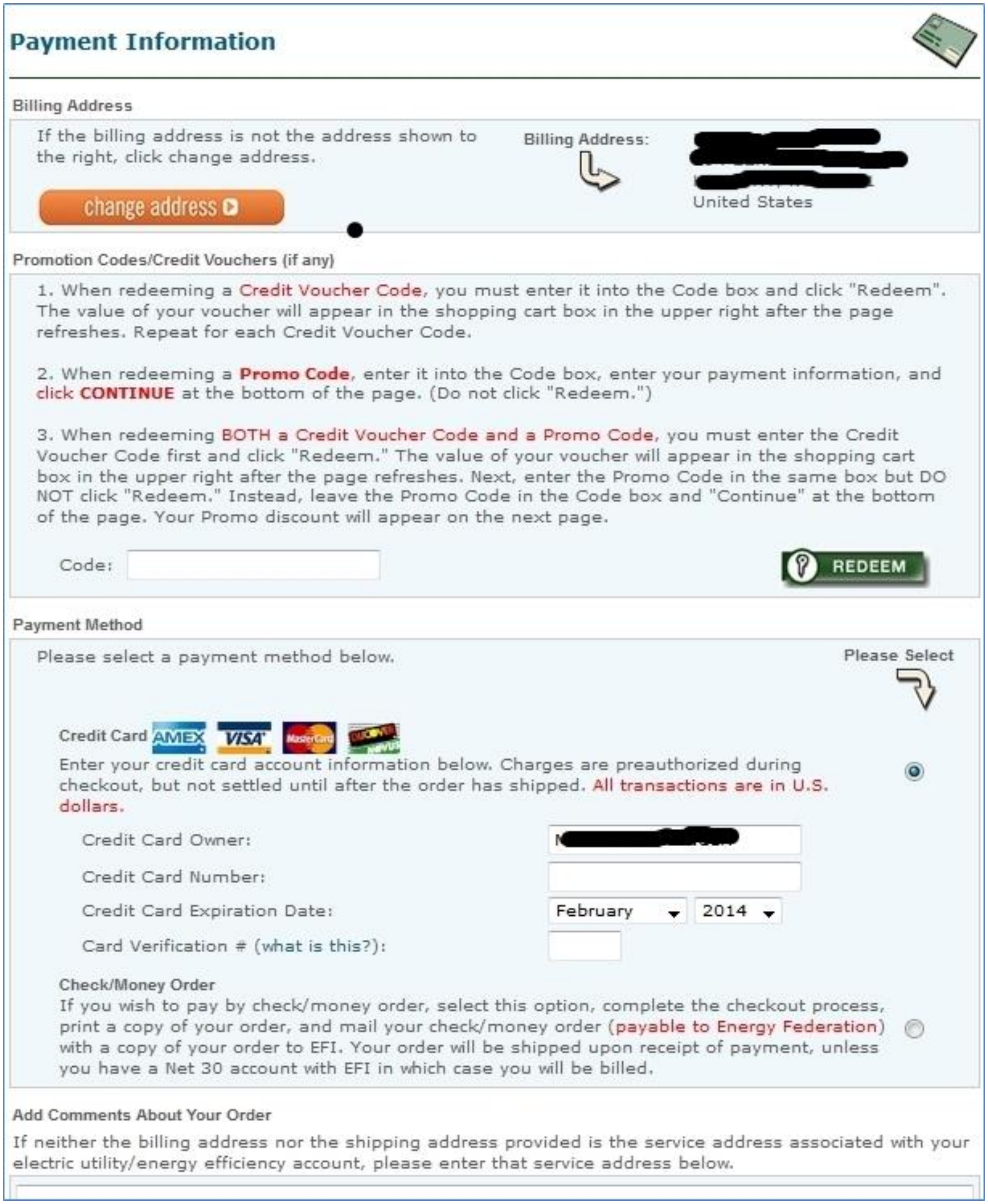


Payment Information

Billing Address

If the billing address is not the address shown to the right, click change address.

change address

Billing Address: [redacted]
United States

Promotion Codes/Credit Vouchers (if any)

1. When redeeming a Credit Voucher Code, you must enter it into the Code box and click "Redeem". The value of your voucher will appear in the shopping cart box in the upper right after the page refreshes. Repeat for each Credit Voucher Code.

2. When redeeming a **Promo Code**, enter it into the Code box, enter your payment information, and click **CONTINUE** at the bottom of the page. (Do not click "Redeem.")

3. When redeeming BOTH a Credit Voucher Code and a Promo Code, you must enter the Credit Voucher Code first and click "Redeem." The value of your voucher will appear in the shopping cart box in the upper right after the page refreshes. Next, enter the Promo Code in the same box but DO NOT click "Redeem." Instead, leave the Promo Code in the Code box and "Continue" at the bottom of the page. Your Promo discount will appear on the next page.

Code:

REDEEM

Payment Method

Please select a payment method below.

Please Select

Credit Card AMEX VISA MasterCard DISCOVER

Enter your credit card account information below. Charges are preauthorized during checkout, but not settled until after the order has shipped. All transactions are in U.S. dollars.

Credit Card Owner: [redacted]

Credit Card Number:

Credit Card Expiration Date: February 2014

Card Verification # (what is this?):

Check/Money Order

If you wish to pay by check/money order, select this option, complete the checkout process, print a copy of your order, and mail your check/money order (payable to Energy Federation) with a copy of your order to EFI. Your order will be shipped upon receipt of payment, unless you have a Net 30 account with EFI in which case you will be billed.

Add Comments About Your Order

If neither the billing address nor the shipping address provided is the service address associated with your electric utility/energy efficiency account, please enter that service address below.

Figure 75. Shopping Cart Screen 3 (part 1)

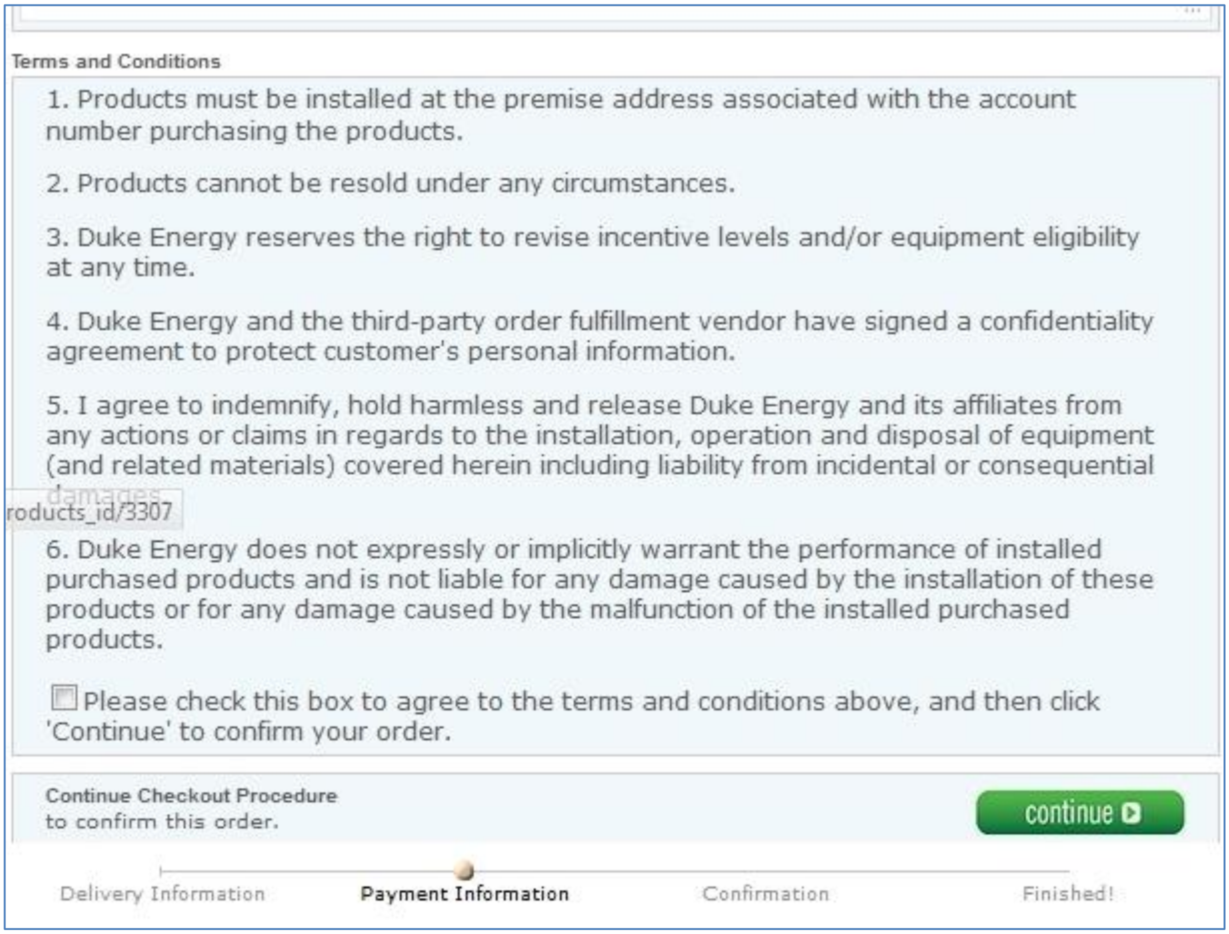
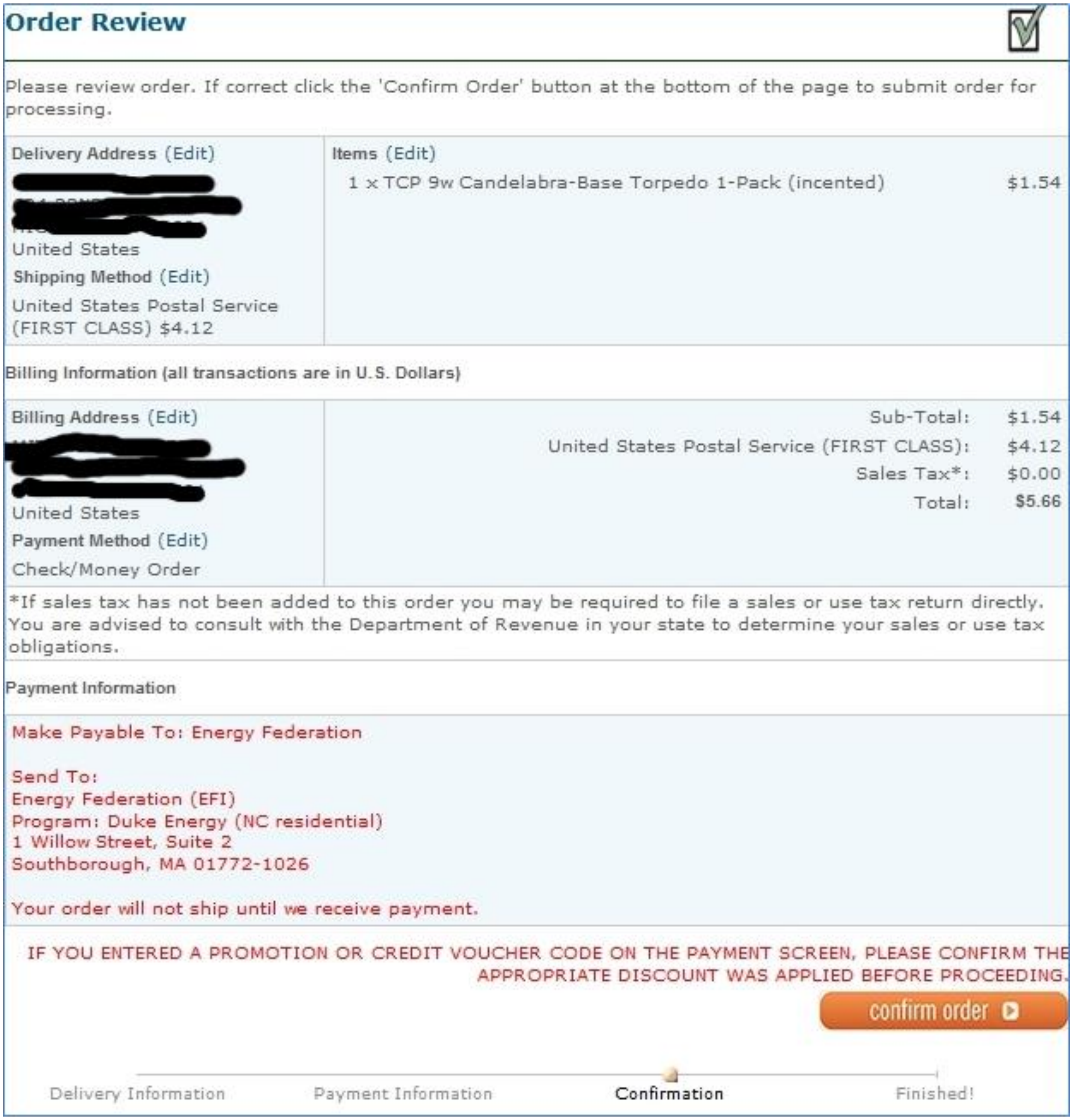


Figure 76. Shopping Cart Screen 3 (part 2)



Order Review

Please review order. If correct click the 'Confirm Order' button at the bottom of the page to submit order for processing.

Delivery Address (Edit)	Items (Edit)	
[redacted] United States **Shipping Method** (Edit) United States Postal Service (FIRST CLASS) $4.12	1 x TCP 9w Candelabra-Base Torpedo 1-Pack (incented)	$1.54

Billing Information (all transactions are in U.S. Dollars)

Billing Address (Edit)		
[redacted] United States **Payment Method** (Edit) Check/Money Order	Sub-Total: United States Postal Service (FIRST CLASS): Sales Tax*: Total:	$1.54 $4.12 $0.00 $5.66

*If sales tax has not been added to this order you may be required to file a sales or use tax return directly. You are advised to consult with the Department of Revenue in your state to determine your sales or use tax obligations.

Payment Information

Make Payable To: Energy Federation

Send To:
Energy Federation (EFI)
Program: Duke Energy (NC residential)
1 Willow Street, Suite 2
Southborough, MA 01772-1026

Your order will not ship until we receive payment.

IF YOU ENTERED A PROMOTION OR CREDIT VOUCHER CODE ON THE PAYMENT SCREEN, PLEASE CONFIRM THE APPROPRIATE DISCOUNT WAS APPLIED BEFORE PROCEEDING.

confirm order

Delivery Information · Payment Information · Confirmation · Finished!

Figure 77. Shopping Cart Screen 4

Package Tracking

UPS (United Parcel Service) Packages:

You may enter either your order number or the UPS assigned tracking code in the appropriate box below. You can obtain your order number through the 'My Account' section of the site. Log in to your account, view 'Order History', and click the 'Track UPS Packages' link of the order you wish to track.

TRACK BY ORDER NUMBER

TRACK BY UPS TRACKING NUMBER

USPS (US Postal Service) Packages:

These orders are not traceable while in transit, but we can request delivery information from the Postal Service. Call 866-849-9704 to request delivery confirmation for your order if the 'My Account' section of the site shows the order has shipped.

