000	-42.00528	-41.35156
201410	-54.21076	.167084	-324.45	0.000	-54.53824	-53.88328
201411	-49.97948	.1673283	-298.69	0.000	-50.30743	-49.65152
201412	-37.59025	.1676063	-224.28	0.000	-37.91875	-37.26174
201501	-30.08971	.1678349	-179.28	0.000	-30.41866	-29.76076
201502	-27.85939	.1680626	-165.77	0.000	-28.18878	-27.52999
201503	-37.86475	2.92806	-12.93	0.000	-43.60365	-32.12586
bill_mo#c.treatment						
201002	-.998046	.2842407	-3.51	0.000	-1.555148	-.4409441
201003	.4027668	.2366512	1.70	0.089	-.0610612	.8665948
201004	.1203498	.237074	0.51	0.612	-.3443069	.5850065
201005	-.3133746	.2375552	-1.32	0.187	-.7789744	.1522252
201006	-.4536421	.2381362	-1.90	0.057	-.9203808	.0130966
201007	-.2999464	.238863	-1.26	0.209	-.7681095	.1682166
201008	.2360616	.2394443	0.99	0.324	-.2332409	.7053641
201009	.0868944	.239879	0.36	0.717	-.38326	.5570487
201010	.0265773	.2405101	0.11	0.912	-.444814	.4979687
201011	-.3733578	.2411148	-1.55	0.122	-.8459344	.0992187
201012	-1.025995	.241623	-4.25	0.000	-1.499567	-.552422
201101	-.4727582	.2420972	-1.95	0.051	-.9472601	.0017438
201102	-.2708105	.2424863	-1.12	0.264	-.7460753	.2044542
201103	-.1256802	.2428652	-0.52	0.605	-.6016874	.350327
201104	.0132733	.2433458	0.05	0.957	-.4636759	.4902226
201105	-.3265831	.2438726	-1.34	0.181	-.8045648	.1513986
201106	-.3675724	.2444279	-1.50	0.133	-.8466426	.1114977
201107	-.8605531	.2450118	-3.51	0.000	-1.340768	-.3803387
201108	.2757044	.2457893	1.12	0.262	-.206034	.7574428
201109	.0671033	.2464435	0.27	0.785	-.4159174	.550124
201110	-.3633624	.2470589	-1.47	0.141	-.8475892	.1208645
201111	-.4876146	.2476892	-1.97	0.049	-.9730767	-.0021526
201112	-.8468378	.2483244	-3.41	0.001	-1.333545	-.3601307
201201	-.6905811	.2488455	-2.78	0.006	-1.178309	-.2028527

dailykwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
201202	-.4779295	.2492989	-1.92	0.055	-.9665467	.0106876
201203	.070529	.249706	0.28	0.778	-.418886	.5599439
201204	-.3044332	.2502229	-1.22	0.224	-.7948614	.185995
201205	-.7378568	.2507476	-2.94	0.003	-1.229313	-.2464002
201206	-.6094133	.2513254	-2.42	0.015	-1.102002	-.1168243
201207	-.8289124	.2522323	-3.29	0.001	-1.323279	-.3345458
201208	-.0081417	.2527725	-0.03	0.974	-.5035669	.4872835
201209	.0401459	.2534003	0.16	0.874	-.4565099	.5368016
201210	-.412818	.2539839	-1.63	0.104	-.9106175	.0849815
201211	-.6717044	.2545403	-2.64	0.008	-1.170594	-.1728144
201212	-.9558326	.2551993	-3.75	0.000	-1.456014	-.4556509
201301	-.531856	.255663	-2.08	0.037	-1.032946	-.0307655
201302	-.387009	.2560817	-1.51	0.131	-.8889201	.114902
201303	-.4753283	.2565858	-1.85	0.064	-.9782275	.0275709
201304	-.1337356	.2569575	-0.52	0.603	-.6373634	.3698921
201305	.0204629	.2576812	0.08	0.937	-.4845832	.525509
201306	-.9167331	.2582406	-3.55	0.000	-1.422876	-.4105907
201307	-.6104597	.2590048	-2.36	0.018	-1.1181	-.1028193
201308	-.8499576	.2597121	-3.27	0.001	-1.358984	-.3409311
201309	-.2013517	.2604294	-0.77	0.439	-.7117841	.3090807
201310	-.5058013	.2685043	-1.88	0.060	-1.03206	.0204578
201311	-.8613226	.2616363	-3.29	0.001	-1.374121	-.3485246
201312	-.8342583	.2622909	-3.18	0.001	-1.348339	-.3201773
201401	-1.191936	.2628821	-4.53	0.000	-1.707175	-.6766958
201402	-.3805718	.2632034	-1.45	0.148	-.8964411	.1352976
201403	-.0221659	.263661	-0.08	0.933	-.5389322	.4946004
201404	-.1577775	.2640256	-0.60	0.550	-.6752585	.3597035
201405	-.7559144	.2644194	-2.86	0.004	-1.274167	-.2376617
201406	-.9643815	.2650808	-3.64	0.000	-1.483931	-.4448324
201407	-.7067365	.2658314	-2.66	0.008	-1.227757	-.1857162
201408	-.9874304	.2665529	-3.70	0.000	-1.509865	-.464996
201409	-.2783146	.2670346	-1.04	0.297	-.8016931	.245064
201410	-.7281917	.2677255	-2.72	0.007	-1.252924	-.2034592
201411	-1.069556	.2683505	-3.99	0.000	-1.595514	-.5435986
201412	-1.009122	.2689758	-3.75	0.000	-1.536305	-.4819385
201501	-1.353346	.2695363	-5.02	0.000	-1.881628	-.8250646
201502	-1.188561	.2699748	-4.40	0.000	-1.717702	-.65942

dailykwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
201503	-11.65033	6.661593	-1.75	0.080	-24.70682	1.406159
_cons	**82.0131**	**.0999769**	**820.32**	**0.000**	**81.81715**	**82.20905**
account_id	**F(38981, 2527640) =**		**96.898**	**0.000**	**(38982 categories)**	

Table 5-2: Regression Coefficients for Cohort 2

Linear regression, absorbing indicators

Number of obs	=	**2,215,528**
F(125,2147061)	=	**3056.70**
Prob > F	=	**0.0000**
R-squared	=	**0.6275**
Adj R-squared	=	**0.6157**
Root MSE	=	**17.1165**

dailykwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
bill_mo						
200902	-17.84575	.2535838	-70.37	0.000	-18.34277	-17.34873
200903	-26.19925	.2531347	-103.50	0.000	-26.69538	-25.70311
200904	-32.98944	.2528066	-130.49	0.000	-33.48494	-32.49395
200905	-35.66793	.2589317	-137.75	0.000	-36.17542	-35.16043
200906	-29.909	.2590535	-115.45	0.000	-30.41674	-29.40126
200907	-15.21319	.2514402	-60.50	0.000	-15.70601	-14.72038
200908	-19.86893	.2509751	-79.17	0.000	-20.36084	-19.37703
200909	-26.36438	.2504607	-105.26	0.000	-26.85527	-25.87348
200910	-33.66827	.2498555	-134.75	0.000	-34.15798	-33.17856
200911	-33.40229	.2492079	-134.03	0.000	-33.89073	-32.91386
200912	-26.59506	.2485237	-107.01	0.000	-27.08216	-26.10796
201001	.2396388	.2481149	0.97	0.334	-.2466577	.7259352
201002	-18.38033	.2476653	-74.21	0.000	-18.86575	-17.89492
201003	-24.10006	.2472001	-97.49	0.000	-24.58457	-23.61556
201004	-34.57466	.2467583	-140.12	0.000	-35.05829	-34.09102
201005	-36.42112	.2462454	-147.91	0.000	-36.90375	-35.93849
201006	-25.46426	.2456017	-103.68	0.000	-25.94563	-24.98289
201007	-15.53018	.2449925	-63.39	0.000	-16.01036	-15.05
201008	-11.66833	.2444006	-47.74	0.000	-12.14734	-11.18931
200912	-28.76546	.0528385	-544.40	0.000	-28.86902	-28.6619
201001	.3056	.0527691	5.79	0.000	.2021744	.4090256
201002	-21.01873	.0527086	-398.77	0.000	-21.12204	-20.91543
201003	-27.55927	.0526373	-523.57	0.000	-27.66243	-27.4561
201004	-37.39013	.0525453	-711.58	0.000	-37.49312	-37.28715

dailykwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
201005	-38.34076	.0524477	-731.03	0.000	-38.44355	-38.23796
201006	-24.88776	.0523285	-475.61	0.000	-24.99032	-24.78519
201007	-14.21335	.0522164	-272.20	0.000	-14.3157	-14.11101
201008	-10.48959	.052125	-201.24	0.000	-10.59175	-10.38742
201009	-20.88162	.0520327	-401.32	0.000	-20.9836	-20.77964
201010	-34.57804	.0519445	-665.67	0.000	-34.67985	-34.47623
201011	-37.13	.0519441	-714.81	0.000	-37.2318	-37.02819
201012	-26.37798	.0519432	-507.82	0.000	-26.47979	-26.27617
201101	-19.7799	.0519429	-380.80	0.000	-19.88171	-19.6781
201102	-22.33467	.0519429	-429.99	0.000	-22.43647	-22.23286
201103	-30.13852	.0519429	-580.22	0.000	-30.24033	-30.03671
201104	-35.18636	.0519432	-677.40	0.000	-35.28817	-35.08456
201105	-37.164	.0519433	-715.47	0.000	-37.26581	-37.06219
201106	-25.96141	.0519436	-499.80	0.000	-26.06322	-25.8596
201107	-16.9804	.0519434	-326.90	0.000	-17.0822	-16.87859
201108	-8.938315	.051946	-172.07	0.000	-9.040127	-8.836503
201109	-24.67757	.0519575	-474.96	0.000	-24.7794	-24.57573
201110	-38.01808	.0520036	-731.07	0.000	-38.12001	-37.91616
201111	-37.20084	.0592597	-627.76	0.000	-37.31699	-37.0847
201112	-30.19244	.1671862	-180.59	0.000	-30.52012	-29.86476
201201	-8.616932	.1714488	-50.26	0.000	-8.952965	-8.280898
201202	-26.47576	.1717789	-154.13	0.000	-26.81244	-26.13908
201203	-31.82217	.1722967	-184.69	0.000	-32.15987	-31.48448
201204	-38.65593	.1727823	-223.73	0.000	-38.99458	-38.31729
201205	-36.26107	.1732934	-209.25	0.000	-36.60072	-35.92142
201206	-27.9528	.173722	-160.91	0.000	-28.29329	-27.61231
201207	-12.43813	.1745602	-71.25	0.000	-12.78026	-12.096
201208	-14.36256	.1751868	-81.98	0.000	-14.70592	-14.0192
201209	-24.17739	.1757735	-137.55	0.000	-24.5219	-23.83288
201210	-37.78688	.1764508	-214.15	0.000	-38.13272	-37.44104
201211	-35.61431	.1770126	-201.20	0.000	-35.96125	-35.26737
201212	-30.62773	.1774865	-172.56	0.000	-30.9756	-30.27987
201301	-23.82765	.1780517	-133.82	0.000	-24.17663	-23.47868
201302	-23.95455	.178416	-134.26	0.000	-24.30424	-23.60486
201303	-26.35051	.1788217	-147.36	0.000	-26.701	-26.00003
201304	-33.01517	.1792701	-184.16	0.000	-33.36653	-32.6638
201305	-28.34157	.1798041	-157.62	0.000	-28.69398	-27.98916

dailykwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
201306	-30.39242	.1803521	-168.52	0.000	-30.7459	-30.03893
201307	-21.86985	.1810211	-120.81	0.000	-22.22464	-21.51505
201308	-23.27711	.1816721	-128.13	0.000	-23.63318	-22.92104
201309	-22.89951	.1821777	-125.70	0.000	-23.25657	-22.54245
201310	-35.64772	.1868459	-190.79	0.000	-36.01393	-35.28151
201311	-35.98843	.1831773	-196.47	0.000	-36.34745	-35.62941
201312	-27.1076	.1837666	-147.51	0.000	-27.46777	-26.74742
201401	-19.90537	.1842915	-108.01	0.000	-20.26657	-19.54416
201402	-17.02074	.1847058	-92.15	0.000	-17.38275	-16.65872
201403	-24.74346	.1850786	-133.69	0.000	-25.1062	-24.38071
201404	-34.68743	.1854264	-187.07	0.000	-35.05086	-34.324
201405	-38.9415	.1859025	-209.47	0.000	-39.30586	-38.57714
201406	-30.24675	.186429	-162.24	0.000	-30.61215	-29.88136
201407	-22.80101	.1870612	-121.89	0.000	-23.16764	-22.43438
201408	-26.6265	.1877749	-141.80	0.000	-26.99453	-26.25846
201409	-24.25507	.1883269	-128.79	0.000	-24.62418	-23.88595
201410	-38.016	.1890465	-201.09	0.000	-38.38653	-37.64548
201411	-36.65798	.1896205	-193.32	0.000	-37.02963	-36.28633
201412	-27.84845	.1901421	-146.46	0.000	-28.22112	-27.47578
201501	-22.73362	.1906389	-119.25	0.000	-23.10727	-22.35998
201502	-22.07558	.1911297	-115.50	0.000	-22.45019	-21.70098
201503	3.442146	4.458205	0.77	0.440	-5.295776	12.18007
bill_mo#c.treatment						
201110	1.177909	5.978137	0.20	0.844	-10.53903	12.89484
201111	1.146676	.0733344	15.64	0.000	1.002943	1.290409
201112	-.199874	.1670335	-1.20	0.231	-.5272536	.1275056
201201	.0946691	.1713191	0.55	0.581	-.2411103	.4304485
201202	-.4378539	.1716699	-2.55	0.011	-.7743207	-.101387
201203	-.4601863	.172207	-2.67	0.008	-.7977058	-.1226668
201204	-.3252151	.1727138	-1.88	0.060	-.663728	.0132978
201205	-.3604106	.1732491	-2.08	0.037	-.6999726	-.0208485
201206	-.1867211	.1737034	-1.07	0.282	-.5271736	.1537314
201207	.0016065	.1745744	0.01	0.993	-.340553	.343766
201208	-.1597837	.1752303	-0.91	0.362	-.5032288	.1836614
201209	-.3251459	.1758454	-1.85	0.064	-.6697965	.0195048
201210	-.4018151	.17655	-2.28	0.023	-.7478468	-.0557833
201211	-.4255667	.1771364	-2.40	0.016	-.7727476	-.0783858

dailykwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
201212	-.4188694	.1776346	-2.36	0.018	-.7670268	-.0707119
201301	-.4948893	.1782221	-2.78	0.005	-.8441983	-.1455802
201302	-.7059721	.1786039	-3.95	0.000	-1.056029	-.3559148
201303	-.4526334	.1790262	-2.53	0.011	-.8035182	-.1017485
201304	-.4723199	.1794961	-2.63	0.009	-.8241258	-.1205139
201305	-.2634995	.1800543	-1.46	0.143	-.6163994	.0894005
201306	-.2902298	.1806272	-1.61	0.108	-.6442527	.0637932
201307	-.2077546	.1813281	-1.15	0.252	-.5631512	.147642
201308	-.3211406	.1820099	-1.76	0.078	-.6778735	.0355923
201309	-.4051002	.1825448	-2.22	0.026	-.7628814	-.0473189
201310	-.4993561	.1874367	-2.66	0.008	-.8667252	-.1319869
201311	-.5429096	.1835963	-2.96	0.003	-.9027518	-.1830674
201312	-.6166717	.1842072	-3.35	0.001	-.9777112	-.2556322
201401	-.5852752	.1847524	-3.17	0.002	-.9473832	-.2231671
201402	-.8195814	.1851818	-4.43	0.000	-1.182531	-.4566318
201403	-.8151091	.1855701	-4.39	0.000	-1.17882	-.4513985
201404	-.5986212	.1859361	-3.22	0.001	-.9630493	-.2341931
201405	-.483908	.1864348	-2.60	0.009	-.8493135	-.1185025
201406	-.4332364	.1869856	-2.32	0.021	-.7997214	-.0667514
201407	-.411869	.1876472	-2.19	0.028	-.7796507	-.0440872
201408	-.5489385	.1883909	-2.91	0.004	-.918178	-.179699
201409	-.4901407	.1889699	-2.59	0.009	-.8605151	-.1197664
201410	-.5050759	.1897156	-2.66	0.008	-.8769116	-.1332402
201411	-.655412	.1903117	-3.44	0.001	-1.028416	-.2824078
201412	-.5599978	.1908548	-2.93	0.003	-.9340663	-.1859293
201501	-.6884544	.1913706	-3.60	0.000	-1.063534	-.3133749
201502	-1.049984	.1918782	-5.47	0.000	-1.426058	-.6739095
201503	-29.74738	4.543176	-6.55	0.000	-38.65184	-20.84292
_cons	**66.72366**	**.0381216**	**1750.28**	**0.000**	**66.64894**	**66.79837**
account_id	F(252162, 16757007) =		**105.772**	**0.000**	(252163 categories)	

Table 5-3: Regression Coefficients for Cohort 3

Linear regression, absorbing indicators	Number of obs	=	**2,926,209**
	F(**89**,**2881572**)	=	**8938.50**
	Prob > F	=	**0.0000**
	R-squared	=	**0.6341**
	Adj R-squared	=	**0.6284**

Root MSE = **16.9490**

dailykwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
bill_mo						
200902	-20.08308	.1292282	-155.41	0.000	-20.33637	-19.8298
200903	-28.33135	.129129	-219.40	0.000	-28.58444	-28.07826
200904	-34.68551	.1290491	-268.78	0.000	-34.93844	-34.43258
200905	-36.3648	.1329541	-273.51	0.000	-36.62538	-36.10421
200906	-28.64306	.1338806	-213.94	0.000	-28.90546	-28.38066
200907	-12.20284	.1288081	-94.74	0.000	-12.4553	-11.95038
200908	-18.30234	.1287244	-142.18	0.000	-18.55464	-18.05005
200909	-24.85322	.1286265	-193.22	0.000	-25.10533	-24.60112
200910	-34.13996	.1285267	-265.63	0.000	-34.39187	-33.88806
200911	-35.20157	.1284045	-274.15	0.000	-35.45324	-34.94991
200912	-27.98245	.1282796	-218.14	0.000	-28.23387	-27.73102
201001	.2747398	.1281792	2.14	0.032	.0235132	.5259665
201002	-20.21861	.1281114	-157.82	0.000	-20.4697	-19.96752
201003	-26.45808	.1280163	-206.68	0.000	-26.70899	-26.20717
201004	-36.06581	.1278986	-281.99	0.000	-36.31649	-35.81513
201005	-37.13915	.1277512	-290.71	0.000	-37.38954	-36.88877
201006	-23.4393	.1275611	-183.75	0.000	-23.68931	-23.18928
201007	-12.27367	.1274291	-96.32	0.000	-12.52342	-12.02391
201008	-8.172411	.1273055	-64.20	0.000	-8.421925	-7.922896
201009	-18.82537	.1271771	-148.02	0.000	-19.07464	-18.57611
201010	-32.89545	.1270799	-258.86	0.000	-33.14452	-32.64637
201011	-36.01282	.1269776	-283.62	0.000	-36.26169	-35.76394
201012	-25.54774	.1268638	-201.38	0.000	-25.79639	-25.2991
201101	-18.81483	.1267612	-148.43	0.000	-19.06328	-18.56639
201102	-21.41847	.1266705	-169.09	0.000	-21.66674	-21.1702
201103	-29.1796	.1265857	-230.51	0.000	-29.42771	-28.9315
201104	-34.04651	.1264717	-269.20	0.000	-34.29439	-33.79863
201105	-35.91511	.1263507	-284.25	0.000	-36.16275	-35.66747
201106	-24.45616	.1262106	-193.77	0.000	-24.70353	-24.20879
201107	-15.42438	.1260733	-122.34	0.000	-15.67148	-15.17728
201108	-6.741755	.1259038	-53.55	0.000	-6.988522	-6.494988
201109	-22.85227	.1257631	-181.71	0.000	-23.09876	-22.60578

dailykwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
201110	-36.65051	.125623	-291.75	0.000	-36.89673	-36.4043
201111	-35.60707	.1254804	-283.77	0.000	-35.853	-35.36113
201112	-29.14901	.1253392	-232.56	0.000	-29.39467	-28.90335
201201	-7.800469	.1252023	-62.30	0.000	-8.045861	-7.555077
201202	-25.62801	.1250952	-204.87	0.000	-25.8732	-25.38283
201203	-30.77386	.1249876	-246.22	0.000	-31.01883	-30.52889
201204	-37.29928	.12484	-298.78	0.000	-37.54396	-37.0546
201205	-34.91514	.1247126	-279.96	0.000	-35.15957	-34.67071
201206	-26.41968	.1245485	-212.12	0.000	-26.66379	-26.17557
201207	-10.12042	.1243494	-81.39	0.000	-10.36414	-9.8767
201208	-12.18418	.124123	-98.16	0.000	-12.42745	-11.9409
201209	-22.42019	.1238963	-180.96	0.000	-22.66303	-22.17736
201210	-36.45393	.1236225	-294.88	0.000	-36.69622	-36.21163
201211	-34.59249	.1232514	-280.67	0.000	-34.83406	-34.35092
201212	-29.73124	.1227097	-242.29	0.000	-29.97175	-29.49074
201301	-23.1828	.1218731	-190.22	0.000	-23.42167	-22.94394
201302	-23.26222	.1218663	-190.88	0.000	-23.50108	-23.02337
201303	-25.33859	.1218663	-207.92	0.000	-25.57745	-25.09974
201304	-31.6114	.1218669	-259.39	0.000	-31.85026	-31.37255
201305	-27.67671	.1218681	-227.10	0.000	-27.91557	-27.43786
201306	-28.91309	.1218699	-237.25	0.000	-29.15195	-28.67423
201307	-20.25727	.1218706	-166.22	0.000	-20.49613	-20.01841
201308	-21.51732	.1218735	-176.55	0.000	-21.75619	-21.27845
201309	-21.117	.1218741	-173.27	0.000	-21.35587	-20.87814
201310	-34.04859	.1232357	-276.29	0.000	-34.29013	-33.80706
201311	-34.78961	.1218748	-285.45	0.000	-35.02848	-34.55074
201312	-26.28201	.121873	-215.65	0.000	-26.52087	-26.04314
201401	-19.43758	.1433209	-135.62	0.000	-19.71848	-19.15667
201402	-15.97063	.2709053	-58.95	0.000	-16.5016	-15.43967
201403	-23.45941	.2719136	-86.28	0.000	-23.99235	-22.92647
201404	-33.3373	.272343	-122.41	0.000	-33.87108	-32.80352
201405	-37.49706	.273018	-137.34	0.000	-38.03217	-36.96196
201406	-28.89414	.2737324	-105.56	0.000	-29.43065	-28.35764
201407	-21.54625	.2747245	-78.43	0.000	-22.08471	-21.0078
201408	-25.65358	.2757888	-93.02	0.000	-26.19412	-25.11305

dailykwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
201409	-23.12908	.2766988	-83.59	0.000	-23.6714	-22.58676
201410	-36.79665	.2774156	-132.64	0.000	-37.34037	-36.25292
201411	-35.57965	.2782292	-127.88	0.000	-36.12497	-35.03433
201412	-26.71026	.2790476	-95.72	0.000	-27.25718	-26.16333
201501	-21.76321	.2797862	-77.79	0.000	-22.31158	-21.21484
201502	-21.04667	.2802922	-75.09	0.000	-21.59604	-20.49731
201503	-31.36456	6.050971	-5.18	0.000	-43.22425	-19.50487
bill_mo#c.treatment						
201401	.7290798	.1624642	4.49	0.000	.4106557	1.047504
201402	-.4451903	.2691996	-1.65	0.098	-.972812	.0824314
201403	-.5906284	.2702741	-2.19	0.029	-1.120356	-.0609007
201404	-.1007311	.2707676	-0.37	0.710	-.631426	.4299638
201405	.0099483	.2715286	0.04	0.971	-.5222383	.5421349
201406	-.0413688	.2723311	-0.15	0.879	-.5751283	.4923906
201407	.1153088	.2734445	0.42	0.673	-.4206329	.6512505
201408	.1721789	.2746147	0.63	0.531	-.3660564	.7104141
201409	.1520319	.2756373	0.55	0.581	-.3882075	.6922713
201410	.0827628	.2764655	0.30	0.765	-.4590998	.6246255
201411	-.3469823	.2773707	-1.25	0.211	-.8906191	.1966545
201412	-.7206714	.2782765	-2.59	0.010	-1.266084	-.1752593
201501	-.700161	.2791075	-2.51	0.012	-1.247202	-.1531202
201502	-1.236595	.2796804	-4.42	0.000	-1.784758	-.688431
201503	1.00154	6.266493	0.16	0.873	-11.28057	13.28365
_cons	**63.56836**	**.0914741**	**694.93**	**0.000**	**63.38908**	**63.74765**
account_id	F(44547, 2881572) =		**94.125**	**0.000**	(44548 categories)	