Figure 78. Package Tracking

Appendix H: Household Characteristics and Demographics

Participant Survey Households

One hundred and ninety-two (192) program participants in Ohio were surveyed for this evaluation; this section presents household and demographic data collected during the participant survey.

In what type of building do you live?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Single-family home, detached construction	171	89.1	89.1	89.1
	Single family home, factory manufactured/modular	1	.5	.5	89.6
	Row House	1	.5	.5	90.1
	Two or Three family attached residence-traditional structure	1	.5	.5	90.6
	Apartment (4 + families)---traditional structure	4	2.1	2.1	92.7
	Condominium---traditional structure	11	5.7	5.7	98.4
	Other: "*MI home*"	1	.5	.5	99.0
	Refused	2	1.0	1.0	100.0
	Total	192	100.0	100.0	

What year was your residence built?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1959 and before	49	25.5	25.5	25.5
	1960-1979	47	24.5	24.5	50.0
	1980-1989	26	13.5	13.5	63.5
	1990-1997	21	10.9	10.9	74.5
	1998-2000	15	7.8	7.8	82.3
	2001-2007	28	14.6	14.6	96.9
	2008-present	5	2.6	2.6	99.5
	DK/NS	1	.5	.5	100.0
	Total	192	100.0	100.0	

How long have you lived in your current home?

Mean: 15.4 years ***Median: 12 years***		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	One year or less	6	3.1	3.1	3.1
	More than one up to 5 years	39	20.3	20.3	23.4
	More than 5 up to 10 years	37	19.3	19.3	42.7
	More than 10 up to 20 years	61	31.8	31.8	74.5
	More than 20 up to 30 years	24	12.5	12.5	87.0
	More than 30 years	25	13.0	13.0	100.0
	Total	192	100.0	100.0	

How many rooms are in your home (excluding bathrooms, but including finished basements)?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4	6	3.1	3.1	3.1
	5	11	5.7	5.7	8.9
	6	26	13.5	13.5	22.4
	7	36	18.8	18.8	41.1
	8	36	18.8	18.8	59.9
	9	27	14.1	14.1	74.0
	1-3	4	2.1	2.1	76.0
	10 or more	43	22.4	22.4	98.4
	DK/NS	3	1.6	1.6	100.0
	Total	192	100.0	100.0	

Which of the following best describes your home's heating system?	Total N=192	
None	0	0.0%
Central forced air furnace	154	80.2%
Electric Baseboard	3	1.6%
Heat Pump	28	14.6%
Geothermal Heat Pump	1	0.5%
Gas pack / gas log fireplace	2	1.0%
Wood burning fireplace / stove	3	1.6%
Boiler / steam heat	5	2.6%
Dual system: furnace and heat pump	3	1.6%
Don't know	0	0.0%

May total to more than 100% because respondents could give multiple responses.

How old is your heating system?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-4 years	51	26.6	26.6	26.6
	5-9 years	42	21.9	21.9	48.4
	10-14 years	42	21.9	21.9	70.3
	15-19 years	20	10.4	10.4	80.7
	19 years or older	27	14.1	14.1	94.8
	DK/NS	10	5.2	5.2	100.0
	Total	192	100.0	100.0	

What is the primary fuel used in your heating system?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Electricity	41	21.4	21.4	21.4
	Natural Gas	139	72.4	72.4	93.8
	Oil	4	2.1	2.1	95.8
	Propane	6	3.1	3.1	99.0
	Geothermal	1	.5	.5	99.5
	Wood	1	.5	.5	100.0
	Total	192	100.0	100.0	

What is the secondary fuel used in your primary heating system, if any?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Electricity	30	15.6	15.6	15.6
	Natural Gas	3	1.6	1.6	17.2
	Propane	1	.5	.5	17.7
	Other, listed below	11	5.7	5.7	23.4
	None	143	74.5	74.5	97.9
	DK/NS	4	2.1	2.1	100.0
	Total	192	100.0	100.0	

Other secondary fuel sources:

- Wood stove / fireplace (n=4)
- Electric space heaters (n=4)
- Propane Space Heater
- Fire place insert
- Pellet stove used 50% of the time for heat
- Water

Do you use one or more of the following to cool your home?	**Total N=192**	
None	0	0.0%
Heat pump for cooling	30	15.6%
Central air conditioning	153	79.7%
Through the wall or window air conditioning unit	12	6.3%
Geothermal heat pump for cooling	1	0.5%
"*Heat pack*"	1	0.5%
"*Radiant water heating and cooling*"	1	0.5%
Don't know	0	0.0%

May total to more than 100% because respondents could give multiple responses.

How many window-unit or through the wall air conditioner(s) do you use?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	15	7.8	7.8	7.8
	2	5	2.6	2.6	10.4
	3	1	.5	.5	10.9
	None	171	89.1	89.1	100.0
	Total	192	100.0	100.0	

What is the fuel used in your cooling system?	Total N=192	
Electricity	188	97.9%
Natural gas	3	1.6%
Oil	0	0.0%
Propane	0	0.0%
Geothermal	1	0.5%
Don't know	0	0.0%

May total to more than 100% because respondents could give multiple responses.

How old is your cooling system?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-4 years	57	29.7	29.7	29.7
	5-9 years	45	23.4	23.4	53.1
	10-14 years	37	19.3	19.3	72.4
	15-19 years	22	11.5	11.5	83.9
	19 years or older	21	10.9	10.9	94.8
	DK/NS	10	5.2	5.2	100.0
	Total	192	100.0	100.0	

What is the fuel used by your water heater?	Total N=192	
Electricity	62	32.3%
Natural gas	131	68.2%
Oil	0	0.0%
Propane	3	1.6%
Don't know	2	0.5%

May total to more than 100% because respondents could give multiple responses.

How old is your water heater?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-4 years	49	25.5	25.5	25.5
	5-9 years	42	21.9	21.9	47.4
	10-14 years	47	24.5	24.5	71.9
	15-19 years	27	14.1	14.1	85.9
	More than 19 years	12	6.3	6.3	92.2
	DK/NS	15	7.8	7.8	100.0
	Total	192	100.0	100.0	

What type of fuel do you use for indoor cooking on the stovetop or range?	**Total N=192**	
Electricity	145	75.5%
Natural gas	46	24.0%
Oil	0	0.0%
Propane	1	0.5%
“*Induction*”	1	0.5%
No stove / range	1	0.5%
Don’t know	0	0.0%

May total to more than 100% because respondents could give multiple responses.

What type of fuel do you use for indoor cooking in the oven?	**Total N=192**	
Electricity	155	80.7%
Natural gas	36	18.8%
Oil	0	0.0%
Propane	1	0.5%
No oven	1	0.5%
Don’t know	0	0.0%

May total to more than 100% because respondents could give multiple responses.

What type of fuel do you use for clothes drying?	**Total N=192**	
Electricity	155	80.7%
Natural gas	33	17.2%
Oil	0	0.0%
Propane	1	0.5%
No clothes dryer	2	1.0%
Don’t know	2	1.0%

May total to more than 100% because respondents could give multiple responses.

About how many square feet of living space are in your home?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	500 to 999	4	2.1	2.1	2.1
	1000 to 1499	26	13.5	13.5	15.6
	1500 to 1999	32	16.7	16.7	32.3
	2000 to 2499	32	16.7	16.7	49.0
	2500 to 2999	33	17.2	17.2	66.1
	3000 to 3499	19	9.9	9.9	76.0
	3500 to 3999	6	3.1	3.1	79.2
	4000 or more	13	6.8	6.8	85.9
	DK/NS	27	14.1	14.1	100.0
	Total	192	100.0	100.0	

Do you own or rent your home?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Own	187	97.4	97.4	97.4
	Rent	5	2.6	2.6	100.0
	Total	192	100.0	100.0	

How many levels are in your home (not including your basement)?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	One	81	42.2	42.2	42.2
	Two	100	52.1	52.1	94.3
	Three	11	5.7	5.7	100.0
	Total	192	100.0	100.0	

Does your home have a heated or unheated basement?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Heated	139	72.4	72.4	72.4
	Unheated	24	12.5	12.5	84.9
	No basement	29	15.1	15.1	100.0
	Total	192	100.0	100.0	

Does your home have an attic?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	155	80.7	80.7	80.7
	No	37	19.3	19.3	100.0
	Total	192	100.0	100.0	

Are your central air/heat ducts located in the attic?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	31	16.1	16.1	16.1
	No	120	62.5	62.5	78.6
	N/A	29	15.1	15.1	93.8
	DK/NS	12	6.3	6.3	100.0
	Total	192	100.0	100.0	

Does your house have cold drafts in the winter?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	51	26.6	26.6	26.6
	No	138	71.9	71.9	98.4
	DK/NS	3	1.6	1.6	100.0
	Total	192	100.0	100.0	

Does your house have sweaty windows in the winter?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	44	22.9	22.9	22.9
	No	144	75.0	75.0	97.9
	DK/NS	4	2.1	2.1	100.0
	Total	192	100.0	100.0	

Do you notice uneven temperatures between the rooms in your home?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	115	59.9	59.9	59.9
	No	75	39.1	39.1	99.0
	DK/NS	2	1.0	1.0	100.0
	Total	192	100.0	100.0	

Does your heating system keep your home comfortable in winter?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	177	92.2	92.2	92.2
	No	12	6.3	6.3	98.4
	DK/NS	3	1.6	1.6	100.0
	Total	192	100.0	100.0	

Does your cooling system keep your home comfortable in summer?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	179	93.2	93.2	93.2
	No	12	6.3	6.3	99.5
	DK/NS	1	.5	.5	100.0
	Total	192	100.0	100.0	

Do you have a programmable thermostat?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	135	70.3	70.3	70.3
	No	54	28.1	28.1	98.4
	DK/NS	3	1.6	1.6	100.0
	Total	192	100.0	100.0	

How many thermostats are there in your home?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	3	1.6	1.6	1.6
	1	177	92.2	92.2	93.8
	2	10	5.2	5.2	99.0
	3	1	.5	.5	99.5
	4 or more	1	.5	.5	100.0
	Total	192	100.0	100.0	

What temperature is your thermostat set to on a typical summer weekday afternoon?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 69 degrees	4	2.1	2.1	2.1
	69-72 degrees	32	16.7	16.7	18.8
	73-78 degrees	130	67.7	67.7	86.5
	Higher than 78 degrees	11	5.7	5.7	92.2
	Off	9	4.7	4.7	96.9
	DK/NS	6	3.1	3.1	100.0
	Total	192	100.0	100.0	

What temperature is your thermostat set to on a typical winter weekday afternoon?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 67 degrees	35	18.2	18.2	18.2
	67-70 degrees	106	55.2	55.2	73.4
	71-73 degrees	28	14.6	14.6	88.0
	74-77 degrees	17	8.9	8.9	96.9
	DK/NS	6	3.1	3.1	100.0
	Total	192	100.0	100.0	

Do you have a swimming pool, hot-tub or spa?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	42	21.9	21.9	21.9
	No	150	78.1	78.1	100.0
	Total	192	100.0	100.0	

Would a two-degree increase in the summer afternoon temperature in your home affect your comfort

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	49	25.5	25.5	25.5
	Slightly	53	27.6	27.6	53.1
	Moderately, or	63	32.8	32.8	85.9
	Greatly	20	10.4	10.4	96.4
	DK/NS	7	3.6	3.6	100.0
	Total	192	100.0	100.0	

How many people live in this home?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	37	19.3	19.3	19.3
	2	77	40.1	40.1	59.4
	3	29	15.1	15.1	74.5
	4	33	17.2	17.2	91.7
	5	11	5.7	5.7	97.4
	6	3	1.6	1.6	99.0
	Prefer not to answer	2	1.0	1.0	100.0
	Total	192	100.0	100.0	

How many of them are teenagers age 13-19?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	158	82.3	82.3	82.3
	1	20	10.4	10.4	92.7
	2	10	5.2	5.2	97.9
	3	2	1.0	1.0	99.0
	Prefer not to answer	2	1.0	1.0	100.0
	Total	192	100.0	100.0	

How many persons are usually home on a weekday afternoon?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	19	9.9	9.9	9.9
	1	78	40.6	40.6	50.5
	2	65	33.9	33.9	84.4
	3	18	9.4	9.4	93.8
	4	2	1.0	1.0	94.8
	5	4	2.1	2.1	96.9
	Prefer not to answer	6	3.1	3.1	100.0
	Total	192	100.0	100.0	

Are you planning on making any large purchases to improve energy efficiency in the next 3 years?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	57	29.7	29.7	29.7
	No	116	60.4	60.4	90.1
	DK/NS	19	9.9	9.9	100.0
	Total	192	100.0	100.0	

What is your age group?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18-34	11	5.7	5.7	5.7
	35-49	35	18.2	18.2	24.0
	50-59	47	24.5	24.5	48.4
	60-64	32	16.7	16.7	65.1
	65-74	40	20.8	20.8	85.9
	Over 74	23	12.0	12.0	97.9
	Prefer not to answer	4	2.1	2.1	100.0
	Total	192	100.0	100.0	

Please indicate your annual household income

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Under $15,000	3	1.6	1.6	1.6
	$15,000-$29,999	12	6.3	6.3	7.8
	$30,000-$49,999	25	13.0	13.0	20.8
	$50,000-$74,999	25	13.0	13.0	33.9
	$75,000-$100,000	33	17.2	17.2	51.0
	Over $100,000	32	16.7	16.7	67.7
	Prefer Not to Answer	56	29.2	29.2	96.9
	DK/NS	6	3.1	3.1	100.0
	Total	192	100.0	100.0	

Non-Participant Survey Households

Eighty customers in Ohio who did not participate in the Specialty Bulbs program were surveyed for this evaluation; this section presents household and demographic data collected during the non-participant survey.

In what type of building do you live?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Apartment (4 + families)---traditional structure	4	5.0	5.0	5.0
	Condominium---traditional structure	2	2.5	2.5	7.5
	Other: town house	3	3.8	3.8	11.3
	Refused	1	1.3	1.3	12.5
	Single family home, factory manufactured/modular	1	1.3	1.3	13.8
	Single family, mobile home	1	1.3	1.3	15.0
	Single-family home, detached construction	65	81.3	81.3	96.3
	Two or Three family attached residence-traditional structure	3	3.8	3.8	100.0
	Total	80	100.0	100.0	

What year was your residence built?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1959 and before	24	30.0	30.0	30.0
	1960-1979	21	26.3	26.3	56.3
	1980-1989	9	11.3	11.3	67.5
	1990-1997	10	12.5	12.5	80.0
	1998-2000	5	6.3	6.3	86.3
	2001-2007	4	5.0	5.0	91.3
	2008-present	2	2.5	2.5	93.8
	DK/NS	5	6.3	6.3	100.0
	Total	80	100.0	100.0	

How long have you lived in your current home?

Mean: 12.9 years ***Median: 11.5 years***		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	One year or less	5	6.3	6.3	6.3
	More than one up to 5 years	27	33.8	33.8	40.0
	More than 5 up to 10 years	6	7.5	7.5	47.5
	More than 10 up to 20 years	23	28.8	28.8	76.3
	More than 20 up to 30 years	10	12.5	12.5	88.8
	More than 30 years	7	8.8	8.8	97.5
	Don’t know	2	2.5	2.5	100.0
	Total	192	100.0	100.0	

How many rooms are in your home (excluding bathrooms, but including finished basements)?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	10 or more	17	21.3	21.3	21.3
	4	4	5.0	5.0	26.3
	41642	3	3.8	3.8	30.0
	5	7	8.8	8.8	38.8
	6	8	10.0	10.0	48.8
	7	11	13.8	13.8	62.5
	8	16	20.0	20.0	82.5
	9	13	16.3	16.3	98.8
	DK/NS	1	1.3	1.3	100.0
	Total	80	100.0	100.0	

Which of the following best describes your home's heating system?	**Total N=80**	
None	0	0.0%
Central forced air furnace	60	75.0%
Electric Baseboard	3	3.8%
Heat Pump	17	21.3%
Geothermal Heat Pump	1	1.3%
Wood burning fireplace / stove	0	0.0%
Boiler / steam heat	2	2.5%
Dual system: furnace and heat pump	0	0.0%
Other: "*Hybrid heat pump*"	1	1.3%
Don't know	1	1.3%

May total to more than 100% because respondents could give multiple responses.

How old is your heating system?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-4 years	31	38.8	38.8	38.8
	10-14 years	13	16.3	16.3	55.0
	15-19 years	6	7.5	7.5	62.5
	19 years or older	9	11.3	11.3	73.8
	5-9 years	6	7.5	7.5	81.3
	DK/NS	14	17.5	17.5	98.8
	Do not have	1	1.3	1.3	100.0
	Total	80	100.0	100.0	

What is the primary fuel used in your heating system?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DK/NS	3	3.8	3.8	3.8
	Electricity	26	32.5	32.5	36.3
	Natural Gas	47	58.8	58.8	95.0
	Oil	3	3.8	3.8	98.8
	Propane	1	1.3	1.3	100.0
	Total	80	100.0	100.0	

What is the secondary fuel used in your primary heating system, if any?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DK/NS	4	5.0	5.0	5.0
	Natural Gas	6	7.5	7.5	12.5
	None	60	75.0	75.0	87.5
	Space heaters	4	5.0	5.0	92.5
	Wood stove / fireplace	4	5.0	5.0	97.5
	"*Gas logs in the fireplace*"	1	1.3	1.3	98.8
	"*Pellet stove*"	1	1.3	1.3	100.0
	Total	80	100.0	100.0	

Do you use one or more of the following to cool your home?	Total N=80	
None	0	0.0%
Heat pump for cooling	18	22.5%
Central air conditioning	60	75.0%
Through the wall or window air conditioning unit	8	10.0%
Geothermal heat pump for cooling	1	1.3%
Don’t know	1	1.3%

May total to more than 100% because respondents could give multiple responses.

How many window-unit or through the wall air conditioner(s) do you use?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	1	1.3	1.3	1.3
	2	7	8.8	8.8	10.0
	3	1	1.3	1.3	11.3
	5	1	1.3	1.3	12.5
	DK/NS	2	2.5	2.5	15.0
	None	68	85.0	85.0	100.0
	Total	80	100.0	100.0	

What is the fuel used in your cooling system?	Total N=80	
Electricity	78	97.5%
Natural gas	2	2.5%
Oil	0	0.0%
Propane	0	0.0%
Geothermal	0	0.0%
Don’t know	1	1.3%

May total to more than 100% because respondents could give multiple responses.

How old is your cooling system?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-4 years	29	36.3	36.3	36.3
	10-14 years	12	15.0	15.0	51.3
	15-19 years	9	11.3	11.3	62.5
	19 years or older	8	10.0	10.0	72.5
	5-9 years	9	11.3	11.3	83.8
	DK/NS	13	16.3	16.3	100.0
	Total	80	100.0	100.0	

What is the fuel used by your water heater?	Total N=80	
Electricity	25	31.3%
Natural gas	49	61.3%
Oil	0	0.0%
Propane	0	0.0%
Geothermal	1	1.3%
Solar	1	1.3%
Don't know	5	6.3%

May total to more than 100% because respondents could give multiple responses.

How old is your water heater?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-4 years	29	36.3	36.3	36.3
	10-14 years	16	20.0	20.0	56.3
	15-19 years	6	7.5	7.5	63.8
	5-9 years	13	16.3	16.3	80.0
	DK/NS	10	12.5	12.5	92.5
	More than 19 years	6	7.5	7.5	100.0
	Total	80	100.0	100.0	

What type of fuel do you use for indoor cooking on the stovetop or range?	Total N=80	
Electricity	51	63.8%
Natural gas	28	35.0%
Oil	0	0.0%
Propane	0	0.0%
No stove / range	0	0.0%
Don't know	1	1.3%

May total to more than 100% because respondents could give multiple responses.

What type of fuel do you use for indoor cooking in the oven?	Total N=80	
Electricity	54	67.5%
Natural gas	25	31.3%
Oil	0	0.0%
Propane	1	1.3%
No oven	0	0.0%
Don't know	1	1.3%

May total to more than 100% because respondents could give multiple responses.

What type of fuel do you use for clothes drying?	Total N=80	
Electricity	63	78.8%
Natural gas	12	15.0%
Oil	0	0.0%
Propane	0	0.0%
No clothes dryer	3	3.8%
Don't know	2	2.5%

May total to more than 100% because respondents could give multiple responses.

About how many square feet of living space are in your home?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1000 to 1499	9	11.3	11.3	11.3
	1500 to 1999	17	21.3	21.3	32.5
	2000 to 2499	12	15.0	15.0	47.5
	2500 to 2999	10	12.5	12.5	60.0
	3000 to 3499	1	1.3	1.3	61.3
	3500 to 3999	4	5.0	5.0	66.3
	4000 or more	6	7.5	7.5	73.8
	500 to 999	4	5.0	5.0	78.8
	DK/NS	15	18.8	18.8	97.5
	Less than 500	2	2.5	2.5	100.0
	Total	80	100.0	100.0	

Do you own or rent your home?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Own	66	82.5	82.5	82.5
	Rent	14	17.5	17.5	100.0
	Total	80	100.0	100.0	

How many levels are in your home (not including your basement)?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	One	31	38.8	38.8	38.8
	Three	12	15.0	15.0	53.8
	Two	37	46.3	46.3	100.0
	Total	80	100.0	100.0	

Does your home have a heated or unheated basement?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DK/NS	1	1.3	1.3	1.3
	Heated	53	66.3	66.3	67.5
	No basement	14	17.5	17.5	85.0
	Unheated	12	15.0	15.0	100.0
	Total	80	100.0	100.0	

Does your home have an attic?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	23	28.8	28.8	28.8
	Yes	57	71.3	71.3	100.0
	Total	80	100.0	100.0	

Are your central air/heat ducts located in the attic?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DK/NS	5	6.3	6.3	6.3
	N/A	25	31.3	31.3	37.5
	No	37	46.3	46.3	83.8
	Yes	13	16.3	16.3	100.0
	Total	80	100.0	100.0	

Does your house have cold drafts in the winter?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DK/NS	2	2.5	2.5	2.5
	No	44	55.0	55.0	57.5
	Yes	34	42.5	42.5	100.0
	Total	80	100.0	100.0	

Does your house have sweaty windows in the winter?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DK/NS	1	1.3	1.3	1.3
	No	59	73.8	73.8	75.0
	Yes	20	25.0	25.0	100.0
	Total	80	100.0	100.0	

Do you notice uneven temperatures between the rooms in your home?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DK/NS	1	1.3	1.3	1.3
	No	25	31.3	31.3	32.5
	Yes	54	67.5	67.5	100.0
	Total	80	100.0	100.0	

Does your heating system keep your home comfortable in winter?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DK/NS	1	1.3	1.3	1.3
	No	4	5.0	5.0	6.3
	Yes	75	93.8	93.8	100.0
	Total	80	100.0	100.0	

Does your cooling system keep your home comfortable in summer?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DK/NS	1	1.3	1.3	1.3
	No	5	6.3	6.3	7.5
	Yes	74	92.5	92.5	100.0
	Total	80	100.0	100.0	

Do you have a programmable thermostat?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DK/NS	1	1.3	1.3	1.3
	No	27	33.8	33.8	35.0
	Yes	52	65.0	65.0	100.0
	Total	80	100.0	100.0	

How many thermostats are there in your home?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	4	5.0	5.0	5.0
	1	72	90.0	90.0	95.0
	2	3	3.8	3.8	98.8
	DK/NS	1	1.3	1.3	100.0
	Total	80	100.0	100.0	

What temperature is your thermostat set to on a typical summer weekday afternoon?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	69-72 degrees	29	36.3	36.3	36.3
	73-78 degrees	37	46.3	46.3	82.5
	DK/NS	2	2.5	2.5	85.0
	Higher than 78 degrees	1	1.3	1.3	86.3
	Less than 69 degrees	7	8.8	8.8	95.0
	Off	4	5.0	5.0	100.0
	Total	80	100.0	100.0	

What temperature is your thermostat set to on a typical winter weekday afternoon?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	67-70 degrees	40	50.0	50.0	50.0
	71-73 degrees	22	27.5	27.5	77.5
	74-77 degrees	4	5.0	5.0	82.5
	78 degrees or higher	2	2.5	2.5	85.0
	DK/NS	2	2.5	2.5	87.5
	Less than 67 degrees	10	12.5	12.5	100.0
	Total	80	100.0	100.0	

Do you have a swimming pool, hot-tub or spa?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	67	83.8	83.8	83.8
	Yes	13	16.3	16.3	100.0
	Total	80	100.0	100.0	

Would a two-degree increase in the summer afternoon temperature in your home affect your comfort

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DK/NS	3	3.8	3.8	3.8
	Greatly	8	10.0	10.0	13.8
	Moderately	22	27.5	27.5	41.3
	Not at all	21	26.3	26.3	67.5
	Slightly	26	32.5	32.5	100.0
	Total	80	100.0	100.0	

How many people live in this home?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	14	17.5	17.5	17.5
	2	34	42.5	42.5	60.0
	3	10	12.5	12.5	72.5
	4	6	7.5	7.5	80.0
	5	10	12.5	12.5	92.5
	6	2	2.5	2.5	95.0
	7	1	1.3	1.3	96.3
	8 or more	1	1.3	1.3	97.5
	DK/NS	1	1.3	1.3	98.8
	Prefer not to answer	1	1.3	1.3	100.0
	Total	80	100.0	100.0	

How many of them are teenagers age 13-19?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	67	83.8	83.8	83.8
	1	9	11.3	11.3	95.0
	2	2	2.5	2.5	97.5
	DK/NS	1	1.3	1.3	98.8
	Prefer not to answer	1	1.3	1.3	100.0
	Total	80	100.0	100.0	

How many persons are usually home on a weekday afternoon?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	18	22.5	22.5	22.5
	1	22	27.5	27.5	50.0
	2	24	30.0	30.0	80.0
	3	5	6.3	6.3	86.3
	4	3	3.8	3.8	90.0
	5	3	3.8	3.8	93.8
	6	2	2.5	2.5	96.3
	DK/NS	2	2.5	2.5	98.8
	Prefer not to answer	1	1.3	1.3	100.0
	Total	80	100.0	100.0	

Are you planning on making any large purchases to improve energy efficiency in the next 3 years?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DK/NS	6	7.5	7.5	7.5
	No	48	60.0	60.0	67.5
	Yes	26	32.5	32.5	100.0
	Total	80	100.0	100.0	

What is your age group?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18-34	17	21.3	21.3	21.3
	35-49	17	21.3	21.3	42.5
	50-59	13	16.3	16.3	58.8
	60-64	11	13.8	13.8	72.5
	65-74	16	20.0	20.0	92.5
	Over 74	4	5.0	5.0	97.5
	Prefer not to answer	2	2.5	2.5	100.0
	Total	80	100.0	100.0	

Please indicate your annual household income

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	$15,000-$29,999	10	12.5	12.5	12.5
	$30,000-$49,999	14	17.5	17.5	30.0
	$50,000-$74,999	11	13.8	13.8	43.8
	$75,000-$100,000	18	22.5	22.5	66.3
	DK/NS	1	1.3	1.3	67.5
	Over $100,000	10	12.5	12.5	80.0
	Prefer Not to Answer	13	16.3	16.3	96.3
	Under $15,000	3	3.8	3.8	100.0
	Total	80	100.0	100.0	

Appendix I: Explanations of Satisfaction and Influence Ratings

Participant Survey

Survey respondents were asked to explain their satisfaction ratings for the program; these comments are categorized and listed below. There are 191 responses from the 192 surveyed participants in Ohio because one survey respondent did not answer the question.

“Very satisfied” with the Savings Store (n=147)

- *I think it was a good deal.*
- *It was a positive experience, from the ad in the mail to getting the light bulb installed, I didn't have any problems.*
- *I was very satisfied because the process was easy and the pricing was low.*
- *I got a bunch of bulbs at a very good price and it gives me a chance to test them and see which ones I like and which ones I don't like.*
- *I got the bulbs I wanted at the price I wanted.*
- *They got everything I needed and the price was right.*
- *It was convenient, it was low priced, and it was what I wanted.*
- *I am very satisfied because of the website navigation, information provided, and bulb pricing.*
- *The price is very good, the service is good, and the product was what I need. It was, overall, a very good experience*
- *Because I got everything I wanted with free shipping and the bulbs cost much less than I'd find in a retail store.*
- *I liked the ease of use and price.*
- *Good prices and variety and home delivery and that I could purchase online.*
- *I like the website and getting CFLs at a discounted price.*
- *It just was convenient and I got what I needed.*
- *They have proven to me that they care about me. Any help I need, they're there, and that's important to me.*
- *I had no troubles with ordering the bulbs and I am happy with the bulbs I purchased for the website.*
- *Ease of use and discount; it's a win-win.*
- *Good prices and good selection.*
- *Low cost and ease of purchase*
- *After I received the globe bulbs, I tried to go back into the website so I could buy more at the higher price but the website wouldn't allow it.*
- *The lights work well and the convenience of ordering online and having the bulbs delivered.*

- *Everything was as I expected with entire process, nothing went wrong*
- *They offered the bulbs at a discounted price.*
- *I liked the Kelvin information available and that the site was easy to use.*
- *So much cheaper than stores*
- *We're in a 'landominium' association. A lot of my neighbors are retired people with second homes that are out of state, and they often visit those homes for weeks at a time. Since I got these bulbs, I told my neighbors about the bulbs and the Store. Where we live, we have no street lights, so it's important for residents to leave their outdoor lights on, even when they're away. The bulbs I used in the past would always burn out. But I've had these bulbs for almost a year. They were on for more two months straight and didn't burn out. They're still working. I would buy another three from you right now.*
- *I would have liked to purchase more that the limit on the number of bulbs that you can purchase at the discounted price.*
- *The entire process was so easy. The price was good, that's why it was such a great thing. Also, the site had what I needed at the time.*
- *The discounted price of the bulbs and the ease of ordering online*
- *I was completely satisfied with everything. It was easy to find what I wanted and order it and the bulbs came quickly.*
- *It was an easy experience.*
- *I thought it was good savings both in energy and dollars.*
- *Because the lights are still working, they are of good quality.*
- *I was happy with everything*
- *I think more people ought to use it. I think that anything that encourages people to complete this conversion is a good thing.*
- *I got what I wanted to order quickly and I put them to good use*
- *There is a wide selection of bulbs, they are of good quality, and I was able to buy them online and have them shipped to my home.*
- *Once I knew about it, I was able to find what I wanted and was even surprised by some of what was there, by the variety.*
- *The main thing that I liked was the low price for the bulbs. I also liked that they came straight to my door.*
- *They got a great selection of bulbs for a very good price.*
- *I was very satisfied with the price, the ease of ordering, and the energy savings and cost.*
- *Buying cheap makes me feel good, buying green makes me feel good and not leaving my house makes me feel good.*
- *It's easy to use.*
- *It was easy to order them and the delivery was great.*
- *I was very satisfied because of the convenience and pricing.*
- *It was just so easy. When I called to confirm some of my questions and arrange a replacement bulb, they were very good at answering my questions.*