Table 5-4: Regression Coefficients for Cohort 4

Linear regression, absorbing indicators

Number of obs	=	**2,751,694**
F(**111**,**2700166**)	=	**5494.96**
Prob > F	=	**0.0000**
R-squared	=	**0.6321**
Adj R-squared	=	**0.6251**
Root MSE	=	**18.1337**

dailykwh	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
bill_mo						
200902	-20.25129	.171211	-118.28	0.000	-20.58686	-19.91573
200903	-30.2696	.1709687	-177.05	0.000	-30.6047	-29.93451
200904	-38.14021	.1707299	-223.40	0.000	-38.47484	-37.80559
200905	-41.35448	.174476	-237.02	0.000	-41.69645	-41.01252
200906	-35.95461	.1750888	-205.35	0.000	-36.29778	-35.61144
200907	-21.35694	.1699891	-125.64	0.000	-21.69011	-21.02376
200908	-27.27395	.1696288	-160.79	0.000	-27.60642	-26.94149
200909	-33.13701	.1692615	-195.77	0.000	-33.46876	-32.80526
200910	-39.70871	.16892	-235.07	0.000	-40.03978	-39.37763
200911	-38.98265	.1685426	-231.29	0.000	-39.31299	-38.65232
200912	-30.40848	.16816	-180.83	0.000	-30.73807	-30.07889
201001	.6655422	.1679019	3.96	0.000	.3364604	.9946241
201002	-20.67216	.1676198	-123.33	0.000	-21.00069	-20.34363
201003	-28.2362	.1673493	-168.73	0.000	-28.5642	-27.9082
201004	-40.24885	.1670529	-240.93	0.000	-40.57627	-39.92143
201005	-42.193	.1666786	-253.14	0.000	-42.51968	-41.86632
201006	-31.69189	.1662477	-190.63	0.000	-32.01773	-31.36605
201007	-22.60924	.1658992	-136.28	0.000	-22.9344	-22.28408
201008	-19.34499	.1654975	-116.89	0.000	-19.66936	-19.02062
201009	-28.34114	.165035	-171.73	0.000	-28.66461	-28.01768
201010	-39.41132	.1646206	-239.41	0.000	-39.73397	-39.08867
201011	-40.00389	.162231	-246.59	0.000	-40.32186	-39.68593
201012	-28.03621	.1601314	-175.08	0.000	-28.35006	-27.72236
201101	-20.915	.1584767	-131.98	0.000	-21.22561	-20.60439
201102	-23.09246	.1570707	-147.02	0.000	-23.40031	-22.78461
201103	-32.2405	.1555568	-207.26	0.000	-32.54539	-31.93562
201104	-38.0825	.1540992	-247.13	0.000	-38.38453	-37.78047
201105	-41.32377	.152781	-270.48	0.000	-41.62322	-41.02433
201106	-32.50975	.1513448	-214.81	0.000	-32.80638	-32.21312
201107	-24.48495	.1500142	-163.22	0.000	-24.77897	-24.19093
201108	-17.46912	.1488199	-117.38	0.000	-17.7608	-17.17744
201109	-31.01415	.1477672	-209.89	0.000	-31.30377	-30.72453
201110	-41.85936	.1470177	-284.72	0.000	-42.14751	-41.57121
201111	-39.33979	.146397	-268.72	0.000	-39.62672	-39.05286
201112	-32.794	.14591	-224.76	0.000	-33.07998	-32.50803
201201	-11.14593	.1459104	-76.39	0.000	-11.43191	-10.85995

dailykwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
201202	-27.89126	.1459087	-191.16	0.000	-28.17724	-27.60529
201203	-33.35837	.1515326	-220.14	0.000	-33.65537	-33.06138
201204	-41.40778	.1588162	-260.73	0.000	-41.71905	-41.0965
201205	-39.51803	.1622632	-243.54	0.000	-39.83606	-39.2
201206	-32.80713	.1715079	-191.29	0.000	-33.14328	-32.47098
201207	-18.50492	.1816578	-101.87	0.000	-18.86096	-18.14888
201208	-19.11961	.1990395	-96.06	0.000	-19.50972	-18.7295
201209	-28.5292	.2087116	-136.69	0.000	-28.93826	-28.12013
201210	-40.30218	.2311143	-174.38	0.000	-40.75516	-39.84921
201211	-37.44886	.2469983	-151.62	0.000	-37.93297	-36.96476
201212	-32.33315	.274504	-117.79	0.000	-32.87117	-31.79513
201301	-24.75941	.332333	-74.50	0.000	-25.41077	-24.10805
201302	-23.59969	.3337977	-70.70	0.000	-24.25392	-22.94546
201303	-26.01468	.3349147	-77.68	0.000	-26.6711	-25.35826
201304	-33.84687	.3369764	-100.44	0.000	-34.50733	-33.18641
201305	-32.9084	.3389911	-97.08	0.000	-33.57282	-32.24399
201306	-34.83838	.3405234	-102.31	0.000	-35.5058	-34.17097
201307	-27.96054	.343106	-81.49	0.000	-28.63302	-27.28807
201308	-28.81061	.345582	-83.37	0.000	-29.48794	-28.13328
201309	-28.81519	.3476441	-82.89	0.000	-29.49656	-28.13382
201310	-38.88659	.356634	-109.04	0.000	-39.58558	-38.1876
201311	-37.35462	.3510228	-106.42	0.000	-38.04262	-36.66663
201312	-27.75676	.3522558	-78.80	0.000	-28.44717	-27.06635
201401	-19.55485	.3540611	-55.23	0.000	-20.24879	-18.8609
201402	-15.30162	.3552365	-43.07	0.000	-15.99787	-14.60537
201403	-23.96568	.3567859	-67.17	0.000	-24.66497	-23.26639
201404	-35.21352	.3584596	-98.24	0.000	-35.91609	-34.51095
201405	-41.10478	.3603802	-114.06	0.000	-41.81111	-40.39844
201406	-34.70073	.3619581	-95.87	0.000	-35.41016	-33.99131
201407	-28.51158	.363894	-78.35	0.000	-29.2248	-27.79836
201408	-31.74411	.3663758	-86.64	0.000	-32.46219	-31.02602
201409	-29.65059	.3677487	-80.63	0.000	-30.37137	-28.92982
201410	-40.56107	.3699773	-109.63	0.000	-41.28621	-39.83592
201411	-37.74686	.3719445	-101.49	0.000	-38.47586	-37.01786
201412	-28.27673	.3734026	-75.73	0.000	-29.00859	-27.54487
201501	-22.64535	.3753153	-60.34	0.000	-23.38096	-21.90975
201502	-20.6132	.3768831	-54.69	0.000	-21.35188	-19.87452

dailykwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
201503	-54.97956	8.17446	-6.73	0.000	-71.00121	-38.9579
bill_mo#c.treatment						
201203	-3.477931	.202189	-17.20	0.000	-3.874214	-3.081648
201204	-.1646119	.1676776	-0.98	0.326	-.4932541	.1640302
201205	-.7160697	.1639019	-4.37	0.000	-1.037312	-.3948277
201206	-.4168556	.163344	-2.55	0.011	-.737004	-.0967072
201207	-1.166466	.1694223	-6.88	0.000	-1.498528	-.8344046
201208	-2.461369	.1844947	-13.34	0.000	-2.822972	-2.099766
201209	-1.493878	.1941168	-7.70	0.000	-1.87434	-1.113416
201210	-1.151437	.2169183	-5.31	0.000	-1.576589	-.7262847
201211	-.6024448	.2334332	-2.58	0.010	-1.059966	-.1449239
201212	-.5923988	.2620799	-2.26	0.024	-1.106066	-.0787314
201301	-1.195092	.3219581	-3.71	0.000	-1.826119	-.5640658
201302	-1.397642	.3235937	-4.32	0.000	-2.031874	-.7634094
201303	-1.401942	.3248704	-4.32	0.000	-2.038677	-.7652078
201304	-1.258486	.3271427	-3.85	0.000	-1.899674	-.6172978
201305	.6833489	.329372	2.07	0.038	.0377914	1.328906
201306	-.1634385	.3311059	-0.49	0.622	-.8123945	.4855174
201307	.5779215	.3339855	1.73	0.084	-.0766784	1.232521
201308	.1703595	.336733	0.51	0.613	-.4896253	.8303444
201309	.4560016	.3390207	1.35	0.179	-.208467	1.12047
201310	-.7493584	.3490173	-2.15	0.032	-1.43342	-.0652968
201311	-1.139674	.3428038	-3.32	0.001	-1.811558	-.4677908
201312	-1.004992	.3442139	-2.92	0.004	-1.679639	-.3303446
201401	-1.432882	.3461749	-4.14	0.000	-2.111372	-.7543911
201402	-1.52963	.3474794	-4.40	0.000	-2.210677	-.8485823
201403	-1.671119	.3491713	-4.79	0.000	-2.355483	-.986756
201404	-1.591489	.3509927	-4.53	0.000	-2.279422	-.9035555
201405	-.9536604	.3530786	-2.70	0.007	-1.645682	-.2616387
201406	-.1102677	.354829	-0.31	0.756	-.8057201	.5851847
201407	.3841673	.3569724	1.08	0.282	-.3154859	1.083821
201408	.019604	.3596724	0.05	0.957	-.6853413	.7245492
201409	.151487	.3612314	0.42	0.675	-.5565138	.8594877
201410	-.9232109	.3636557	-2.54	0.011	-1.635963	-.2104584
201411	-1.166625	.3657934	-3.19	0.001	-1.883567	-.4496826
201412	-1.047418	.3673891	-2.85	0.004	-1.767488	-.3273483
201501	-1.207977	.3694445	-3.27	0.001	-1.932076	-.483879

dailykwh	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
201502	-1.624065	.3711396	-4.38	0.000	-2.351486	-.8966445
201503	29.33989	8.337253	3.52	0.000	12.99917	45.68062
_cons	**66.99022**	**.1216746**	**550.57**	**0.000**	**66.75174**	**67.2287**
account_id	F(51416, 2700166) =		**78.284**	**0.000**	(51417 categories)	