- *It was just so easy!*
- *From beginning to end, the delivery was quick, easy, not complicated, and seamless; the whole thing just worked out fine.*
- *It's all about the cost savings through energy savings.*
- *I found a bulb type to suit all of my needs, they offer energy savings, and the bulbs are better for our environment.*
- *It's easy to get through, it's good pricing, it's fast delivery, and they packed it like plutonium.*
- *I liked the product that they offered, and it was quick and easy.*
- *It did exactly as it said it would. I like that I could order online and get what I wanted.*
- *I had no problems with the ordering and getting my order. Everything's OK with them.*
- *The bulbs are cheap and they're all consistent.*
- *The price and delivery was great.*
- *It was easy enough to get the bulbs that I wanted.*
- *Because of the good price that they had. I would be even more satisfied if they had more choices in LED bulbs.*
- *I got what I needed for a low price. The limit affected it a little bit, but I understand it needed to be there.*
- *I'm very satisfied simply because of the ease and the price.*
- *I'd like it if they offered more variety in LED light bulbs, if they were clearer about what each LED bulb does versus an incandescent, and if they had more detailed about colors of LEDs available. And do away with the limitation.*
- *It was easy, the bulbs were less expensive and I did not have to leave my chair.*
- *I really liked the ease and the product you got for the cost; it's a nice service they're doing for their customers.*
- *I accomplished what I needed to do very easily and efficiently, and the prices were good.*
- *It was convenient. The price was acceptable; the experience was quick and relatively painless.*
- *Everything worked out the way I wanted and I was finally able to find out the information I needed.*
- *I am very satisfied because everything worked well: price, ordering, and delivery.*
- *It was just easy, fast, and I didn't run into any obstacles.*
- *I like the convenience of going online to purchase bulbs. It probably saved me a half hour walking around a store trying to find what I needed.*
- *Ease of navigation; ease of understanding information (idiot proof)*
- *For ease, price, and quality: you get all three (and it was fast)*
- *It was hassle free. A no-brainer. It was easy.*
- *Savings and ease of use*

- *I am very satisfied because of the ease of ordering, convenience of home delivery, and because the bulbs fit seamlessly into existing sockets.*
- *I am very satisfied because I was able to save money on bulb purchases.*
- *I had no problems at all, the information was all there at the website for me.*
- *It was very convenient: quick and easy to order*
- *Because I was able to get what I wanted at the price I wanted and it was relatively easy*
- *I am very satisfied with the price, convenience, and selection of bulbs available there.*
- *It is an easy way to buy bulbs.*
- *I am very satisfied with the price and convenience offered from the Duke store.*
- *It is great I couldn't ask for more.*
- *They bulbs came very quickly. I liked the savings.*
- *I was very satisfied because of the simplicity of the transaction, pricing, and the bulbs arriving undamaged.*
- *I was very satisfied because it was easy and I experienced no problems.*
- *I was very satisfied because I got what I wanted and had no problems.*
- *It was easy to do.*
- *It was easy to go online and buy them. I like to shop online because I don't have to drive anywhere.*
- *I like the convenience of shopping online.*
- *I was very satisfied because the Savings Store was easy to use and find the items I was looking for.*
- *I was very satisfied because it was such a positive experience.*
- *I ordered some bulbs, they came, I plugged them in, and they work.*
- *I thought it was nice; I had no issues with the Savings Store.*
- *Everything went well. I used the information provided by the website to pick out the lights that I wanted for the house. I saved money on the bulb purchase, they were delivered quickly, and the bulbs are working well.*
- *The bulbs were cheaper than anywhere else and they were very convenient to shop for and buy from the Savings Store.*
- *They sell excellent bulbs.*
- *The program did what I needed it to do. I wanted to switch the specialty lighting over to CFLs but didn't want to spend the large amount of money that it would have required. I was able to switch over to CFLs at a minimal cost.*
- *It's something that I wanted and they had it at a price that I was happy to pay. I probably did it sooner than I might have otherwise because it was convenient.*
- *I was very satisfied but nothing is perfect.*
- *I saved money on the light bulbs. CFLs last longer than the older bulbs so I won't have to change the bulbs as often.*
- *I am very satisfied due to the ease of acquiring bulbs and fast delivery.*

- *I am very satisfied because of the cost savings associated with this CFL purchase.*
- *Convenience and savings*
- *Because at the time, it was a transition towards having to use these new CFLs and it was a lot easier to do it because of the convenience of the Savings Store. It's a great resource, a good thing to be able to look at what you're buying.*
- *The bulbs were cheap and it was easy enough to order online and have the bulbs delivered*
- *I like what it has done. I like my savings that it has brought me.*
- *It's a good deal. I like what they're doing, and I will probably eventually buy more.*
- *The site had what I needed and the price was right.*
- *The site provided the type of energy efficient lighting that I had wanted and provided adequate information for each bulb type.*
- *I was very satisfied because I was able to find the bulbs I needed for a good price.*
- *It's very easy to use, a good product, and good price.*
- *I liked the convenience of ordering the bulbs online and saving money on the bulb purchase*
- *When I went there, they had what I wanted at reasonable prices and they were delivered right to my door.*
- *I was very satisfied because it was a good experience.*
- *I think it was a good offer and it was really easy to order them and get them. And, I have a little supply on hand.*
- *I am very satisfied because, electricity-wise, Duke Energy has always been there for me.*
- *The price was good and everything came as it was supposed to.*
- *Everything about it was easy to do, the price was right, there were good descriptions, and I got free shipping.*
- *I liked the low price of the bulbs and I liked all of the informational resources provided.*
- *I am very satisfied because the ordering process was simple and saving energy is good for the environment.*
- *The website was simple to use and saved money on the light bulb purchase*
- *I thought the prices were great and so was the delivery time.*
- *I am very satisfied because of the pricing and convenience.*
- *Anytime I don't have to go out shopping, I'm happy.*
- *It met everything it said it was going to do. Time of delivery was very efficient.*
- *I liked the convenience of ordering the bulbs online and saving money on the bulb purchase*
- *The only thing I had was with some of the descriptions being vague and everything else was easy.*
- *I have not had any problems.*
- *I am very satisfied because the Savings Store met my needs.*

- *I am very satisfied because the website was fairly easy to navigate and the bulbs were sold at a discounted price.*
- *The Savings Store was easy to use and the price discount was great.*
- *We liked everything about it. It was convenient. We didn't have to go out to purchase the bulbs, they came quickly and the price was very good.*
- *I was very satisfied because it was convenient, user friendly, hassle-free, and a good deal price-wise.*
- *I liked the convenience of ordering the bulbs online*
- *I have no problem with them.*
- *I got what I wanted for the price that I wanted.*
- *I feel like I got a really good deal. I feel like I have a very good quality light bulb. And, I feel the bulbs are not only helping with saving me money, but are helping with energy usage.*
- *It was easy and economical.*
- *It's Duke, that's all I need to know about it. I trust them. They do the job, as I would expect from Duke. I guess you can call me a loyal customer.*
- *It provided me what I needed at a good price.*
- *For the most part the website was very clear and there was plenty of information that helped you know what you were picking out.*
- *I could basically get the bulbs I wanted at the price I was willing to pay.*
- *Great value with a good product*
- *It was very convenient to order the bulbs and the website was good.*
- *I was very satisfied because everything was as advertised and the transaction went smoothly.*
- *The prices were great and they delivered right to the house. The bulbs save me energy.*
- *Because I am looking for ways to save energy and save costs. With this program, I was able to get satisfaction both ways. Since I installed those bulbs I have not replaced any.*

"Somewhat satisfied" with the Savings Store (n=37)

- *I am somewhat satisfied because the Savings Store could still be improved quite a bit.*
- *There is always room for improvement. Perhaps they can offer free shipping or an energy bill credit.*
- *I am somewhat satisfied because I think the shipping cost is too high.*
- *I am somewhat satisfied because some bulb types are only available for residential customers and are non-procurable through my Duke Energy business account.*
- *I'm never totally satisfied, nobody ever is; there is no such thing as 100% satisfied.*
- *I thought it could have been easier to compare the standard incandescent bulbs with the CFL equivalent*
- *I wish that there was more variety and a greater number of bulbs that you can purchase at the discounted price.*

- *I like the prices*
- *Internet purchases aren't fun. I don't use the internet for general purchases but I will on occasion use the internet to find something specific or purchase something that is inexpensive.*
- *I like the saving savings it has and the ease of home delivery.*
- *I think the shipping time could have been less.*
- *I am somewhat satisfied because of the convenience, but there is room for improvement.*
- *Everything's OK so far.*
- *Everything was as advertised.*
- *The experience wasn't perfect, but it was pretty good.*
- *I am somewhat satisfied because I was not completely wowed by the Savings Store.*
- *The price was competitive and I was able to find what I wanted.*
- *I was somewhat satisfied because it was a cumbersome process to find the bulb pricing.*
- *Nothing's perfect.*
- *I liked saving money on the light bulb purchase but I needed a lot more of the dimmable CFLs than the limit allowed.*
- *I am somewhat satisfied because the website did not clearly indicate whether bulbs were dimmable or not, and I would prefer free shipping.*
- *I have problems in cold weather with dimmer reflector bulbs; I have ten bulbs that take a long time to get bright.*
- *The price was great. I think for the candelabra, it would be better to buy more at a time.*
- *The bulbs I ordered didn't fit.*
- *I was very satisfied with the website and the pricing but I wasn't able to purchase all the bulbs that I needed for the house. We have a larger house with a lot of lighting. If I would have been able to change all the lights over to CFLs I would have been more satisfied.*
- *The price is great; they could have more types of bulbs though.*
- *The website was easy to use. I was frustrated that the bulbs weren't clearly marked as CFLs because I thought I was ordering Globe CFLs*
- *I wish some of the bulbs that I purchased came in a smaller size. I was also hoping for a small chandelier style bulb, but couldn't find one.*
- *I am somewhat satisfied because I had a minor issue with the bulb descriptions.*
- *I am somewhat satisfied because the bulbs I ordered were the wrong size and it was too expensive to return them.*
- *I am somewhat satisfied. I was disallowed from purchasing as many bulbs as I wanted, and the delivery time was too long.*
- *I wish they had an option to let you place an order over the phone.*
- *I was only somewhat satisfied because I had to purchase Globe bulbs through the other section of the Store that sold them at a higher price.*

- *Because of the one three-way bulb I have to replace already now, and the candelabras are not dimmable.*
- *I was only somewhat satisfied because the 3-way bulbs ceased working properly.*
- *None of 'em burned out yet. I wasn't sure what I was ordering.*
- *I didn't like the quality of the warm up time, and one bulb failed sooner than it should have.*

"Neither satisfied nor dissatisfied" with the Savings Store (n=6)

- *I'm not sure yet and the bulbs are flickering, which may mean there's something wrong with them.*
- *It was confusing to pick out the light bulbs. There are not many bulbs on a page which made it hard to compare them with other bulbs.*
- *I am rather neutral because nothing stood out as being particularly amazing but I didn't experience any problems either.*
- *The resource is nice; I really just liked the convenience of shopping online.*
- *I think there could be more options in bulbs. Buying bulbs from here wasn't something I could do quickly. Finding the right bulbs and going through the checkout process took a while.*
- *The website was easy to use but I'm not thrilled with the bulbs themselves.*

"Somewhat dissatisfied" with the Savings Store (n=1)

- *I found it hard to navigate. I had trouble finding what I was looking for.*

"Very dissatisfied" with the Savings Store (n=0)

- No surveyed participants gave this response.

Overall Satisfaction with Duke Energy

Satisfaction with Duke Energy is generally high among these program participants, with a mean rating of 8.38 on a ten-point scale where "10" means "very satisfied." Forty-two participants (21.9%) rated their satisfaction with Duke Energy at "7" or less on a ten-point scale and were asked how this situation could be improved; these responses are listed below. The most common responses have to do with concerns about energy costs, billing and environmental issues.

Satisfaction with Duke Energy: rating "7 out of 10" or lower

- *A contractor hired by Duke, wearing a T-shirt with a logo from some other electric company, came around, knocked on our door and asked to see our bill. He said that some of the 'rider' charges on our bill are not supposed to be there. He told us to call Duke and ask about the superfluous 'rider' charges. He seemed legit but it was weird.*
- *Billing and customer service could be more professional.*
- *Cost efficiency; the company needs to do more. This may be happening now that Duke's monopoly has been broken.*

- *Duke could allow people to check the energy billing histories of addresses via the Duke Energy public website.*
- *Duke could clarify how its pricing compares with other energy providers.*
- *Duke could offer such things as cycling water heaters, handyman services, and referrals for professional contractors.*
- *Duke customer service could be more knowledgeable about the programs and services that they offer. I've twice tried & failed to enroll in the Power Manager program. Customer service representatives could have the ability to speak to customers in laymen's terms.*
- *Duke Energy can be more environmentally responsible in their operations.*
- *Duke Energy could improve service reliability and decrease outage repair times.*
- *Duke Energy could straighten out my billing issues so I don't fall behind on payments. I tend to receive my Duke Energy bill intermittently or not at all.*
- *Every few months, you get offers of alternative providers, even though the service still comes from Duke Energy. Duke Energy never shows us how they're rates rank against other providers. They need to proactively explain why we should continue to use Duke and not others.*
- *Get rid of the fixed cost on usage on natural gas and electric. It's a little stiff. In the summertime, I only use a little gas and they're charging $50. It's ridiculous. I'm thinking of moving to Kentucky where they don't have these agreements in place. I think it's called deregulation. I know they can't always get rid of rate increases. It also deregulated the CEO's pay, and she's able to make a lot more than the guy before. It leaves me scratching my head.*
- *I am dissatisfied with the year-round mandatory cost of having a gas hook-up with a monthly flat rate of $38 dollars per month weather you use the gas or not. I have not been using the gas at all in a house that I am fixing up which is uninhabited, yet I am required to pay this fee. I think it is too high of a fee, it should not be any higher than what the electric flat rate charges are, the fee should not be over $15 per month.*
- *I have no problem with the service provided by Duke Energy but I have downgraded them due to their environmental practices. The problem with the Dan River ash flow is concerning as it seems like Duke wants to pass off the cleaning on the river to its customers while they routinely announce profits in the billions.*
- *I just like to know what I can do to keep my bill as low as possible. What techniques?*
- *I want them to eliminate the coal power plants and go to renewable energy. I'd like them to be a company that environmentalists can be proud of.*
- *I wish they were more responsive to customers. I own a business that did contract work for Duke Energy and they never paid the bill. I have a three-year-old invoice that they've never paid. I've had wildly fluctuating bills since they installed a wireless meter and I've tried to get a hold of them, but can't get any response. Duke offered an energy audit of our home and they overcharged me; we paid $150 and we never received a report; the energy audit was in May of this year.*

- *I would like better communication explaining how they set the budget billing for Duke Energy Customers.*
- *I would like to see an easier comparison and conversion to alternate providers, which might be self-defeating. I know that it's out there, but there doesn't seem to be a central place to compare and sign up.*
- *I'd be more satisfied if they were faster to respond to power outages.*
- *I'd like to have more communication during power outages. Many times our neighborhood is out of power and nobody else around us has their power out. We never get any explanation about why our power is out, and these occurrences happen during fair weather. I would like to have explanation as to why these happen and maybe even a heads up before the power outs are going to happen if it is something Duke Energy is controlling.*
- *I'm very happy with services but would prefer that Duke Energy had a more environmental mind set with their business decisions. I'd like to see them looking into directly investing in renewable resources and do more with waste products (better containment of coal ash, better CO2 capture, and flue-gas desulfurization).*
- *It's still a bill I need to pay every month, and my wife leaves the lights on during the day.*
- *It's very hard to get a hold of someone or even just get a human on the phone. Also, we have a cabin that loses power frequently. When I call for someone to repair the power they tell me that someone will have it fixed in an hour or 2 but it usually takes 5-6 hours instead. If we were told that it would take 5-6 hours we would got back into town to the house.*
- *Last year, I heard noises outside and discovered that a Power Manager device had been installed on my air conditioning. While the crew left a hanging card on my door to indicate the device could be removed at my request, I don't recall requesting or authorizing the installation. I would have liked to have been notified in advance.*
- *My son who uses gas to heat his home has to pay $30 a month just for being connected. It almost doubles his monthly bill.*
- *Sometimes when we lose electricity, it takes some time to get things back to normal (but this has improved somewhat). Also, in the MyHER comparison reports mailed to us, no matter what we do, we're way higher than others. I wish the report would make it easier to understand why that's so.*
- *The Home Energy reports keep telling us that our home is less efficient than the average house but I can't figure out why that would be. More than half of our light bulbs are the CFL type and the house is only 11 years old. We think that Duke is trying to convince everyone that their homes aren't efficient so that Duke can get them to buy things through them to increase their home's efficiency.*
- *When we have severe thunderstorms, we might lose power for one to five hours. It seems the outages are excessive and only in certain parts of the neighborhood.*
- *Whoever Duke has contracted to trim the trees in they are pretty much butchering them. Obviously trees need to be trimmed but these people are cutting out the middle portions of the trees and it looks terrible. Also, I was trying to participate in the Appliance Recycling program a few months ago and the paperwork involved was too much for me*

to fill out. It's like they wanted to make the paperwork so difficult that people would give up instead of trying to fill it all out.

- *The service is great but the prices are terrible. It is an electric company for profit, what do you expect?*
- *They could lower the cost of delivering my electricity. Also, they could start trimming the trees around the wires again; they used to come by every year and perform that critical maintenance but have not done it in many years now.*
- *Lower prices on utilities*
- *Lower the electric rates.*
- *Quit raising our bills.*
- *Stop jacking up the rates. Where is all that money going?*
- *The rates are high and keep getting higher.*
- *The rates are high but I've had no problems with service.*
- *I'd like to see them focus on trying to lower the power rates.*
- *I want my rates to be lower.*
- *It's too expensive.*
- *I don't know.*

Survey respondents were asked to explain the influence ratings they gave for the reduced price of bulbs, the information provided at the Savings Store website and the convenience of online ordering on their decision to purchase bulbs from the Savings Store. These comments are categorized and listed below.

Influence of Savings Store reduced pricing: rating "10 out of 10"

- *I like that the bulbs were cheap.*
- *The reduced pricing was my main influence.*
- *Because if they were same price at a store, I'd probably purchase the bulbs I needed from a store instead of waiting to receive my order thru the mail.*
- *The reduced pricing was very influential because the Savings Store was less expensive than I could find elsewhere.*
- *The reduced pricing was influential because it amounted to one-third to one-half less cost than the big-box stores.*
- *That was the whole reason I had chosen to purchase the bulbs from the saving store. I knew that I wanted the bulbs and I wanted them at the lowest price possible.*
- *Duke's price was even better than Costco.*
- *It was the main reason that I purchased the bulbs online.*
- *The reduced pricing was influential because I did shop around beforehand.*
- *The reduced pricing was the primary influence on my decision.*
- *I was price conscious.*

- *The reduced pricing was very influential because I knew Duke's prices were lower than what I could find elsewhere.*
- *The reduced price was the main reason I chose to purchase bulbs from the saving store.*
- *At the time I was comparing prices, I figured it would be stupid to not buy them there.*
- *The reduced pricing was my main reason for going on the website.*
- *I like saving money.*
- *I wanted to save as much money as possible while we are trying to switch over to the CFL bulbs. The reduced pricing was the main factor influenced the purchase.*
- *Reduced pricing is always a good thing for light bulbs.*
- *Those kind of bulbs are not that cheap; they're perhaps 40% more elsewhere. I also like to buy in quantity, and these seemed to be at a good price.*
- *The reduced pricing was my primary influence.*
- *Because it saved me money and has the potential to save me more money in the long run by using more energy efficient bulbs.*
- *The reduced pricing was my main consideration.*
- *Energy savings were my primary consideration and the reduced bulb pricing was a bonus.*
- *I was pricing bulbs at like Walmart, and these were less.*
- *Compared to the pricing I'd seen at some of the local stores, it was very attractive.*
- *These are the first LED bulbs I'd purchased. I wasn't going to go out spend a ton of money, if I wasn't going to be satisfied with the light they put out.*
- *If that's going to be the lower price that I could find, that's where I'm going to buy them from.*
- *Based on what I thought the price ought to be, the prices were very attractive.*
- *The price of the bulbs and the free shipping is what made me decide to purchase online rather than at a local store.*
- *It was significantly reduced. It was the cheapest price I could find for that quality of bulb.*
- *It described the price, which was extremely low.*
- *The reduced pricing, which was roughly half-off normal pricing, was very influential.*
- *The price was extremely attractive.*
- *Well, actually, I give it that score because before I went to the Duke Store, I had to purchase outdoor CFLs from a local retailer and I found that specialty CFLs are very expensive. The prices offered at the Savings Store were very good compared to what I would find in stores.*
- *I wanted inexpensive bulbs*
- *The savings were significant.*
- *They were so reasonable. Honestly, I just feel like they were giving them away. For what my husband paid for one bulb at Walmart, I got four from Duke's store.*

- *I had wanted to switch the candelabras in the living room over to CFLs but because I needed 6 of them I was waiting until I could get a good price on candelabra CFLs. The discounted bulbs provided at the website are the main reason I chose to order.*
- *If it had not been a reduced price, I probably would have bought light bulbs from the store, not Duke.*
- *The deep discount on the price of the bulbs is why I purchased as many bulbs as I did.*
- *The mailing showed bulbs were priced at 20% of their normal cost.*
- *The CFLs offered on the Saving Store website were cheaper than in a store.*
- *The reduced price was the main reason I wanted to order from the website.*
- *The discounted price was the main reason I chose to purchase bulbs from the saving store.*
- *Comparable single bulb was $16 in the store; I paid $7 plus for all six.*
- *I know that bulbs that offer long usage are usually quite expensive. I went to look at these at stores like Home Depot and Lowe's. For the price Duke sold these bulbs, they were a deal.*
- *I was looking to get some CFL candelabras for a good price and these were the lowest price I could find.*
- *I knew that the three-way bulbs I was interested in were very expensive in other places that I looked, like at Target and Lowe's.*
- *The pricing was the reason I ordered from the website.*
- *I wanted to try the bulbs specialty bulbs inexpensively.*
- *The store offered good prices.*
- *Because I could not get those types of CFL bulbs at that price any place else.*
- *I wanted inexpensive CFLs for my home. I had received the free CFLs from Duke Energy about years ago and I really like that the bulbs don't burn out as quickly as the old bulbs. I was hoping to get more CFLs inexpensively so I had stopped buying bulbs and was letting them burn out around the house until I could afford the CFL type bulbs.*
- *The reduced pricing was the main thing that caused me to buy them from the Savings Store.*
- *The prices were really good. The prices were hard to pass up.*
- *It's so much cheaper than going into Home Depot.*
- *I liked that the bulbs were so super cheap so I bought a bunch.*
- *It was very influential because they were much cheaper than I could get them anyplace else.*
- *The reduced pricing at the Savings Store was influential because it was substantially cheaper than Lowe's and/or Kroger.*
- *That's what captured my attention.*
- *I recall they did have a reduced price for the bulb.*
- *I wanted to buy them, but didn't want to pay the full price.*

- *The price of an item is always the first thing that is considered when I want to buy something. It needs to be a good fair price for the quality offered by the item.*
- *I compared the price and it really was, legitimately, 70 to 80 percent cheaper than Home Depot.*
- *That's why I bought them. It just seemed like a very good deal in comparison to the stores.*
- *As I recall, they were below $10, and it was worth the price for the number of bulbs that I received.*
- *Why would anybody not want to save more money?*
- *The prices were better than the stores near me.*
- *I have not seen bulbs for such a low price anywhere else.*
- *As far as I could tell, it was the cheapest price for the bulbs I wanted, which made me want to buy them at the store.*
- *The difference is like four times less expensive.*
- *The bulbs were much cheaper than I could buy elsewhere.*
- *The pricing was so much better than what you could find in the stores for the product that I got.*
- *I recognized the savings when I got the flyer and it made me make the move to make the purchase. And, it was free shipping too.*
- *In some cases the price was less than half what I would have paid in other stores.*
- *It was just extremely affordable.*
- *The bulbs I purchased cost less than I could have purchased anywhere else.*
- *It was like half the price. Before, when I went shopping I could only buy one or two bulbs a month. This allowed me to buy everything I needed for the house all at once instead of just slowly changing a couple of bulbs at a time.*
- *They were 90% off prices: ungodly cheap.*
- *Very influential; bulbs were less than half of the store price.*
- *The reduced pricing was very influential because saving money on bulb purchases was the main reason I decided to purchase through the Savings Store.*
- *I price shopped at local retailers (Lowe's and Home Depot). The Duke price was much better than I could have got at the other stores; maybe $2 a bulb difference?*
- *It made it worth it for me to buy from a store I never bought from before; worth the extra time to enter data*
- *Price is kind of the only rational for purchasing any item. These were offered at a good price, so I went ahead and took advantage of the offer.*
- *They were cheaper than Costco.*
- *The savings were the major reason for purchasing the bulbs.*
- *The reduced pricing was very influential because it was ridiculously cheaper than I could find elsewhere.*

- *I kind of compared prices to GE bulbs in a Walmart. At those prices, I would not have purchased any. The Store gave me the chance to try out new technology at a price I could afford.*
- *It was the cheapest. It sounded too cheap to be true.*
- *I like that the bulbs were less expensive than what I could find at a local store.*
- *The pricing was very influential because CFLs are still too expensive in stores like Lowe's.*
- *The reduced pricing was very influential because I generally dislike the cost of these new light bulbs. I was grateful to be able to stock up and save money.*
- *I like to save money, the bulbs were inexpensive.*
- *I was looking for dimmable indoor flood lighting and the website offered the least expensive ones. I looked at Home Depot, Menards or Lowe's, which all had higher prices. Since I had done so much remodeling in the basement, I needed to buy 18 light bulbs and buying that many CFLs gets very expensive.*
- *I liked the price of the bulbs and the energy they save and that they last so much longer.*
- *The reduced pricing was the major reason I bought the bulbs from the Saving Store. I knew what types of bulbs I wanted and I wanted a lower price for them than I could find at the Meijer's store.*
- *At that time, $8.95 for an LED bulb was unheard of.*
- *The bulbs sold on the website were cheaper than elsewhere, Home Depot in particular.*
- *I knew I wanted certain bulbs for the house and I wanted them at a low cost. I had purchased some CFLs in bulk from Costco and the ones offered online were less expensive.*
- *The reduced pricing was the most influential factor in my decision-making process.*
- *Price was a lot higher elsewhere*
- *Price is important, and after shopping in other retail stores I knew that these bulbs at the Savings Store were priced very well. I don't know exactly how much money I saved, but I know it was pretty good.*
- *I knew that I wanted more CFLs for the house and I wanted then inexpensively. I compared prices at the Home Depot and the ones sold by Duke were a lot cheaper.*
- *I've been experiment with different types of bulbs, and it's expensive. They were low enough in price that, if they didn't work in my residents for my purpose, they would work for my rental property.*
- *I couldn't touch it anyplace else for that price.*
- *I verified that they were the best quality of bulbs provided at the least expensive price compared to what I looked at Home Depot, Lowe's, Target, and Walmart.*
- *The reduced pricing was the most influential factor in our decision to purchase through the Store.*
- *They were very inexpensive compared to what I used to paying.*
- *The reduced pricing was the main reason I ordered the bulbs from the Saving Store.*

- *There was enough difference to make it really worthwhile.*
- *I knew that we wanted to start switching the bulbs over to CFLs and the pricing offered on the website was lower than I could have gotten in stores.*
- *I shopped around at other retailers and I knew that the bulbs that Duke offered were the most economical.*
- *The reduced pricing was influential because it was cheaper than what I could find through local hardware stores.*
- *The lower price available at the Saving Store was the main reason we ordered the bulbs.*
- *It could save me a lot of money. I even purchased extra bulbs for later.*
- *The reduced pricing was my main consideration. I would not have purchased the bulbs at a higher price.*
- *It was a good value and it was easy to do.*
- *The reduced pricing was the main reason I wanted to order the bulbs.*
- *The reduced pricing at the Savings Store was very influential because it was comparatively cheaper than other stores.*
- *The prices were right on.*
- *My husband was impressed with the prices. We had spent more on purchasing bulbs in the past from other places.*
- *The reduced pricing was very influential because I'm always looking for a bargain.*
- *The bulbs were cheaper at the Saving Store.*
- *I was only there because of the savings and the efficiency.*
- *I normally wouldn't spend a lot on light bulbs all at once, but the prices were so good.*
- *I'd researched the price and the bulbs aren't the easiest thing to find. When I found the bulbs, my search was done.*
- *It was all about convenience and price.*
- *They were much cheaper than Home Depot.*
- *I would not have even looked at the website if they didn't have the reduced prices.*
- *It was significantly less than the retail price.*
- *I wanted the CFLs but the number that we needed for our house was so great that it was cost prohibitive to switch them all over at once. The website made switching all those bulbs over more affordable. I got 39 bulbs and all of them are installed and I could have used at least twice that number.*
- *The reduced bulb pricing and potential energy savings were my primary considerations.*
- *I liked that Duke subsidized the price.*
- *Everybody wants to save. The economy is not that good, so I want to save at every opportunity.*