Table 5-5: Regression Coefficients for Cohort 5

Linear regression, absorbing indicators

Number of obs	=	**2,215,528**
F(125,2147061)	=	**3056.70**
Prob > F	=	**0.0000**
R-squared	=	**0.6275**
Adj R-squared	=	**0.6157**
Root MSE	=	**17.1165**

dailykwh	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
bill_mo						
200902	-17.84575	.2535838	-70.37	0.000	-18.34277	-17.34873
200903	-26.19925	.2531347	-103.50	0.000	-26.69538	-25.70311
200904	-32.98944	.2528066	-130.49	0.000	-33.48494	-32.49395
200905	-35.66793	.2589317	-137.75	0.000	-36.17542	-35.16043
200906	-29.909	.2590535	-115.45	0.000	-30.41674	-29.40126
200907	-15.21319	.2514402	-60.50	0.000	-15.70601	-14.72038
200908	-19.86893	.2509751	-79.17	0.000	-20.36084	-19.37703
200909	-26.36438	.2504607	-105.26	0.000	-26.85527	-25.87348
200910	-33.66827	.2498555	-134.75	0.000	-34.15798	-33.17856
200911	-33.40229	.2492079	-134.03	0.000	-33.89073	-32.91386
200912	-26.59506	.2485237	-107.01	0.000	-27.08216	-26.10796
201001	.2396388	.2481149	0.97	0.334	-.2466577	.7259352
201002	-18.38033	.2476653	-74.21	0.000	-18.86575	-17.89492
201003	-24.10006	.2472001	-97.49	0.000	-24.58457	-23.61556
201004	-34.57466	.2467583	-140.12	0.000	-35.05829	-34.09102
201005	-36.42112	.2462454	-147.91	0.000	-36.90375	-35.93849
201006	-25.46426	.2456017	-103.68	0.000	-25.94563	-24.98289
201007	-15.53018	.2449925	-63.39	0.000	-16.01036	-15.05
201008	-11.66833	.2444006	-47.74	0.000	-12.14734	-11.18931
201009	-20.6726	.2438814	-84.76	0.000	-21.1506	-20.1946
201010	-32.89579	.2434299	-135.13	0.000	-33.37291	-32.41868
201011	-34.51137	.2425508	-142.29	0.000	-34.98676	-34.03598
201012	-24.35761	.2418283	-100.72	0.000	-24.83159	-23.88364

dailykwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
201101	-17.75408	.2446891	-72.56	0.000	-18.23366	-17.2745
201102	-19.99735	.2459046	-81.32	0.000	-20.47932	-19.51539
201103	-27.30946	.2451443	-111.40	0.000	-27.78994	-26.82899
201104	-32.36415	.2441671	-132.55	0.000	-32.84271	-31.88559
201105	-35.23274	.2430855	-144.94	0.000	-35.70918	-34.7563
201106	-26.06252	.2418926	-107.74	0.000	-26.53662	-25.58842
201107	-18.00164	.2406066	-74.82	0.000	-18.47322	-17.53006
201108	-9.94067	.2390074	-41.59	0.000	-10.40912	-9.472224
201109	-24.22129	.2370839	-102.16	0.000	-24.68597	-23.75661
201110	-35.83312	.2347754	-152.63	0.000	-36.29328	-35.37297
201111	-33.73498	.2319013	-145.47	0.000	-34.1895	-33.28046
201112	-27.96645	.2287111	-122.28	0.000	-28.41471	-27.51818
201201	-9.793194	.2236752	-43.78	0.000	-10.23159	-9.354798
201202	-24.23723	.2196393	-110.35	0.000	-24.66772	-23.80675
201203	-29.62073	.216009	-137.13	0.000	-30.0441	-29.19736
201204	-36.43671	.2132637	-170.85	0.000	-36.8547	-36.01872
201205	-34.69293	.2108353	-164.55	0.000	-35.10616	-34.2797
201206	-27.70136	.2085684	-132.82	0.000	-28.11015	-27.29258
201207	-13.20681	.207167	-63.75	0.000	-13.61285	-12.80077
201208	-14.41315	.2059905	-69.97	0.000	-14.81688	-14.00942
201209	-23.35565	.2042997	-114.32	0.000	-23.75607	-22.95523
201210	-35.25979	.2029714	-173.72	0.000	-35.65761	-34.86198
201211	-32.45737	.2020025	-160.68	0.000	-32.85329	-32.06145
201212	-27.68312	.201272	-137.54	0.000	-28.0776	-27.28863
201301	-21.2508	.2015737	-105.42	0.000	-21.64588	-20.85573
201302	-20.64013	.2019604	-102.20	0.000	-21.03597	-20.2443
201303	-22.8294	.201788	-113.14	0.000	-23.2249	-22.43391
201304	-29.88356	.2017703	-148.11	0.000	-30.27902	-29.4881
201305	-27.54289	.2018069	-136.48	0.000	-27.93842	-27.14735
201306	-28.86421	.2020797	-142.84	0.000	-29.26028	-28.46814
201307	-21.05213	.2018071	-104.32	0.000	-21.44766	-20.65659
201308	-22.24494	.2010395	-110.65	0.000	-22.63897	-21.85091
201309	-21.59074	.1999411	-107.99	0.000	-21.98262	-21.19886
201310	-32.67049	.2014073	-162.21	0.000	-33.06524	-32.27574
201311	-32.20081	.2014192	-159.87	0.000	-32.59558	-31.80603
201312	-23.67996	.2021088	-117.16	0.000	-24.07609	-23.28383
201401	-16.62776	.2036089	-81.67	0.000	-17.02683	-16.2287

dailykwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
201402	-12.97563	.2044666	-63.46	0.000	-13.37638	-12.57488
201403	-20.30845	.2069333	-98.14	0.000	-20.71403	-19.90287
201404	-30.12111	.2084358	-144.51	0.000	-30.52964	-29.71259
201405	-34.4822	.2109107	-163.49	0.000	-34.89558	-34.06882
201406	-26.79331	.2169204	-123.52	0.000	-27.21847	-26.36815
201407	-19.61109	.2229228	-87.97	0.000	-20.04801	-19.17417
201408	-22.96147	.2272353	-101.05	0.000	-23.40685	-22.5161
201409	-20.24028	.2273951	-89.01	0.000	-20.68596	-19.79459
201410	-32.31459	.2376536	-135.97	0.000	-32.78038	-31.84879
201411	-31.23013	.2685874	-116.28	0.000	-31.75656	-30.70371
201412	-22.86217	.3066084	-74.56	0.000	-23.46311	-22.26122
201501	-17.37898	.4494226	-38.67	0.000	-18.25983	-16.49813
201502	-15.83936	.4553166	-34.79	0.000	-16.73176	-14.94696
201503	-11.6503	4.094214	-2.85	0.004	-19.67482	-3.625782
bill_mo#c.treatment						
201101	3.813102	.6853941	5.56	0.000	2.469753	5.15645
201102	5.225165	.5699988	9.17	0.000	4.107987	6.342342
201103	.7775768	.5701695	1.36	0.173	-.3399354	1.895089
201104	-1.040399	.5707562	-1.82	0.068	-2.159061	.0782637
201105	-1.879752	.5710489	-3.29	0.001	-2.998988	-.7605162
201106	-1.116906	.5723311	-1.95	0.051	-2.238655	.004843
201107	-.9879711	.5741218	-1.72	0.085	-2.11323	.1372876
201108	-1.97695	.5747574	-3.44	0.001	-3.103455	-.8504456
201109	-2.649437	.5755413	-4.60	0.000	-3.777478	-1.521396
201110	-2.920558	.5759159	-5.07	0.000	-4.049333	-1.791783
201111	-2.059963	.5760767	-3.58	0.000	-3.189053	-.9308725
201112	.0765715	.5786362	0.13	0.895	-1.057535	1.210678
201201	9.499195	.5780055	16.43	0.000	8.366324	10.63207
201202	2.555006	.5772737	4.43	0.000	1.423569	3.686442
201203	.7574856	.5764458	1.31	0.189	-.3723281	1.887299
201204	-1.999755	.5759714	-3.47	0.001	-3.128638	-.8708708
201205	-2.059104	.5762069	-3.57	0.000	-3.188449	-.929758
201206	-1.667399	.5762308	-2.89	0.004	-2.796791	-.5380064
201207	-1.280187	.5786626	-2.21	0.027	-2.414345	-.1460282
201208	-2.630291	.5788297	-4.54	0.000	-3.764777	-1.495805
201209	-3.420206	.5791161	-5.91	0.000	-4.555254	-2.285159
201210	-3.609899	.5801438	-6.22	0.000	-4.74696	-2.472837

dailykwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
201211	-2.362982	.5804063	-4.07	0.000	-3.500558	-1.225406
201212	-.7030058	.5819815	-1.21	0.227	-1.843669	.4376576
201301	1.672536	.3927317	4.26	0.000	.9027952	2.442276
201302	1.394577	.2746455	5.08	0.000	.8562818	1.932873
201303	.7872685	.2405541	3.27	0.001	.3157908	1.258746
201304	.4733666	.2143658	2.21	0.027	.0532172	.893516
201305	2.008772	.1957524	10.26	0.000	1.625104	2.39244
201306	.4378648	.1772609	2.47	0.014	.0904395	.78529
201307	.6465542	.1682486	3.84	0.000	.3167928	.9763156
201308	.4684289	.1648051	2.84	0.004	.1454168	.7914411
201309	.4394908	.1648236	2.67	0.008	.1164422	.7625393
201310	-.8918674	.1588828	-5.61	0.000	-1.203272	-.5804626
201311	-.6093534	.1471362	-4.14	0.000	-.8977352	-.3209715
201312	.268544	.1428581	1.88	0.060	-.011453	.5485409
201401	.3121121	.141024	2.21	0.027	.03571	.5885143
201402	.4797521	.1407488	3.41	0.001	.2038893	.7556149
201403	-.4479907	.1401949	-3.20	0.001	-.7227678	-.1732136
201404	-.938113	.1408947	-6.66	0.000	-1.214262	-.6619644
201405	-1.268604	.1424086	-8.91	0.000	-1.54772	-.989488
201406	-.7901265	.1475334	-5.36	0.000	-1.079287	-.5009661
201407	-1.014501	.1544132	-6.57	0.000	-1.317145	-.7118565
201408	-1.234247	.159877	-7.72	0.000	-1.547601	-.9208939
201409	-1.502204	.1605661	-9.36	0.000	-1.816908	-1.1875
201410	-2.278337	.1732904	-13.15	0.000	-2.61798	-1.938694
201411	-1.404285	.211993	-6.62	0.000	-1.819783	-.9887856
201412	-.8677994	.2579375	-3.36	0.001	-1.373348	-.3622508
201501	-1.480291	.4175256	-3.55	0.000	-2.298626	-.6619551
201502	-1.627024	.4239438	-3.84	0.000	-2.457939	-.7961085
201503	-7.997612	4.196511	-1.91	0.057	-16.22263	.2274029
_cons	**60.04233**	**.1810004**	**331.72**	**0.000**	**59.68757**	**60.39708**
account_id	F(68341, 2147061) =		**47.239**	**0.000**	(68342 categories)	

Appendix D Awareness and Engagement Index

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, 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. Nexant applies 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 of a hypothesis of MyHER influence.

Consider a series of coin flips. What is the probability of obtaining 30 heads in 45 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 30 out of 45 survey questions if MyHER has no influence on customer awareness and attitudes about energy efficiency?

Nexant assigned each survey question a category. Table 5-6 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 5-6: Classification of Survey Responses and Treatment Group "Success Rate"

Question Category	Count of Q where T>C	Number of Q in topic area	Portion of Q where T>C higher
Duke Energy's Public Stance on Energy Efficiency	3	3	100%
Customer Engagement with Duke Energy Website	3	6	50%
Customers' Reported Energy-saving Behaviors	3	6	50%
Customers' Past & Future Equipment Purchases	9	16	56%
Customer Motivation, Engagement & Awareness of Energy Efficiency			
Awareness	2	2	100%
Engagement	2	4	50%
Motivation	5	5	100%
Customer Satisfaction with Duke Energy	3	3	100%
Total	**30**	**45**	**67%**

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. Instead, the treatment group provided answers consistent with a MyHER treatment effect in approximately 67% of the survey questions. Using standard statistical techniques (specifically, the non-parametric sign test), Nexant calculated the probability of randomly obtaining this result is less than 1%. Nexant concludes the overall pattern of survey responses gives strong indication the MyHER affects customers' behaviors, opinions, attitudes, and level of engagement with energy efficiency.

Appendix E MyHER Control Group Size Memorandum

May 11, 2015

To: Roshena Ham, Rose Stoeckle, Jean Williams; Duke Energy

From: Rush Childs, Jon Cook, Jesse Smith, Mike Sullivan; Nexant

CC: Jim Herndon, Patrick Burns, Dulane Moran; Nexant

RE: Analysis of Control Group Requirements for DEO MyHER

Introduction

Duke Energy requested that Nexant determine whether it is possible to reduce the size of the DEO MyHER control group while continuing to meet regulatory EM&V requirements. The control group consists of DEO customers withheld from the MyHER program; these customers serve as a baseline for determining the energy savings impacts of the MyHER program. Customer response to the information contained in the reports was estimated to save an average of 220 kWh per customer during program year 2013.