Influence of Savings Store reduced pricing: rating “8 or 9 out of 10”

- *The reduced pricing was my main influence.*

- *That was the main aspect that persuaded me to buy light bulbs thru the website.*
- *I've shopped for these sorts of bulbs in hardware stores and felt Duke was significantly cheaper.*
- *We wanted the longer lasting bulbs and the discounted price of the bulbs coupled with free shipping really made the transaction worth it.*
- *The reduced pricing was somewhat influential. I wanted the bulbs regardless.*
- *If it's not comparable to what I could buy, I wouldn't have done it.*
- *I went from regular light bulbs to the CFLs which were free then.*
- *I thought the prices were good.*
- *The pricing of the bulb was a factor, but the type of bulb and the energy savings was as much of a factor.*
- *I wanted to save money on light bulbs and I did.*
- *It was quite influential, but the ease of purchase/convenience was equally important.*
- *Sometimes it's hard to shop for stuff through mail order or online, I was not familiar with the product. I would have liked to see the bulbs in person before I purchased them, but the price that was offered on the website was so good that I just went ahead and bought them.*
- *The reduced pricing was influential because it was less expensive than other retailers.*
- *The price was not why I purchased the bulbs.*
- *It was one of the driving factors that I chose to go there instead of someplace else.*
- *The bulbs are supposed to last. So, I spend more money and I don't have to buy them as often, I guess.*
- *The reduced pricing was influential because it made my purchasing decision easier.*
- *It was a better price and I really like the bulbs.*
- *The discounted price was the main reason I chose to purchase bulbs from the Saving Store.*
- *Some of the bulbs, like the dimmable indoor reflector CFLs, we had been looking for in local stores. We could not find any of those bulbs available in those stores at that price; the pricing offered by the Duke site was unbeatable.*
- *I just ordered what I needed, but the prices were good.*
- *Price is always important*
- *The biggest number of bulbs was the lowest price. The prices seemed pretty reasonable in the floodlight bulbs.*
- *The reduced pricing was influential because it was cheaper than Home Depot and/or Lowe's.*
- *I love sales. I enjoy a good buy.*
- *As I can't directly recall, it must have been a good price if my husband was willing to buy them.*

- *I probably wouldn't have gone to the site if that offer wasn't in front of me. It was and experiment on my part.*
- *The price was 20 to 30 percent less than Target.*
- *If I had found the same bulbs at the same price locally, I wouldn't have waited for them. The price made it worth waiting for shipping.*
- *The reduced pricing and convenience of shopping online both heavily influenced my decision.*
- *The reduced pricing was influential because it was cheaper than what I could find at other retail outlets.*
- *Because price is always important to me, these bulbs were offered at a good price online. If these bulbs were offered at a store for the same price, I would probably buy them from a store because I'd have them immediately, instead of having to wait for the bulbs to be delivered to my house.*
- *The reduced pricing was influential because I was able to find LEDs cheaper there than anywhere else.*
- *The reduced pricing was influential because I am a penny pincher.*
- *Yes, price was the main influence for me, and I do remember that these bulbs from Duke were much cheaper than bulbs I looked at in any retail store.*
- *The reduced pricing was influential because it was 92% less than standard retail.*
- *I don't give a lot of thought to that.*
- *Combined price plus free shipping made it cheaper than stores.*

Influence of Savings Store reduced pricing: rating "6 or 7 out of 10"

- *The reduced pricing was a secondary consideration after my desire to save the environment.*
- *The ones I was positive about were a ten and the other ones I wasn't sure about. There were lots of choices.*
- *I'm not all sure that Duke Energy has the best price. They were OK. I was debating whether to go with Amazon or Duke Energy.*
- *Looking for a more efficient bulb, the prices were a little bit higher than other stores you go into, but they seem to be lasting longer and hopefully saving energy.*
- *The reduced pricing was influential because I would not have bought them otherwise.*
- *The pricing was influential because the bulbs were comparatively cheaper than those at Lowe's.*

Influence of Savings Store reduced pricing: rating "5 or less out of 10"

- *The reduced pricing wasn't an influential selling point. I simply needed bulbs and the Savings Store was convenient at the time.*
- *The price of the bulb is only one component of what I'm trying to operate here. I'm mainly looking for what I can get a long life out of and for the energy savings.*

Influence of Savings Store reduced pricing: rating "don't know"

- *I don't remember if the bulbs were being offered at a reduced price on the website.*
- *I don't know.* (n=10)

Influence of information at the Savings Store website: rating "10 out of 10"

- *All the info was I needed was there at the website. I don't know much about light bulbs, so the descriptions were great to find exactly what I wanted and needed.*
- *I was mostly influenced by the bulb descriptions.*
- *If I had to buy them from a local store, I wouldn't save much relative to the bulb price. But at the price offered, I can expect payback within a year.*
- *The information was influential because it provided me with an estimate of my potential energy savings per year.*
- *The descriptions helped me decide if I wanted to do that and which ones to get.*
- *The information provided made it seem like purchasing through the Savings Store was cost effective and easy to do.*
- *The price was right and the bulbs are what I was looking for.*
- *It described the price, which was extremely low.*
- *I was influenced by the bulb descriptions and energy saving estimates.*
- *The descriptions were clear.*
- *We were just at Walmart pricing some of those light bulbs. With as tight as money is today, those light bulbs were a good price!*
- *The price information.*
- *The cost of the bulbs compared with retail.*
- *I liked the information on how much light they provided.*
- *The descriptions and explanations were very good.*
- *All of the information I needed was there, it explained everything. I found the information very influential towards making my purchase decision.*
- *The information showed how much money I could save and that the bulbs last for a long time seemed very convincing.*
- *It gave me all the information I needed.*
- *Even though I knew what I wanted, the information provided sealed the decision.*
- *We especially liked the information about the energy savings estimates. We like anything that saves us money.*
- *They described what I needed to know and this made me decide to purchase.*
- *It states on there how much you save by using CFL or LED, as opposed to whatever the others bulbs are.*
- *That's what captured my attention.*

- *I know it's accurate and the pricing was good.*
- *Knowing that the savings is there and the information makes it very helpful and appealing.*
- *It was very easy to navigate through it and everything was self-explanatory. They seemed like they were at a good price.*
- *The descriptions were good.*
- *I was able to figure out the pricing and size of the bulbs I needed, so it made it an easy decision.*
- *It was easy and they gave you enough information to make an informed decision.*
- *It was easily laid out and I already knew price points.*
- *Cost was the biggest factor, and the price was right there at the website.*
- *They had almost all the stuff, the information, readily available.*
- *It was very easy, it was very understandable, and it made my choice very easy.*
- *Because it simplified everything. The page said, 'here's the bulb, here's what it will do for you, and here's the price.' It gave information about the bulb's lifespan, and that it takes less energy. The explanations of the product were excellent, and they did the job.*
- *The photos were very helpful.*
- *The information was influential because it told me how much money I was saving on bulb purchases versus retail pricing, and the bulb descriptions were helpful.*
- *The descriptions were very good.*
- *The information prompted me to buy the light bulbs.*
- *I received a pamphlet that was very influential. It explained everything, and included pictures and prices.*
- *It was easy to do.*
- *The information was very influential because I was able to compare lumens and pricing versus bulbs available at Lowe's. The Savings Store had the information I was looking for.*
- *The price was the main influence of why I bought these from Duke. I can't find outdoor bulbs that are incandescent or halogen in any stores anymore, so that was the other reason I got these. The information provided just helped me make sure I was buying the correct type of bulb for my needs.*
- *I found that it was easier having all of the light bulbs grouped in one place, it made it easier to find what I was looking for, and all of the information I wanted about each bulb was right there in one place. It's the easiest thing I've done online.*
- *If I couldn't use them in my home, I had another spot where I could use them and it would be a big energy-saver for me.*
- *It was very easy to understand and navigate on it. It was well-explained and all that.*
- *The site gave me all the information that I wanted to know. I liked how it gave comparisons of cost savings with other varieties of bulbs, and comparisons of wattage.*

The site provided all the information I would have sought out myself as far as researching the bulbs.

- *The ratings, watts used, lumens, approximate hours, and the price were all good.*
- *I liked how long the bulbs lasted and I figured I'd save in the long run.*
- *Overall, I felt this was a good way to buy them and I saw a definite advantage to cashing in on the savings.*
- *Because seeing the description and everything told me about each bulb I looked at. The site provided and told me what I needed to know as far as lumens, indoor/outdoor, and best usage for each bulb. The descriptions were very good.*
- *It helped me pick out the light bulbs that we wanted for the house. We have a lot of different types of light bulbs in the house. The information also let us know how much energy we would be saving by switching to CFLs.*
- *The information on saving energy was very helpful. I am very interested in saving the environment.*
- *I was looking for how much lighting I would get per kilowatt. I also was interested in how long the bulb would last.*
- *I didn't have any problems.*
- *The information was very influential because I tend to leave lights on all the time so I was looking for energy efficient bulbs.*
- *The information about bulb longevity and energy cost savings was very influential.*
- *I understood all the information provided and it helped me choose the bulbs that I wanted to try out.*
- *I was only there because of the savings and the efficiency.*
- *I knew that if they were offer them, they were good quality and they were what I needed.*
- *It described exactly what I needed and it was a good price.*
- *The information allowed me to pick what I wanted for the house easier than just pictures.*
- *The website was easy to navigate and told us how much we would save on our bill.*
- *Because I wanted to lower my costs of energy, and when I saw that information, it was clear and straight to the point. It informed my decision making.*
- *I don't know.*

Influence of information at the Savings Store website: rating "8 or 9 out of 10"

- *How much savings am I really receiving in energy use? I'm not sure if the time they say they last is accurate either. Everybody should at least try them.*
- *Sometimes you just have to know what your needs are. The information provided on the website helped me figure out what I needed. Although, I did have to go to a local retailer to visually and physically see the items I was shopping for so I could use that knowledge to make the comparison with what was available in the Savings Store.*
- *The informational video with the lady at the beginning was very helpful.*

- *I had already gathered the information I needed and was predetermined on the type of bulb I wanted.*
- *I knew what I was looking for the home so I didn't really need the bulb descriptions as much and didn't look at the energy savings estimates at all. The information provided was helpful but I just didn't need that much help.*
- *The information was good.*
- *It was pretty influential. It provided all the information I needed to make the decision.*
- *The information was influential because I compared pricing with other retail outlets.*
- *I only had that one question when I called, so I assumed that the bulbs were what I needed.*
- *The bulb pricing and multi-pack information influenced my decision.*
- *It was helpful, but I already knew what I wanted.*
- *I understood the descriptions and knew what I wanted to buy.*
- *It informed us about how long the LEDs were going to last, which encouraged us to but the bulbs.*
- *It was a fairly large factor, given the information I saw there.*
- *Because I never had gotten that kind of information. There was more information provided at the website than there was in the flyer I received in the mail. The additional information helps me decide which bulbs to buy for which lamps I wanted them in.*
- *The information was easy to digest but I wish it would have provided more information about the sizes of bulb bases.*
- *I was able to compare wattage to what I think I need and order them on that basis. The other thing is the shape of the LED bulbs. I'm not crazy about the curly cue bulbs.*
- *I think there was a video on the main public webpage that I thought was helpful. It was a video showing the variety of bulbs available, which persuaded me to take a further look at the website.*
- *As long as the pricing is comparable and the convenience, I'd shop there.*
- *You can't always believe what you read. You have to take all information with a grain of salt.*
- *The information was helpful but I used the information provided in the insert that I received with my bill more.*
- *It helped me pick out the light bulbs that I thought would be best for me home.*
- *I think that information was fine.*
- *Because I already know that I'm going buy CFLs, I did not need that information to persuade me. I've used CFLs in the past, I already know about their benefits, so the information provided did not have a huge impact on my prior knowledge.*
- *I already knew that CFLs and LEDs were better than incandescent bulbs when it came to longevity of the bulb and the energy savings, so the information provided did not have much influence on my decision to buy these bulbs from the Duke store.*
- *The information was influential because I was able to find what I was looking for.*

- *I have a lot of light bulbs in my house. We burn a lot of lights. We're looking for energy savings and we have a lot of bulbs that are exposed. So, the information on the website encouraged me to try what was available on the website for the LED capsule bulbs and the CFL globes.*
- *The information helped me figure out what I needed. I was looking for CFLs that were both dimmable and indoor flood lighting, which was harder to find in stores than I thought.*
- *The information on the website was influential because we compared bulbs and the website confirmed what we read in the Savings Store mailing brochure.*
- *I'm not really sure why I gave it that score. I was just being nice. I pulled that number out of the air.*
- *Nothing is perfect but the descriptions were pretty good.*
- *I did not visit the store online. I received a Savings Store brochure in the mail and placed my order over the phone.*
- *The information was helpful. It was easy to use and description the descriptions helped me pick out what I wanted.*
- *The information was influential because it helped me calculate my Return On Investment (ROI).*
- *It was easy.*
- *The information was helpful but I was already well set on getting the bulbs before I read the information about them.*
- *I knew there were savings involved and I knew it was a good price on the bulb. I didn't go into the technical aspects.*
- *The combination of potential energy savings, bulb pricing, and the variety of bulb selection were all influential in my decision.*
- *The information confirmed what I already knew.*
- *I thought I could trust the information.*
- *The information was relevant and it was factual.*
- *The information comparing standard retail versus Savings Store pricing was very influential.*
- *The information was influential because it showed that I was going to save energy and money.*
- *I thought it was very informative and it had what I needed.*
- *I got what I ordered. I didn't end up with something I ordered by mistake.*
- *At my age the descriptions made it easy for me to understand what we were getting.*
- *The information helped me pick out the bulbs that I wanted for the house.*
- *I wasn't really looking at the time and the information. The savings convinced me to give it a shot.*

- *Because when I first read it and the Savings Store talked about the prices for each specialty bulb, I was hooked on ordering from there. The price was the main thing for me, but I really did find what I was looking for from the bulb descriptions.*
- *The information was influential because it helped me decide which LED bulb I wanted to try.*
- *Because it was almost perfect, the only issue we had was that the candelabra bulbs were not what we expected. The light quality of the candelabras is not what we expected, their light is more yellow than I would like. I was expecting a clear white type of light from them.*
- *Without the descriptions I would not have known which bulbs to purchase.*
- *I found information about dimmable LED bulbs.*
- *Because of the energy and the price.*
- *I found the equivalency of CFL to incandescent wattage helpful.*
- *Everything was really good. There was one bulb that I couldn't find anything comparable. I couldn't find anything that would give brightness as between 60W and 100W.*
- *Because the descriptions on energy savings were really good*
- *Because it was easy to make a decision about what I needed based on the information provided at the website, everything was there for me.*
- *It helped confirmed that the cost of operation is going to save me money. It's almost unbelievable, too good to be true.*
- *The energy auditor from the Home Energy House Call program told us that we'd save money on our bills if we switched more lights over to the CFL type and that they were selling the discounted specialty CFLs on the website.*
- *Easy to get all the information in one place*
- *Was able to determine that the bulb size offered would fit my fixture.*
- *The information was influential because it seemed accurate.*
- *It was helpful.*
- *I don't know.* (n=3)