Customers in the MyHER control group do not receive information from the MyHER that could potentially help them identify ways to reduce their home energy consumption. Although Nexant is currently developing estimates of the MyHER program impacts for the 2014 program year, we have developed a statistical simulation that explores the potential for reducing the control group size while continuing to meet regulatory EM&V requirements. Nevertheless, the interpretation of the results depends on several technical points that Duke Energy may wish to consider from the standpoint of regulatory strategy.

Key Concepts and Considerations

Regulatory requirements for statistical confidence and precision describe the uncertainty around estimates of program energy savings impacts. Current requirements are to report program savings with 90% confidence and a relative precision of 10%. There are two critical concepts embedded in this requirement. The first concept is that of the uncertainty inherent to statistical estimates. The second concept is absolute versus relative precision of statistical estimates. The current regulatory requirement takes an implicit stance on both topics, but other valid positions exist and may be more appropriate for behavioral programs like MyHER.

The 90/10 requirement is designed to limit sampling error for point estimates of loads and energy consumption. This standard is designed to limit the risk that the sampling process has resulted in significant over or under estimation in the case where the objective is to assess the

difference between claimed and verified energy savings from energy efficiency investments. It is easy to see how the same logic can be applied to the estimation of energy savings from behavioral interventions measured by randomized controlled trials (RCT). However, it is important to keep in mind the fact that the choice of precision (i.e. 10%) and the confidence level (i.e., 90%) are essentially arbitrary. That is, one could choose to set the lower limit of precision at 5%, or 20% or any other number that utilities and regulators can agree is reasonable in light of their appetite for risk and the costs associated with selecting a given sample size. The utility is currently compensated for the average difference between the treated and untreated populations in any case. That means there is a 90% chance that the utility will not be over or under compensated by more than 10%. The utility takes this risk as well as the regulator. The risk is symmetrical so that both parties take an equal share of the risk. It should be clear that both parties could agree to take more risk on the upside and the downside; and that the agreed upon level of risk is purely arbitrary.

Controlling risk arising from the sampling process in an RCT comes at a cost to the utility and the regulator because the energy savings that would occur from exposing control group customers to the treatment are not realized. So, in essence the utility and regulator are agreeing to trade off *certain* savings in order to limit the possible error in the estimation of the magnitude of the savings. In determining the appropriate size of sample for the MyHER program, it is necessary to consider both the benefits and costs of setting the control group sample size at a given number. This memorandum describes a Monte Carlo simulation process developed by Nexant to quantify the tradeoffs between the practical benefits of engaging a larger number of Duke Energy customers in household energy management and the uncertainty of reported program impacts. The remainder of the memorandum describes our simulation process, its results, and discusses how the results may be used by Duke Energy to select its preferred size for the MyHER control group.

In analyzing the ex-ante assumptions that were made in forecasting future savings from the MyHER program, Nexant discovered that the control and treatment groups are unbalanced with respect to the average energy consumption of households in the groups prior to assignment to the experiment. This imbalance makes the calculation of monthly savings virtually impossible and leads to counter intuitive results (i.e., dramatic winter savings coupled with offsetting gains in electricity consumption during the summer) when program impacts are analyzed over time. The only way to correct this imbalance is to reduce the size of certain cohorts in the control group. This memo also describes how the control group should be rebalanced in order to make it possible to track the performance of the program on a monthly basis – allowing Duke and its regulator to observe how the performance of the program is changing over time – another somewhat different but important mechanism for controlling risk.

Simulation Process

The Monte Carlo simulation calculates the sampling precision of simulated MyHER experiments by randomly assigning MyHER treatment customers to “treatment” and “control” groups a large

number of times—each time comparing electricity consumption between customers that are randomly assigned to a treatment and control group, mimicking the current randomized control trial structure of the MyHER program. The repeated estimates are stored, and the resulting variation of the estimates is compared for different control group sizes to determine what control group size is needed to maintain the desired level of statistical precision 90% of the time[7].

The simulation model applies an approach to sample size estimation, known as Bootstrapping, which avoids uncertainty associated with the actual MyHER savings impact because the simulation is performed using only the MyHER treatment customers. We refer to this approach as a false experiment. When we randomly assign MyHER treatment group customers to a treatment or control group, *we know there is no treatment intervention* that causes their consumption patterns to differ. Any estimated difference between our false treatment and control groups is strictly due to random variations in energy consumption among the MyHER treatment households that have been assigned to the "treatment" and "control" groups. The statistical precision of our estimated impact is determined by the size of the control group, which provides a source of comparison for the absence of treatment.

Results

The simulation results are presented in Table 5-7. While the mean impact of the false experiment is known to be zero kWh across all repetitions of the model, the standard deviation of the estimated impacts can be used to calculate the absolute precision of the model estimates. As previously stated, the false experiment approach allows us to be certain about the true impact, so the simulation results simply present the precision of the model as a function of control group size. The estimated impact column in Table 5-7 is based on the current average annual consumption for Duke Energy customers in the MyHER program during the year prior to being assigned to treatment or control group (13,686 kWh).

[7] To expand: the point estimate of each comparison is stored. Over 300 such comparisons are made for each control group size. Once the simulation is complete, the standard deviation of the accumulated point estimates describes the uncertainty associated with any given iteration of the false experiment. The standard deviation is then multiplied by the critical value (z-score of a normal distribution) to determine the range of kWh values associated with the chosen confidence interval.

Table 5-7: Simulation Results for DEO MyHER "False Experiment"

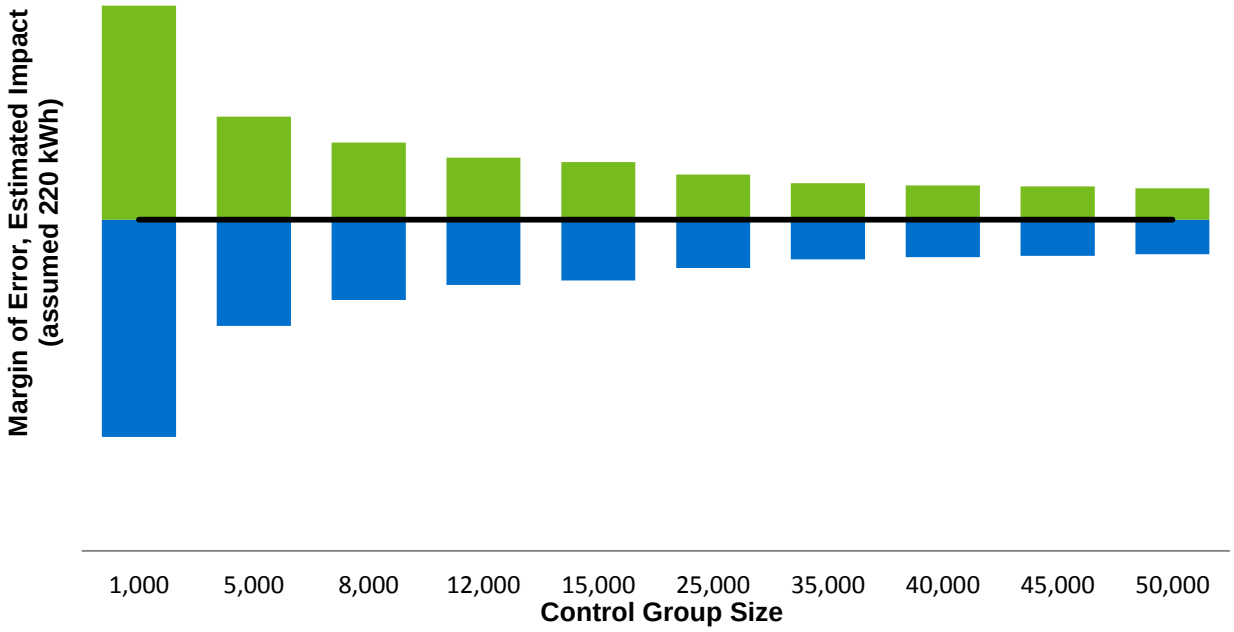
Control Group Size	Estimated Impact (kWh)	Estimated Std. Error (kWh)	Absolute Margin of Error (kWh)		Absolute Precision	
			95% Confidence	90% Confidence	95% Confidence	90% Confidence
1,000	9.1	87	+/-171	+/-143	+/-1.25%	+/-1.05%
5,000	-1.9	42	+/-83	+/-70	+/-0.61%	+/-0.51%
8,000	-1.5	32	+/-62	+/-52	+/-0.45%	+/-0.38%
12,000	-0.9	26	+/-50	+/-42	+/-0.37%	+/-0.31%
15,000	0.6	28	+/-47	+/-39	+/-0.34%	+/-0.29%
35,000	-1.9	15	+/-30	+/-25	+/-0.22%	+/-0.19%
40,000	-1.4	14	+/-28	+/-24	+/-0.21%	+/-0.17%
45,000	-1.4	14	+/-27	+/-23	+/-0.2%	+/-0.17%
50,000	-0.6	16	+/-26	+/-22	+/-0.19%	+/-0.16%

These results indicate an impact for the average customer, even though we know for a fact there is no impact from our false experiment. For example, if the annual impact of the MyHER is 220 kWh, this would represent an annual savings of 1.6% for the average customer. If the control group size were only 1,000 customers, the 90% confidence interval for the annual savings percentage would be 0.55% to 2.65% (77 kWh to 363 kWh). This confidence interval indicates a relative precision of 65%. Using the same example, if the control group size were 50,000 customers, the 90% confidence interval for the annual savings percentage would range from 1.44% to 1.76%, which indicates a relative precision of 10%.

Figure 5-1, below, depicts these results graphically. As control group size increases, so does the precision of the impact estimates. It is important to note the decline in estimation error *is a non-linear* function of control group size. Incremental gains in precision decease as the control group size increases. The black line in Figure 5-1 shows the constant impact estimate of 220 kWh remains unchanged, while the uncertainty around the value decreases with increasing control group sample size. It is readily apparent in the figure that very small incremental gains in precision arise from increasingly large increases in sample size; and that the improvement in precision between 15,000 observations and 50,000 observations in the control group is at best modest. In essence, the reduction in risk of measurement error comes at an increasingly higher cost (lost savings) as the size of the control group increases. From the standpoint of sampling efficiency, the most appropriate sample size for the MyHER control group is about 15,000. The problem is a sample size of 15,000 produces a relative precision of about plus or minus 17%—somewhat higher than the agreement Duke Energy currently has with regulators. Moreover, to get to the standard that has been set by the regulators Duke would have to increase its sample size from the current 42,000 to about 50,000—this change only produces a 1% incremental gain

in precision[8]. On its face, this is a ridiculously small improvement that comes at substantial cost. One cannot imagine the regulator instructing Duke to deprive a large number of customers for the opportunity to save energy to achieve such a small incremental reduction in the risk.

Figure 5-1: Change in Precision of Estimated Impacts as Control Group Size Increases



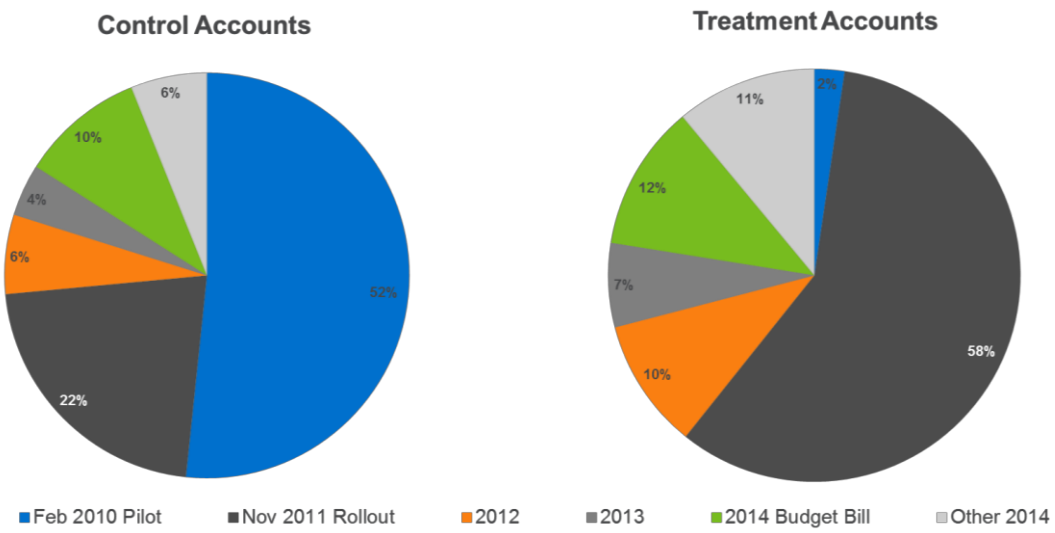
Addressing MyHER Cohort Imbalance

A potentially more important motivation for reducing the size of the MyHER control group is the need to balance the distribution of the control and treatment groups across cohorts. As described in Nexant's April 17, 2015 Memorandum re: Review of Ex-Ante Savings Assumptions, there are significant differences in pre-treatment energy consumption between treatment and control group customers across cohorts. These differences may confound estimates of the MyHER impact. Nexant believes these differences are related to unobservable, time-dependent differences in consumption from one cohort to another and the proportional representation of cohorts in the current treatment and control groups. This proportional representation is shown by cohort below in Figure 5-2[9].

[8] A sample size of 40,000 has an absolute precision of +/- 24 Kwh; 24/220 = 0.11, or 11% relative precision. A sample size of 50,000 has an absolute precision of +/- 22 kWh; 22/220 = 0.10, or 10% relative precision.

[9] We added the 2014 on-bill financing cohort to these charts—an update from the April 17 memorandum.

Figure 5-2: Comparison of Treatment and Control Group Composition by Cohort



This cohort imbalance may be addressed by randomly selecting control group accounts from each cohort for release to the treatment group in upcoming treatment waves. The number of accounts randomly selected from each cohort will vary, but the overall goal is to restore balance between treatment and control cohorts under the restriction that accounts may only be released from the control group. One example of exact numbers that could be released from each cohort is presented below in Table 5-9.

Table 5-8: An Example Control Group Release Scenario

Cohort	Accounts Released	Percent of Current Cohort
Feb 2010 Pilot	21,445	98.3%
Nov 2011 Rollout	13	0.1%
2012	1,061	39.7%
2013	716	40.8%
2014 Budget Bill	2,374	56.8%
Other 2014	830	32.2%
Total	**26,438**	**62.6%**

Unfortunately, the large imbalance between the number of customers assigned to the treatment and control group during the 2011 program rollout places a limit on the number of customers that can be released from that cohort. To explain further, Nexant believes there are time-

dependent differences in consumption patterns that vary by the cohorts[10]. If Duke Energy chooses to release customers from the control group, the best way to control for these unobservable, time-dependent differences in consumption is to reduce all cohorts by the same proportion. The need to release customers proportionally by cohort, combined with the limited number of accounts available for release from the Nov. 2011 Rollout control group cohort, limits the proportion of customers that should be released, if Duke Energy chooses to do so, to somewhere between 62.6% and 71% of the control group. The exact figure would be subject to Duke Energy's preference for risk. Table 3, below, shows the remaining control group composition by cohort under a scenario were 62.6% of the control group is released to treatment.

Table 5-9: An Example of Post-Release Control Group Composition by Cohort

Cohort	Control Accounts	Treatment Accounts	Percent of Control	Percent of Treatment
Feb 2010 Pilot	373	7,698	2.4%	2.4%
Nov 2011 Rollout	9,220	190,228	58.4%	58.4%
2012	1,613	33,276	10.2%	10.2%
2013	1,039	21,437	6.6%	6.6%
2014 Budget Bill	1,806	37,263	11.4%	11.4%
Other 2014	1,744	35,991	11.0%	11.0%
Total	**15,796**	**325,893**	**100.0%**	**100.0%**

Discussion and Recommendation

The decision of how much to reduce the control group size depends on Duke Energy's interest in renegotiating the regulatory requirements for confidence and precision on the MyHER program and the expected payoff, in units of aggregate annual program savings, relative to the resulting precision of annual participant savings estimates. In absolute terms, the precision of estimated impacts is robust with respect to the control group size. As shown in the previous examples, even with a control group size of 1,000 customers, the achievable *absolute* precision is +/- 1%, which would put the range of MyHER estimates between 77 kWh and 363 kWh. Yet given the current size of MyHER impacts and sheer number of program participants, Duke Energy may prefer a greater level of precision for MyHER impact estimates instead of the additional savings that comes with releasing control group customers. With a control group size of only 1,000 customers, the estimation error for total program impacts is approximately +/-43 GWh per year (based on 300,000 MyHER participants and 42,000 control group customers).

[10] Nexant's April 17, 2015 memorandum describes how billed kWh usage in 2009 for customers that were later assigned to treatment is, on average, 611 kWh less energy than the control group customers. Likewise, differences exist for customers assigned between 2012 and 2014 – in this case billed kWh usage in 2012 for customers later assigned to treatment is greater than usage for customers assigned to control in the same period.

The risk of estimation error declines with increases to control group size, but the total savings claimed by the program increases as customers are released to treatment. Table 5-10 quantifies this tradeoff. Nexant's control group simulations suggest that the decision to release additional control group customers is constrained by the need to address unobservable, time-dependent factors that may confound impact estimates (as discussed more fully in the April 17 ex-ante memorandum). This constraint on releasing control group customers is due to the imbalance between treatment and control group assignment for cohort 2, which occurred during the full program rollout in November 2011. The small number of control group customers in this group, combined with the large share of total treatment customers drawn from this group means that no more than 71% of the control group can be released from each cohort without running the risk of leaving too few control group customers in cohort 2. As presented in Table 5-9, reducing the control group to approximately 15,000 customers imposes an estimation error of +/- 12 GWh per year, while the increased annual program savings would be approximately 6 GWh. Table 5-10 also provides a generic benefit-cost ratio that describes the expected benefit of control group release to the absolute precision of aggregate annual program savings. These estimates and comparisons are based on a fixed program size of 300,000 MyHER recipients and a control group of 42,000 customers. Note the maximum point achieved by the benefit-precision ratio with a control group size of 15,000; Figure 5-3 illustrates these concepts.

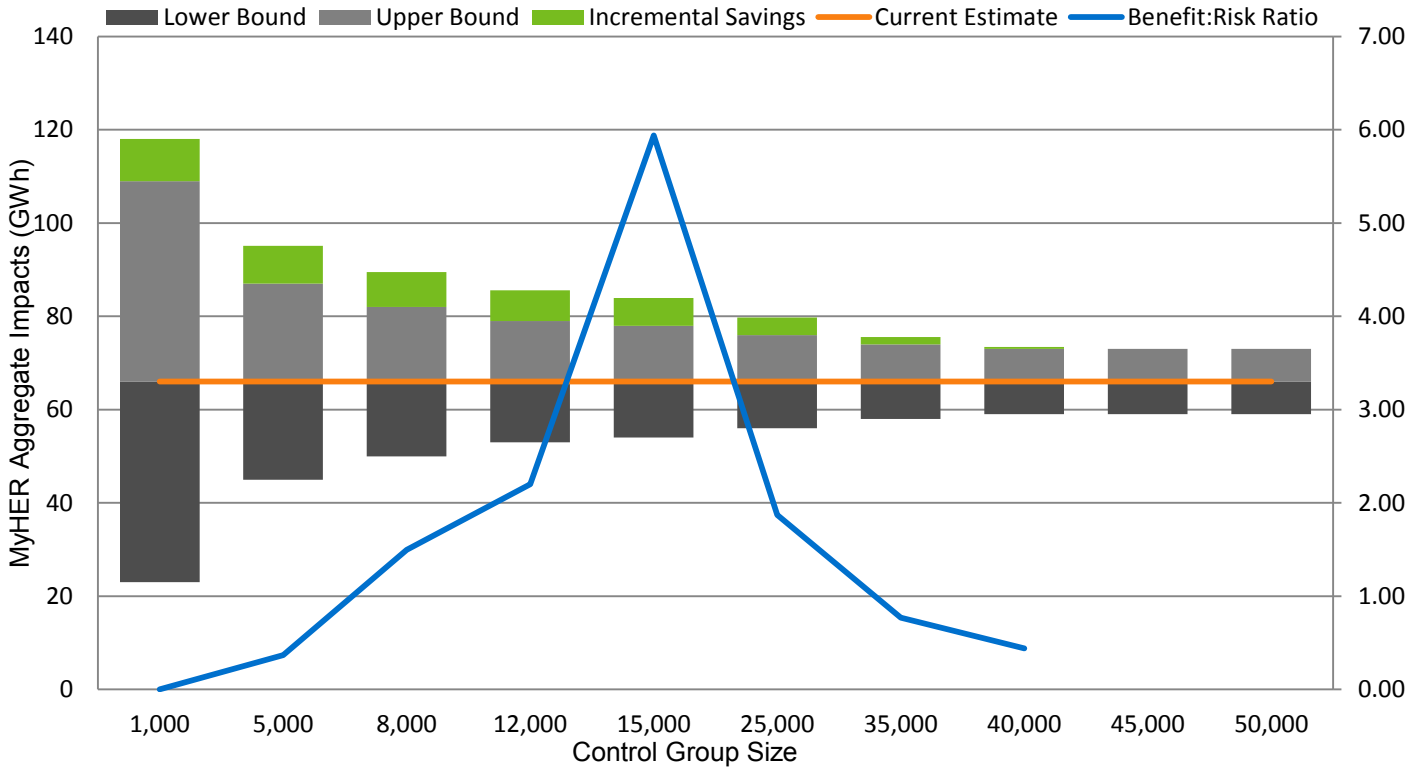
Table 5-10: Tradeoffs between Estimation Error and Potential Gains from Releasing Control Group Accounts

Control Group Size	Aggregate Estimation Error (GWh)	Incremental Change in Precision (GWh)	Benefit: Precision Ratio	Benefit: Precision Ratio
1,000	+/-43	N/A	9	N/A
5,000	+/-21	22	8	0.37
8,000	+/-16	5	7	1.50
12,000	+/-13	3	7	2.20
15,000	+/-12	1	6	5.94
25,000	+/-10	2	4	1.87
35,000	+/-8	2	2	0.77
40,000	+/-7	1	0	0.44
45,000	+/-7	0	-1	0
50,000	+/-7	0	-2	0

The relative precision of 10% is difficult to achieve for a program with the scale and per-unit impact of the MyHER. In fact, our simulations indicate that a relative precision of 10% is only achievable with a control group size of 50,000. Should Duke Energy attempt to renegotiate this point with regulatory authorities, Nexant believes Duke Energy can release control group customers to treatment without major impacts to the absolute precision of MyHER household average savings estimates. The release of control group customers should ensure that balance in the share of treatment and control groups drawn from each cohort is restored, as illustrated in Table 5-9. Assuming Duke Energy achieves regulatory approval for releasing control group

customers and determines that doing so is within its own risk tolerance, Nexant recommends releasing control group customers to balance the cohorts. We recommend a control group size of approximately 16,000 customers with equal cohort proportions between the remaining control and treatment customers. This control group size maximizes the benefit to precision risk ratio presented in Table 5-10 while satisfying the constraints of cohort balance.

Figure 5-3: Risks and Benefits of Control Group Release



Appendix F Review of Ex-ante Savings Estimates Memorandum

Memorandum

April 17, 2015

To: Roshena Ham, Melinda Goins, Rose Stoeckle, Jean Williams; Duke Energy

From: Jesse Smith, Mike Sullivan; Nexant

CC: Jim Herndon, Rush Childs, Patrick Burns, Dulane Moran; Nexant

RE: Review of Ex-Ante Savings Assumptions

Background

Duke Energy Ohio (DEO) has retained Nexant to perform an impact and process evaluation of its MyHER program. This memorandum is pursuant to Milestone D of the Statement of Work for the evaluation – "Review of Ex Ante Estimated/Deemed Savings Assumptions". The MyHER program is an energy awareness and conservation initiative that provides participating homes with reports eight times per year that compare their energy consumption to comparable homes and provides recommendations for saving energy. The review presented in this memo is based on publicly available evaluations conducted in other jurisdictions as well as files describing energy consumption for treatment and control groups provided to Nexant by DEO for this evaluation. A brief description of these files is included below.