Influence of information at the Savings Store website: rating "6 or 7 out of 10"

- *It didn't link to any reviews. I needed other sources to find out reviews on the bulbs.*
- *Because I'm already pretty familiar with CFLs in general.*
- *The information was moderately influential because I already knew which type of bulb I wanted.*
- *The information was somewhat influential only because I already knew which bulbs I wanted.*
- *I already knew what I was looking for so the information didn't need to do a lot of convincing.*

- *I had it in my mind that I was going to do that before and the reduced cost was one of the big factors. The energy savings and the descriptive factors all played a small part.*
- *I was looking make sure I had correct socket size and compare the wattage of the bulbs.*
- *The information could have been better.*
- *Some of the information was informative and some made me concerned whether we could use those bulbs. I had to look at the different lamps in my house.*
- *The information was influential, but once I received the bulbs it became evident that they weren't what I expected.*
- *It would be helpful if the website would show different bulb of a similar type. Like for the canned flood light show all the different sizes that you sell so the customer can compare them and pick out the size bulb they need. Then the customer can select the size and then go through the other options, like dimmable/non-dimmable, wattage, etc.*
- *Basically, I had already decided what I was going to purchase.*
- *I knew what I was buying and that I needed light bulbs.*
- *I really didn't use the information provided on the website because there was a lot of information in the insert that can with my bill. I liked how much information was on the insert. It helped me decide to order from the website.*
- *The prices are a ten and the descriptions are a five because I didn't feel I got all the information I needed.*
- *I didn't have to be influenced. I needed bulbs, they're prices were better than Target, and I was already using that type.*
- *I really was looking at price and consistency in bulbs.*
- *It was helpful to know what kind of bulbs they had, but I already knew what I wanted.*
- *I was already familiar with the bulbs.*
- *The information was somewhat influential because I already knew which bulbs I wanted.*
- *The information was influential because the energy savings estimates are comparable to similar bulbs available elsewhere.*
- *I would say it was pretty influential, I don't know, I ended up buying the bulbs, so I guess the information was influential enough for me to make a purchase.*
- *The information was helpful but not necessarily influential.*
- *Because I already knew that they were going to save me money by being energy efficient. I also knew that the bulbs offered at the website were cheaper than what I had seen at Lowe's.*
- *We knew what we wanted before visiting the store.*

Influence of information at the Savings Store website: rating "5 or less out of 10"

- *The insert that came with my bill provided me with the information that I needed to pick out the bulbs I wanted to try out.*
- *The information was not at all influential because I was going to purchase the bulbs regardless.*

- *On estimates of energy use you have no idea what you'll be saving money-wise on your bill. My lights aren't on all the time.*
- *I was basing it all on the brochure they sent me.*
- *I had already made up my mind, so it didn't make any difference. I knew I could put a lampshade on them and I knew what CFLs do.*
- *I had already decided to make a purchase from this Duke store based on the price they were offering, which is lower than what I could find in any store.*
- *It would be better if you showed pictures of the CFLs with their standard incandescent equivalent bulbs. I had a hard time picking out which candelabra bulbs I needed. I don't remember seeing the information on the energy saving estimates for each bulb.*
- *My husband told me what to buy.*
- *I had to research outside their website.*
- *The information was moderately influential because we already knew which bulbs we wanted.*
- *It was all about convenience and price.*
- *I did not feel the information gave me enough information to know which would be a good outdoor bulb.*
- *I didn't really know what I wanted.*
- *The information was influential but bulb pricing was the deciding factor.*
- *The information was adequate. I try to make eco-friendly decisions.*
- *The information helped with making decisions about which lights to purchase but I used the insert just as much.*
- *The information was moderately influential because I already knew which bulbs I wanted. I could have used more information about bulb base sizes.*
- *It's a guess because I don't remember. I had to make sure the bulb had the right base and right appearance.*
- *The information was nice for picking out the bulbs I wanted but it was the low prices that got me interested.*
- *I already had the information I needed before I made my purchase.*
- *The mailer and the pricing were more influential to me.*
- *I'm pretty neutral. The information helped me select what I wanted but it didn't cause me to buy the light bulbs. I knew I wanted certain bulbs for the house and I wanted them at a low cost.*
- *The information wasn't particularly influential because I already knew which bulbs I wanted. I wasn't visiting the site to analyze potential energy savings.*

Influence of information at the Savings Store website: rating "don't know"

- *The information was as good as any place else, but I knew what I wanted going in.*
- *I don't have a computer. I made a phone call and ordered then.*
- *My son did this online purchase for me.*

- *I don't remember going online to make purchase.*
- *I got a brochure that gave information about the different types of bulbs that they offer. I did not use the website; I only called the phone number provided on the brochure to place my order.*
- *I don't own a computer and don't use one. My sister ordered the bulbs for me on her computer.*
- *I knew that I wanted the bulbs and I wanted a lower price for them than I could find at the Meijer's Store. Cost was the driving influence of the purchase. The information was only helpful in choosing the bulbs.*
- *I don't know.* (n=5)

Influence of convenience of shopping online: rating "10 out of 10"

- *Because I was able to look at things online.*
- *The convenience was very influential. I don't think I would have made the purchase otherwise.*
- *I guess you see the advertisement for the Savings Store when you pay your energy bill; a time when you are probably thinking about how to save energy or consume less energy, so it was convenient to just follow that link.*
- *I prefer not to go out.*
- *It was so easy.*
- *The process was so easy. I enjoy shopping through the internet.*
- *I wanted the light bulbs delivered. I am a big online customer.*
- *It was easy and I'm lazy.*
- *I like online shopping.*
- *I enjoy shopping online when I can because it saves money and time.*
- *Online ordering turned out to be easy and they were shipped very quickly.*
- *If you were disappointed by not finding what you wanted on-line, it's not as big a waste of time as if you got in a car and went to the store. It's also easy to shop from the comfort of home.*
- *All I had to do was get on my computer. I didn't have to go anywhere.*
- *The convenience of online shopping made it easy. I wouldn't have bought the bulbs otherwise.*
- *Convenience of not having to fight the crowds at a store and delivery to my door.*
- *I hate shopping. I bet I do 85% of my shopping online.*
- *The convenience of shopping online, bulb availability, low pricing and home delivery were all contributing influences.*
- *I just prefer shopping for most things online, especially when free shipping is offered.*
- *Convenience and variety.*

- *It was easy to order the bulbs and have the delivered. The insert explained everything that I needed to know about the different bulbs available.*
- *I'm more comfortable doing things on the internet than my wife. It's easy to understand what you got online.*
- *I'm killing two glasses with one rock, getting two things done at once: paying my bills and ordering light bulbs. I trust Duke Energy and I have no complaints about them at all.*
- *It was handy to order the bulbs online. I order a lot online because I find it more convenient than shopping in a store.*
- *It was very easy to just go online and make the purchase versus going into the Duke office to pick them up.*
- *I could compare things between different websites that were selling bulbs.*
- *So easy; I didn't have to get in the car. Just a couple of clicks, and I had made my purchases.*
- *It was easy to order online and I didn't have to go to a store the bulbs.*
- *I knew I could get my son to do it.*
- *I didn't have to go to a store of them. It was convenient to order the bulbs online.*
- *Just because it's easy to shop online then and there, I was already there to pay my Duke Energy bill online.*
- *The website's ease of use and the amount of time it took make the purchase was quick. I didn't need the bulbs immediately so I don't mind waiting for them to be delivered.*
- *I love to buy stuff online.*
- *It was convenient.*
- *Because I did not have to look around from store to store and try to shop through all the different bulbs on the store shelf or compete with other customers while trying to make my decision.*
- *I don't get out much. I'm older and it's hard for me to go to the store, push a cart around, and carry so many bags into the house. Picking out items online for delivery helps me get the things I need.*
- *Because it was easy to shop online and it was what we wanted, energy efficient bulbs sent straight to us.*
- *It was the most convenient way. My time's too precious.*
- *Because it was easy, simple, the price was good, the shipping was fast. It was so great just being able to order these from the convenience of my own home and have them brought straight to my doorstep.*
- *Doing anything on the internet is the easiest: I don't have to search around; I don't have to talk to anybody; and I don't have to go into the store.*
- *I love shopping online. It was a one stop shop with all the information I needed available.*
- *There's nothing exciting about light bulb shopping.*
- *It was extremely easy. They took my money on my charge card and they came in a minimum amount of time.*

- *Because I don't like buying light bulbs in the store. When shopping in-store, it's often hard to find what you want in one place. Trying to figure out or matching exactly what you need is harder when you are in a store, away from the actual source where the bulb is needed. Shopping online can be much easier because there is less guessing for what you need.*
- *It was just easier. I could do it in the convenience of my own home. I could click and it was done.*
- *I like shopping at home.*
- *I go to the grocery and forget to buy light bulbs. I just go with the store there because I pay all my bills online and shopping online is so convenient.*
- *I wouldn't go into a store for these specialty bulbs.*
- *It was just easier for me to sit here instead of taking the time to go to the store.*
- *I would not have purchased these if it weren't for the convenience of ordering online.*
- *I don't know what I'm looking for when I go to the store and the Saving Store provides information that I need.*
- *I do most of my purchasing online for the convenience factor. Because I travel every other week, it's about the only way I do shopping. I don't have time to shop. I probably do 80 percent of my shopping online.*
- *It saves me a trip to go somewhere to shop for them and they're delivered right to my house, which is very convenient.*
- *The convenience of shopping online and home delivery were very influential. I do most of my shopping online these days.*
- *I hate going into like a Lowe's and they have every light bulb you'd want to buy. I like the convenience of having them delivered to my home and they were really well-package. I liked being able to order them on my lunch hour at work.*
- *I like to shop online.*
- *I like the fact I didn't have to leave the house, that the information was clear, and that the price was good.*
- *Because I could buy what I needed while in my house, so I could see what I needed. With so many bulbs in the house, I can't remember all of them when I'm at the store. The website let me check what I needed as I shopped.*
- *Anytime I can order online I do. I don't want to have to put up with people at stores.*
- *The convenience of shopping online was very influential because it meant I didn't have to (leave my home and) go to the store.*
- *The convenience of online shopping was very influential because I prefer to do a lot of my shopping online.*
- *Shopping online was easy and it saved time.*
- *I buy anything online that I can.*
- *I don't like going around the stores shopping. The Duke store had more bulb choices.*

- *I visited the website, thought I was nearing completion of my order, but soon became confused. I then called the Savings Store's support telephone number and placed my order directly over the phone. The customer service representative was very helpful.*
- *It was really easy to do and I didn't have to leave the house to go buy them anywhere.*
- *It is a lot easier to shop online than going to home depot.*
- *The convenience of shopping online was very influential because of all the helpful information available.*
- *The convenience of shopping online was very influential because I dislike going to the store.*
- *I just like the convenience of shopping online; I was able to make price comparisons from the use of the internet instead of running from store to store trying to find the best price. Also, it's great shopping for bulbs online while you are at home so you can be assured that you are buying the correct type of bulb that you need for a particular light.*
- *I didn't have to leave the house and I was able to thumb through the catalog of available bulbs from the comfort of my home.*
- *Well, it was much better than going to a store to try to figure out what kind of bulbs I needed, plus I didn't have to drive anywhere and waste a bunch of gas driving around from place to place looking for what I wanted. That shipping price the website had set was not bad in comparison to the time and money that would have been spent shopping around from store to store.*
- *The convenience was very influential because it was so easy and the shipping cost was reasonable.*
- *Easier than placing an order by mail.*
- *Because it is a lot easier shopping for the bulbs online than going to a store. It can be overwhelming when I am trying to decide on what I want or need in the store. The website had all of the information I wanted all in one, easy to use place. It's the easiest thing I've done online.*
- *It was very easy to navigate on the site. They gave an estimated time for delivery and it came within that time. It was a piece of cake.*
- *I didn't have to go to the store for the bulbs.*
- *I didn't have to go find them. That was nice. I have arthritis and it's difficult for me to go out to the stores.*
- *It was very easy to do.*
- *It was very easy to order the bulbs from home and have them delivered. The lower price was more influential.*
- *I prefer shopping online for stuff like this. It was really great how all of the information I needed to make a purchase was all available for me to read in just one location.*
- *The convenience of shopping online was influential because not having to go anywhere made it easy.*
- *I like ordering things online. It's easy to do.*
- *The convenience of shopping online was influential because it's so easy to do.*

- *It was very convenient.*
- *It was very easy to use. The website was easy to navigate around, and shopping online is very easy when you have kids. It's just one less thing you have to get in the car and do.*
- *The convenience of shopping online was influential because I do a lot of eBay. It saves running around and burning gasoline.*
- *It was very easy. My husband, recently deceased, was disabled and I am also physically disabled so shopping online is wonderful.*
- *The convenience of shopping online was influential because it allowed me to browse at my leisure, with no sales pressure, and more time to contemplate my order. I felt secure placing my order online through Duke Energy.*
- *I really like online shopping because it's so easy to get things delivered to the house.*
- *It was like any other reputable company online, no surprises.*
- *I don't like wasting time going to Lowe's. I'd rather spend my time on other things.*
- *It was all about convenience and price. The service is just the high quality I expect from Duke. They're always trying to help you along as a consumer.*
- *I like shopping online because it saves time for me and money. Any time I take the kids shopping with me I end up spending more money on things for them.*
- *I enjoy buying things online because it's easy to having things delivered.*
- *Because I like working through an electronic system. Sometimes word of mouth doesn't influence me, but online information does.*

Influence of convenience of shopping online: rating "8 or 9 out of 10"

- *We had the option of going and shopping around, but it was so convenient just ordering them online and having the bulbs sent straight to the house.*
- *The convenience of shopping online was influential because it made things easy.*
- *I find the internet convenient.*
- *It was very easy and convenient to shop online. I didn't have to drive anywhere.*
- *The convenience of shopping online was one of the main reasons I decided to purchase bulbs through the Savings Store.*
- *It was not the top factor, but it was important enough.*
- *The transaction was very easy to complete. I wasn't able to touch it and feel, but I didn't have to go anywhere and that made the transaction very easy.*
- *I liked the convenience for the price.*
- *I would have rather picked up the bulbs at a brick and mortar store.*
- *The only thing that could have made it better was there wasn't as much of a selection of LEDs as I would have liked. If I had gone to a store, I would have had a wider selection of wattages and lighting levels in specifically LEDs. I would have bought more.*
- *The main reason I did it was for the savings, but I did enjoy the convenience.*
- *I could have purchased them anywhere.*