1) *MyHER deemed savings report DEI DEO DEK DEC 02 01 2015.xlsx.* The savings assumptions shown in Table 5-11 were taken from this spreadsheet.

Table 5-11: DEO MyHER Ex-Ante Savings Assumptions

Measure Name	Annual kWh Gross w/o losses	Saved Summer Coincident kW w/o losses	Annual non-coincident kW w/o losses	Measure Life	Free Rider %
My Home Energy Report (EMV 12.1.13)	220	0.0674	0.0725	1	0.00%

2) *Process and Impact Evaluation of the My Home Energy Report (MyHER) Program in Ohio*. This previous evaluation report was completed in 2013 and formed the basis of the savings estimates in Table 5-11.

3) *2015-03-02-MyHERParticipationCountsByMonth.xlsx.* This file was provided by Darby Sharp on March 16, 2015 and lists the number of MyHER participating accounts by month for each jurisdiction.

4) *MyHER Evaluation Data Request Response.* Preliminary analysis of the data supplied to Nexant to perform the analysis of 2014 MyHER impacts

Benchmarking

The 220 kWh/year average impact per treatment customer claimed by DEO is comparable to other deployments of Home Energy Report programs across the United States. Table 5-12 shows energy savings estimates from 11 other HER deployments. Although this type of summary information can be deceptive because it does not account for differences in the types of homes targeted, heating fuel saturations, or weather, it does provide an initial “sanity check” that the 220 kWh value is reasonable when compared to findings in other jurisdictions.

Table 5-12: Annual Impact Estimates from HER Deployments

Utility	Implementation Period	Treatment Customers	Annual kWh per Treated Home
Pennsylvania Power & Light	June 2012-May 2013	93,924	388
AEP Ohio	2012	197,646	377
Puget Sound Energy	2013	40,000	325
ComEd	June 2010-May 2011	45,171	282
Indianapolis Power & Light Company	March 2012-February 2013	25,000	266
Connexus Energy	March 2009-January 2010	40,000	229
Indiana Michigan Power	May 2012-December 2012	47,987	200
FirstEnergy Ohio	2013	73,000	175
Ameren Illinois	August 2010-November 2011	198,494	159
Pacific Gas & Electric	2014	1,017,692	104
Duquesne Light	June 2012-May 2013	50,000	91

Because of the differences in pre-treatment electric consumption across jurisdictions and HER deployments it is helpful to also consider impacts on a relative or percent reduction basis. Nexant analysis of the DEO billing history for MyHER treatment group accounts shows an average annual consumption of 13,686 kWh per year prior to receiving their first MyHER mailing. A 220 kWh annual reduction would equal a 1.61% reduction in electric consumption. Again, this is very much in line with accepted industry findings that HER impacts are between 1.5% and 2.5% annually.

Experimental Design

Impact estimation from HER deployments relies on a randomized control trial (RCT). In an RCT subjects (in this case customers) are randomly assigned to treatment (receiving the HER) and control (not receiving HERs) groups. When done properly the only possible explanation for an observed difference in energy consumption between the treatment and control groups is the effect of treatment. When analyzing impacts from this type of design our first step is always to conduct a series of “equivalence tests” between the groups to confirm that there were no pre-existing differences between the groups that would confound the effect. This analysis indicates that there are significant pre-treatment differences in energy consumption between the treatment and control groups in the DEO MyHER experiment.

Figure 5-4 displays a boxplot comparing the 2009 billed kWh usage of MyHER accounts that were later assigned to the treatment and control groups. No one had received an HER at that point. The blue box in the middle of each plot is the interquartile range comprising the 25th to the 75th percentile of monthly usage. The dark line in the middle is the median value. The ‘whiskers’ on either end of the box extend 1.5 times the length of the interquartile range or to the most extreme observations. This graph indicates that the accounts who would later be assigned to the control group used more electricity in the winter months than the accounts who would later be assigned to the treatment group.

Figure 5-4: Boxplots of Pre-Assignment Monthly Consumption by Group

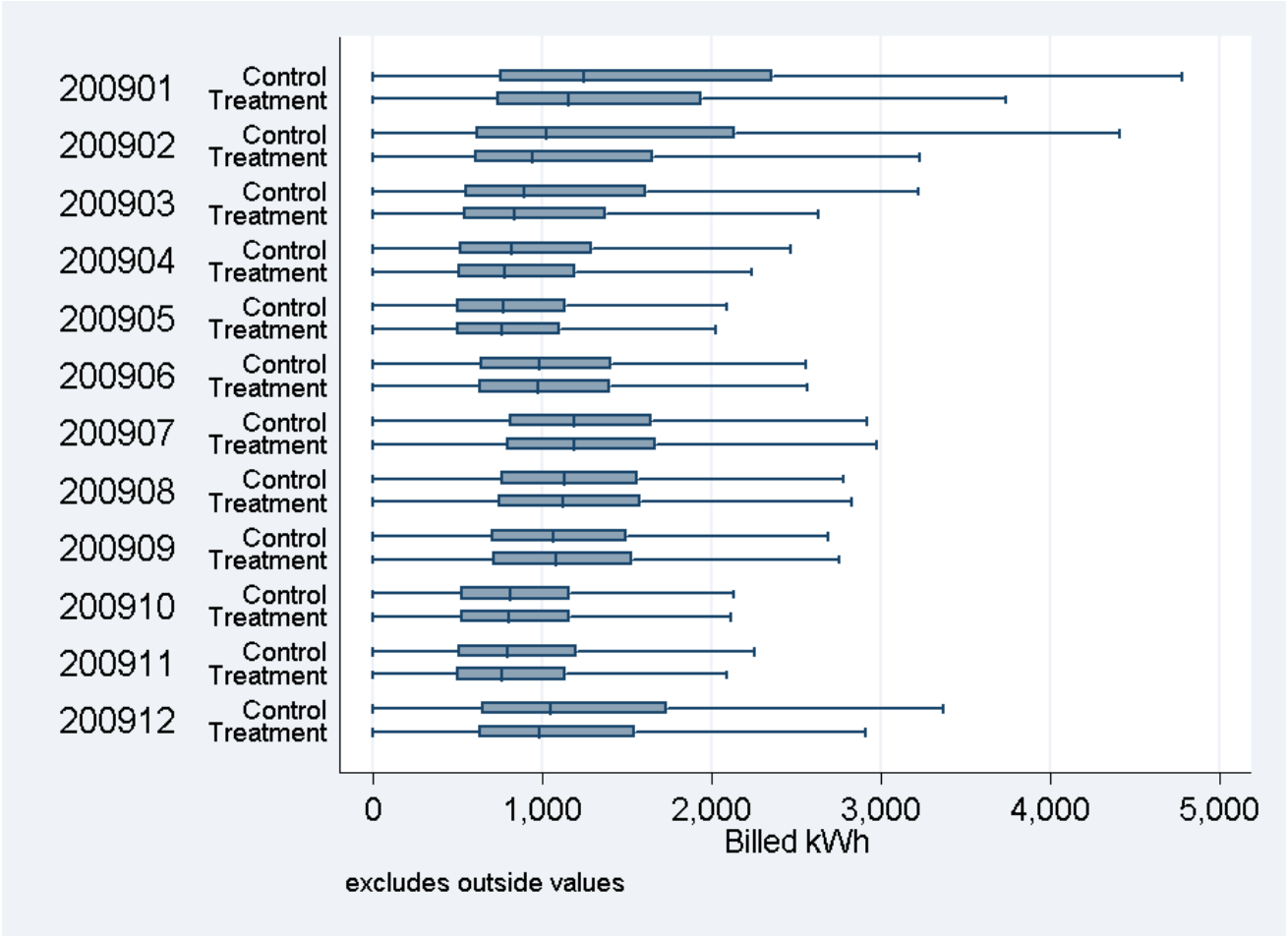


Table 5-13 presents summary statistics using the same data set. Notice that the accounts that would later be assigned to the control group used an average of 611 kWh more than the accounts who would later be assigned to treatment. In a properly specified RCT, this number should be very close to 0 kWh. The monthly average consumption columns show that the difference is most significant during the winter months. The number of accounts being summarized is also provided in Table 5-13 to demonstrate that the systematic difference applies to a large share of the MyHER population.

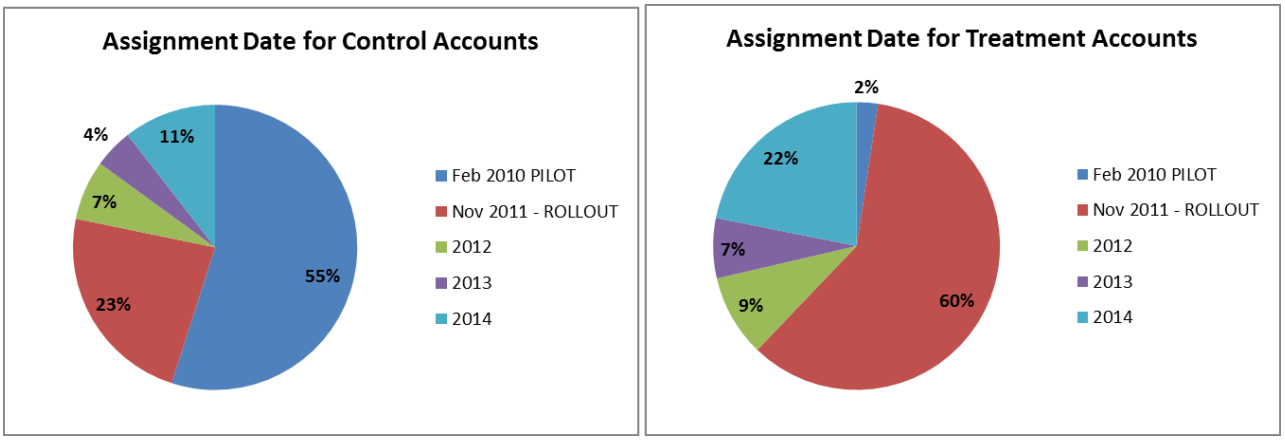
Table 5-13: Pre-MyHER Usage Comparisons by Group and Month

Bill Month	Mean Control Group kWh	Mean Treatment Group kWh	Difference (Control - Treatment)	# of Control Accounts	# of Treatment Accounts
Jan-2009	1,723	1,541	182	45,080	276,589
Feb-2009	1,536	1,355	180	45,136	277,556
Mar-2009	1,192	1,094	98	45,234	279,069
Apr-2009	972	930	43	45,336	280,527
May-2009	878	868	10	40,431	254,534
Jun-2009	1,105	1,102	3	40,899	250,712

Bill Month	Mean Control Group kWh	Mean Treatment Group kWh	Difference (Control - Treatment)	# of Control Accounts	# of Treatment Accounts
Jul-2009	1,303	1,312	-10	45,628	286,148
Aug-2009	1,238	1,239	0	45,783	288,366
Sep-2009	1,175	1,198	-23	45,910	290,604
Oct-2009	906	910	-4	46,030	292,822
Nov-2009	916	884	32	46,153	295,086
Dec-2009	1,320	1,221	99	46,291	297,195
2009 Total[11]	**14,265**	**13,654**	**611**	**44,826**	**280,767**

Nexant believes that this seasonal difference between the treatment and control group probably arose through cohort imbalance. If we define a cohort as a group of accounts that are added to the program (either to treatment or control at a given time) the MyHER Ohio program would have many cohorts. For simplicity we have collapsed this definition into five cohorts, one for each calendar year 2010 through 2014. Figure 5-5 considers the MyHER group populations as of December 2014 and compares the relative size of each cohort.

Figure 5-5: Comparison of Treatment and Control Group Composition by Cohort



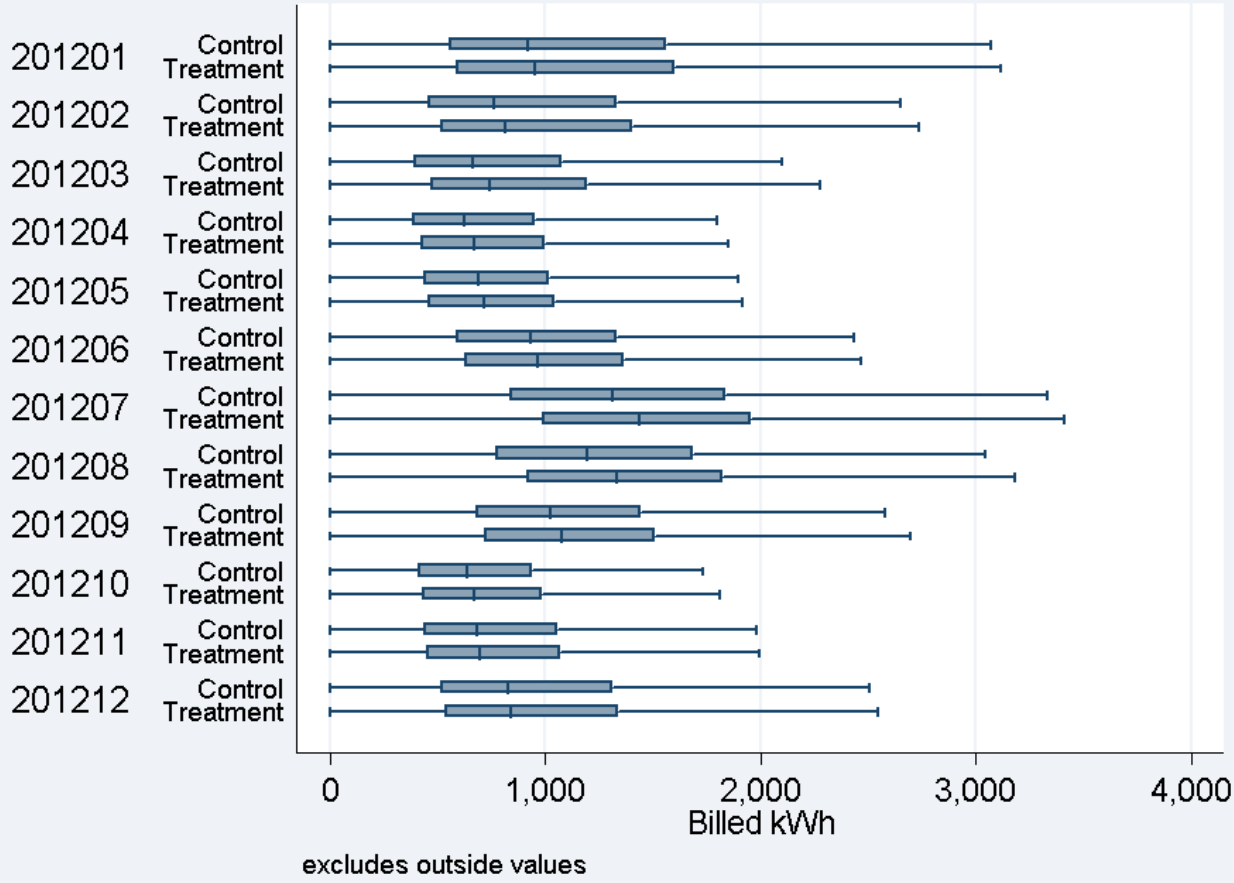
Notice in Figure 5-5 that 55% of the control group accounts are from the initial 2010 pilot while only 2% of the treatment group came from this cohort. Similarly, 60% of the current treatment group was added in the November 2011 roll-out of the program, but only 23% of the control group came from this cohort. While the pre-assignment consumption looks well aligned between treatment and control within each cohort, there appear to be some fundamental differences between the cohorts. The most notable difference is the lower winter usage among the 2011 cohort than the 2010 cohort that was explored in Figure 5-4 and Table 5-13.

If the control group customers used more energy than the treatment group during winter months before assignment, a comparison of means during the treatment period will show an inflated

[11] The number of accounts columns in this row display the average number of accounts in each month.

effect during winter months. This was the case during Nexant's preliminary analysis. However, we also observed a negative effect during summer months (customer using more energy in the summer because of MyHER). The MyHER effect appears to be confounded with pre-existing differences within groups. Figure 5-6 compares the average monthly usage of accounts assigned between 2012 and 2014[12] for each month in 2012. In this plot we see that the accounts who were later assigned to the MyHER treatment group use more energy in the summer months than the accounts that were later assigned to the control group. If this pre-existing difference is not addressed in the analysis, the analysis will produce erroneous results.

Figure 5-6: 2012 Usage Comparison for Accounts Assigned 2012-2014



We do not believe that there is any flaw with the randomization process itself. When the pre-assignment usage of each cohort is considered in isolation the groups appear well-matched. It is the fact that the cohorts differ from one another and the fact that the groups have very different cohort representation that is causing issues with the experimental design. Fortunately,

[12] For customers assigned to a MyHER group in 2012 the months after assignment are excluded.

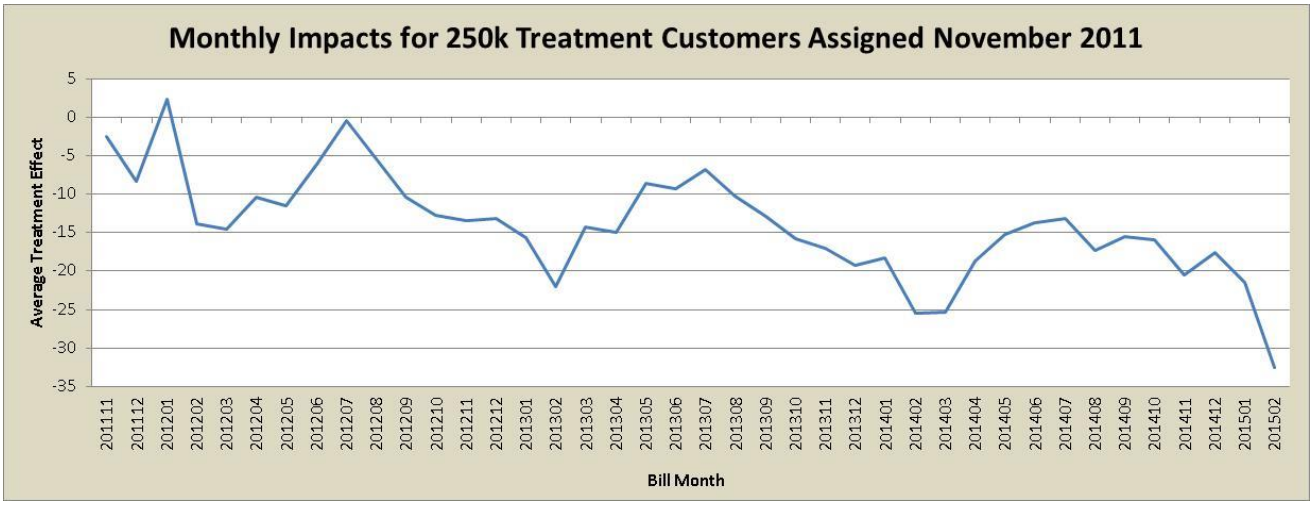
the upcoming reduction of the control group size offers a perfect opportunity to correct these differences if done correctly.

Previous Evaluation

Our review of the previous evaluation report did not indicate that any analysis was performed to verify the equivalence of the treatment and control group. The fixed-effects model specification presented on page 14 appears to have been run for all MyHER participants together making it susceptible to imbalances when the groups did not use energy in the same way prior to joining the program. The evaluator also used a single term for the MyHER treatment rather than interacting it with month to produce monthly estimates of the effect. Because the MyHER effect was not estimated on a monthly basis it likely wasn't noted that the effect was unrealistically high in the winter and low (negative) in the summer months.

Fortunately the two structural differences between the treatment and control group prior to MyHER group assignment (control used more kWh in the winter, treatment used more kWh in the summer) are directionally opposite so they offset one another to some extent on an annual basis. Our initial assessment is that the previous evaluation overstates the average savings per home during the period analyzed in the previous evaluation. However, our preliminary analysis also indicates that the 220 kWh per home figure may not prove to be unreasonable for the 2014 time period considered in this evaluation because the MyHER effect appears to be growing over time. Figure 5-7 shows estimates of the average treatment effect, by month, for the MyHER accounts assigned to treatment in November 2011. The general downward trend of the line indicates an increasing reduction in energy consumption over time, or a larger average program effect per home.

Figure 5-7: Monthly Average Treatment Effect November 2011 to February 2015



It is important to note that the impact estimates shown in Figure 5-7 have not been adjusted to account for the incremental participation of treatment customers in non-MyHER energy efficiency programs. Since the effect of other EE installations accumulate over time as

customers install additional measures, the kWh quantity that must be subtracted to avoid double-counting is also growing. Once the necessary data is provided to quantify the non-MyHER energy efficiency effect, Nexant will make a determination whether the MyHER effect is indeed increasing over time or if the growth shown in Figure 5-7 is due to accumulation of measure impacts from other DEO programs that will ultimately be netted out.

Program Participation

Duke provided Nexant with a spreadsheet showing the estimated number of MyHER program participants by month and some guidelines about the business rules Duke uses to define participation and estimate this quantity. Using the billing history, MyHER customer database, and Tendril report history, Nexant produced an independent estimate of participants by month using the following criteria to define a participant:

The account had been assigned to the MyHER treatment group and the meter read date associated with the bill month is greater than the treatment start date (treat_start) for the account. Our understanding is that the treat_start field corresponds to the date the first report was sent to the printer.

A MyHER report had been sent to the printer (date_sent_to_print) within 180 days prior to the meter read date associated with the bill month.

For accounts with a non-missing value for the treatment end date (treat_end), the meter read date associated with the bill month was prior to the treatment end date for the account.

Table 5-14 compares the results of Nexant's preliminary participation count analysis with the figures provided by Duke. The estimated counts are very close, with the Nexant numbers averaging 1.42% lower over a 12 month period and all monthly differences within ± 6%. These minor differences are likely due to inconsistent handling of dates or definitions in the two analyses. We believe it will be beneficial to further align participation definitions prior to finalizing impact estimates to ensure the per-home evaluation results are an "apples-to-apples" comparison with the participation counts claimed by Duke for cost recovery and other regulatory reporting requirements.

Table 5-14: Comparison of Duke and Nexant Participation Estimates

Month	Duke	Nexant	Percent Difference
Jan-2014	245,006	257,378	5.05%
Feb-2014	289,533	294,343	1.66%
Mar-2014	290,092	296,327	2.15%
Apr-2014	297,659	292,882	-1.60%
May-2014	297,659	292,495	-1.73%
Jun-2014	300,073	295,029	-1.68%

Month	Duke	Nexant	Percent Difference
Jul-2014	296,114	293,794	-0.78%
Aug-2014	304,596	287,545	-5.60%
Sep-2014	299,805	287,072	-4.25%
Oct-2014	299,805	286,960	-4.28%
Nov-2014	298,786	292,363	-2.15%
Dec-2014	298,786	291,677	-2.38%
2014 Average	**293,160**	**288,989**	**-1.42%**

Conclusion

The ex-ante estimates of energy savings for the MyHER program is near the median value claimed by the eleven other jurisdictions we reviewed. In this respect the ex-ante estimate of annual energy savings per household is reasonable. Yet at this point, the estimated savings from the DEO MyHER implementation cannot be used to assess the reasonableness of the ex-ante estimates of energy savings from the program. As discussed above, the estimated savings provided by the prior evaluation did not take account of large pre-existing differences between treatment and control group customers. Moreover, until we can account for the energy savings from exposure to other DEO programs, we cannot accurately determine the actual energy savings per household that the DEO MyHER is achieving. Nevertheless, taking account of the complexity of the analysis induced by the pre-existing differences in treated and control groups, it appears that the program is causing a reduction in energy consumption that appears to be increasing over time. So, at this point in time there is no reason to believe that the expected savings for the program have been overestimated.

Summary: Annual Report ANNUAL ENERGY EFFICIENCY STATUS REPORT
OF DUKE ENERGY OHIO, INC. electronically filed by Carys Cochern on behalf of Watts, Elizabeth H. Ms.