- *I didn't have to leave the house and it was easy. The price was the main driver, but it was nice not to have to run out to get them.*
- *It was really nice to be able to do it at my own time; however my first instinct would be to go to the store. Once I saw it was cheaper, this is why I went to the Savings Store.*
- *It was simple to buy the bulbs.*
- *I do most of my shopping online. When you consider the time and gas wasted trying to get somewhere, it's very convenient.*
- *I think I remember a deal before where I got a coupon and had to go to Wal-Mart to get the bulbs. I went and they were out. That was inconvenient. Here, I didn't have to travel out of my way.*
- *Because it's not that inconvenient to get light bulbs from a store. I saw the advertisement while I was online accessing my account anyways, so I went ahead and took a look at the bulbs and decided that it was a good opportunity to buy energy efficient bulbs.*
- *Everything made it easy to do and save money*
- *I really wanted the low price for the bulbs. Being able to shop for the bulbs online was nice but it wasn't something that really made me want to get these light bulbs.*
- *I couldn't do it myself and I had to rely on my daughter to do it for me. If I hadn't had to rely on my daughter to do it, it would have been a ten.*
- *There was no other way to buy these bulbs other than from the Duke Energy website. Well, it was easy and convenient to shop online too.*
- *The convenience of shopping online was influential because it's so easy to do when I'm busy otherwise. Plus, there were bulbs available at the Savings Store that I couldn't find in stores.*
- *It was so easy, and they delivered right to the door at an excellent price.*
- *The convenience and bulb selection were influential. The Savings Store had the bulbs I wanted but I was annoyed with the inflated shipping cost.*
- *It's a very easy way to order.*
- *It was the price that influenced me not so much buying online.*
- *It was easy to do and it was convenient. I could sit at my computer and do it and not have to go driving around and looking for it.*
- *I liked being able to compare bulbs' features and wattages without having to walk around the store, which was a great help. I was able to compare the Savings Store and Home Depot online at the same time.*
- *It's a bit easier than going to a store. I didn't have to drive to the store to shop for bulbs away from home.*
- *I'd rather click a button than get in my car and go somewhere. And, the availability was influential because these bulbs are not the easiest to find.*
- *I can sit down at home and order them instead of running to Home Depot.*
- *Convenience is important to you when you are older. I was able to research the product online, I could call people with questions if I wanted to, I did not have to leave my house, it was all so easy for me.*

- *I like the convenience of ordering online. It's easier to get the information that you want about the product but it's harder to compare the incandescent bulbs to their CFL equivalent bulb.*
- *I liked shopping online.*
- *Buying online is very convenient.*
- *I like the ease and that's what the wife wanted to do.*
- *I didn't have to go through any effort. I didn't really need all the bulbs.*
- *Online buying was easy.*
- *It was convenient but it wasn't the main reason that I ordered from the website.*
- *The convenience of shopping online was influential because it was easier than going to a store to look for a deal.*
- *You can pick everything you need all at once and have it all sent to your house, it's simple and easy.*
- *I like to shop online. When I've been in stores before, they didn't have what I wanted at a reasonable price.*
- *I like cheap.*
- *There was a wide selection of bulbs available. I got free shipping and the bulbs arrived quickly. Ordering online is easy enough even at my age, and I'm in my mid-70s.*
- *The convenience of shopping online was influential because that's how I prefer to shop. There's often a wider selection and cost ranges available online.*
- *It was very convenience and made financial sense to do it. I do a good deal of purchasing online. It was easy, clear, and quick.*
- *Online shopping is great.*
- *Because of having the options and the ability to see the products and compare the prices. I could also do it at my leisure; I didn't the pressure to make a purchase as I would have if I had driven to a store.*
- *Because I do a lot of shopping on-line. I can compare products and prices without wasting gas and time.*
- *Because it's convenient to shop from home. Sometimes I don't have time to stop at a store and shop for the things I need in a store, it can be a hassle.*
- *I wouldn't have gone to the store to get them. It's too easy to order online and have them show up on my porch.*
- *The convenience of shopping online was influential because I could sit down at home and browse through the selection.*
- *It was easy, convenient, and comfortable. I felt like I got all the information I needed. It was easy to access.*
- *The convenience was very influential because otherwise I would not have purchased bulbs at that time. I would not have used an in-store voucher as readily as I made the Savings Store purchase online.*

- *I like to shop online. I could have just as easily bought the bulbs in a store but I like having things delivered.*
- *The convenience of shopping online was influential because it was fairly easy to do.*
- *All the information was there; it was concise. The pricing and structure needed for quantity discounts was all laid out. And taking advantage of no-cost shipping was also a factor.*
- *It was very easy and I like shopping online. I don't like shopping in stores.*
- *I don't know.* (n=2)

Influence of convenience of shopping online: rating "6 or 7 out of 10"

- *I don't mind ordering online but it was really the price and the free shipping that really drove the purchase.*
- *I can buy them somewhere else.*
- *I'm not very computer literate so I had a harder time ordering the bulbs than other people would have had.*
- *I probably would have bought them wherever they were at that price.*
- *I'm somewhat ambivalent about going out and buying things from a store versus shopping online. I'd much rather avoid having to wait for the things I buy to delivered, I don't like waiting for things, yet, I'd rather order something from the convenience of my own computer while I'm at home instead of running around from store to store trying to find what I'm looking for at a good price.*
- *Because I would have preferred to have seen the bulbs physically, though the descriptions were good enough for me to make a confident decision in purchasing the bulbs online.*
- *I like the convenience of shopping online with delivery but I also like to be able to compare what I'm shopping for so I can be certain to get the item that I need.*
- *It didn't have much influence. I just wanted to try it out.*
- *The convenience made it easy to shop leisurely at home and saved me a trip to the store.*
- *The convenience of shopping online was influential, as was my desire to purchase the bulbs directly from Duke Energy.*
- *They could have given you more product reviews; that would have made it easier.*
- *I prefer to talk to people when I order but the description was just as helpful in ordering. I like to have things delivered to the house instead of going to store.*
- *I would have been happy with ordering the CFLs any way: through mail order, over the phone, etc. It was easy enough to order online.*
- *It was convenient, but the price and my energy consultant's advice were more influential over my persistence.*
- *The convenience of shopping online meant it was easy to sit down, peruse the variety, place the order and have it shipped.*
- *It was convenient. I do a lot of shopping online, so I'm used to doing that.*

- *I don't really care about being able to order online. I ordered these bulbs (and other bulbs in the past) before I needed to replace bulbs that had burned out. It was convenient but not a necessity.*
- *I wanted the bulbs that I wanted at a low price. Being able to order the light bulbs online really didn't get me to buy the bulbs. It was convenient but it wasn't necessary.*
- *It was helpful to be able to be at home, but then I didn't get them instantly.*
- *The convenience of shopping online was influential because I would not have known about the Savings Store otherwise.*

Influence of convenience of shopping online: rating "5 or less out of 10"

- *I am going to spend my money where I get the best deal. It doesn't matter where I get them from.*
- *The convenience of shopping online was not influential. I don't shop online. I received an informational brochure in the mail about the Savings Store and placed my order over the phone.*
- *Shopping online was convenient but it wasn't as influential as bulb pricing.*
- *Bulb pricing was my main consideration. The website was not very convenient.*
- *I am not fond of shopping online. It's usually a hassle but I will do it on occasion if there is some specific I'm looking for or a good price.*
- *It was pretty good.*
- *Whether I purchase online or have to drive to a store doesn't matter to me - price is my primary consideration.*
- *The convenience of shopping online was nice but not as influential as the price of the bulbs.*
- *I would have been more satisfied with being able to order the bulbs over the phone. I prefer shopping for things by catalog and phone orders with customer service.*
- *I don't have a computer. My sister ordered for me.*
- *I don't mind going to the store. I'd probably be picking up something else for the house at the same time so having to get light bulbs at the store isn't an issue.*

Influence of convenience of shopping online: rating "don't know"

- *I have not yet installed the bulbs.*
- *I ordered by phone. I do not own a computer.*
- *I don't recall the online transaction.*
- *I don't know.*

Non-Participant Survey

As discussed in *Satisfaction with and Impressions of the Savings Store* on page 163, Ohio customers were asked to rate their satisfaction with the Savings Store using a five-point Likert scale ranging from "very satisfied" to "very dissatisfied." Their responses are shown in full below.

Table 126. Ohio Satisfaction Ratings and Explanations

Rating	Verbatim Explanation
Very Satisfied	*I like the way it was setup. It looked good, and the prices looked reasonable.*
Very Satisfied	*Last time I got bulbs through Duke, I got the free CFLs. They came quickly, were high quality, and were well-packaged.*
Very Satisfied	*I thought prices were very good. I liked that Duke was doing something that would be money-saving in the long run.*
Very Satisfied	*I like to order online.*
Very Satisfied	*I thought the pictures were very nice and they gave me a good description including the information on the savings. It was very easy to navigate and neat. I thought it was a very nice site.*
Very Satisfied	*Because of the lower price and the good descriptions offered. Home Depot only shows you the bulbs. The Savings Store gives bulb lifespan and energy use information.*
Very Satisfied	*It was easy to use and the information was clearly stated.*
Very Satisfied	*It's a great program to help people save energy and save money while doing it. And you can't find bulbs less expensive than these.*
Very Satisfied	*Everything I was looking for was there. It was all easy to find and convenient to use.*
Very Satisfied	*I liked the option of being able to find light bulbs. It's easier than trying to find them at Lowe's or something.*
Very Satisfied	*It was easy to use, straightforward and clear. It was convenient.*
Very Satisfied	*Based on what I have seen so far I am very satisfied and plan on making a purchase.*
Very Satisfied	*It seemed to me that it was easy to navigate. The descriptions were good and there were pictures of the bulbs. I remember there was information on savings, but I didn't pay much attention at the time; that wasn't the reason I looked at the site.*
Very Satisfied	*It had a good selection and was easy to use.*
Very Satisfied	*I thought it was very easy to use, and good price were offered for the energy saving bulbs.*
Very Satisfied	*It seemed like they had a lot to offer.*
Somewhat Satisfied	*They still don't have the bulbs I am looking for.*
Somewhat Satisfied	*I felt compelled to look at the site but did not to make a purchase at that time.*
Somewhat Satisfied	*The prices on the LEDs could have been lower.*
Somewhat Satisfied	*I have not bought anything from the Savings Store yet.*
Somewhat Satisfied	*I think it's great to offer discount light bulbs.*
Somewhat Satisfied	*I didn't have any need for it when I visited, but I'd go back there.*
Somewhat Satisfied	*I did not think the prices were that much different from retail stores and I was not able to find the chandelier bulb I was looking for.*

Somewhat Satisfied	*Everything was fine, but it lacked a little bit of information. I wanted to know the color spectrum on the bulbs. Also, I think there could have been a little more variety.*
Somewhat Satisfied	*I remember seeing some really interesting bulbs. I liked the variety.*
Somewhat Satisfied	*I'm not so sure that I would get the right wattage of the bulbs. I have gone back and talked to electrician friends, checking with them to see what they recommend. I really was looking for some of the daylight bulbs. Those are what I'm looking for and I didn't see them there. Maybe I didn't get to the right part of the website. I would like those bulbs for outside use.*
Somewhat Satisfied	*I have not bought anything from there yet, so it's hard to tell. I like that Duke is offering the energy efficient light bulbs to their customers through this easy to use website though.*
Somewhat Satisfied	*It seemed like a good resource to be able to get those bulbs from an online site, I'm satisfied with what I've seen from it so far.*
Somewhat Satisfied	*I've been there three times or so and I have not made a purchase yet, so I guess I'm satisfied so far.*
Somewhat Satisfied	*The website is set up well. It was designed very well. They made the process simple and easy.*
Somewhat Satisfied	*The pricing*
Somewhat Satisfied	*I didn't really spend much time looking at the site. I get a lot of offers to check out new items, and I know changes are coming for light bulbs. I also still have tons of energy-saving bulbs from the Duke give-away.*
Somewhat Satisfied	*The website was easy to use and the prices were OK.*
Somewhat Satisfied	*It is a good resource for buying energy efficient bulbs if you have the time to look through the entire site and link along to all of the additional features. I think the site could be streamlined and made simpler for the average person to use.*
Somewhat Satisfied	*I was somewhat satisfied because I wish the shipping costs were cheaper or free.*
Neither Satisfied nor Dissatisfied	*I was just browsing. It did not really matter much to me.*
Neither Satisfied nor Dissatisfied	*I was neither satisfied nor dissatisfied because it did not make much of an impression on me.*
Neither Satisfied nor Dissatisfied	*I was just looking so I don't know. I was not in the market for bulbs at that time.*
Neither Satisfied nor Dissatisfied	*I didn't make a purchase so I don't know.*
Neither Satisfied nor Dissatisfied	*I have not made a purchase from the Savings Store, so I really don't have a say for satisfaction.*
Neither Satisfied nor Dissatisfied	*I've not gotten anything from there, so I can't say.*
Neither Satisfied nor Dissatisfied	*It was a good store, but didn't have what I needed.*
Neither Satisfied nor Dissatisfied	*I didn't end up purchasing anything. I was undecided.*
Neither Satisfied nor Dissatisfied	*I had no problem with the store but the prices could have been better.*
Neither Satisfied nor Dissatisfied	*Having to buy bulbs in larger quantities*
Neither Satisfied nor Dissatisfied	*Price*
Neither Satisfied nor Dissatisfied	*I'm not sure.*

Neither Satisfied nor Dissatisfied	*It was easy to use, but the prices were not good.*
Somewhat Dissatisfied	*The shipping costs*
Very Dissatisfied	*It's not really adding any value to me. It's not much of resource.*

Appendix J: Participant Suggestions for Other Services

- *I'd like a program that provides a surge suppressor.*
- *Bring back The Question of the Day challenge. It challenged people to try new things and provided information about energy savings. It was fun.*
- *Duke should offer discounts for programmable thermostats.*
- *Duke could advertise their programs and services through social media.*
- *Duke could be more involved with setting the codes for new houses and renovations and new constructions.*
- *Duke could provide a drop off hub and pick up services for recycling old electronics.*
- *Duke could provide free insulation and roofing.*
- *Duke could provide incentives for wind turbine, solar, and/or geothermal equipment purchases.*
- *Duke could provide low cost spray foam insulation services.*
- *Duke could provide recommendations and discounts for trade allies.*
- *Duke could provide tree trimming services around the power lines coming to my house from the pole.*
- *Duke could reduce gas and electric rates.*
- *Duke Energy could develop a mobile app that would allow customers to check their daily energy usage via Smartphone.*
- *Duke Energy could educate children about energy efficiency.*
- *Duke Energy could install Smart Meters to allow customers to monitor energy use in real time.*
- *Duke Energy could provide energy efficiency education to children, young adults, and the elderly. Duke could also provide energy kits to young adults.*
- *Duke Energy could provide energy efficient products for free to raise awareness.*
- *Duke Energy could provide information about solar power technologies.*
- *Duke Energy could provide insulation and weatherization services and/or rebates.*
- *Duke Energy could provide more education about ways to be energy efficient.*
- *Duke Energy could provide solar panel sales and installation. They could also provide water electrolysis (hydrogen) technologies.*
- *Duke should be trimming limbs around all the power lines at least once per year.*
- *Give more information on solar. I would like to know how to sell energy from solar to Duke.*
- *Duke should have a watt meter loan program.*
- *Have an insulation rebate program that the homeowner could apply for rather than the contractor; our contractor refused to apply for the rebate because he said it would cost him money to apply on our behalf, which was the only way he said we could get the rebate. Also, a solar program would be nice.*
- *Have discounts on weather proofing for windows and doors and have the materials at the Savings Store.*
- *Help with comparison of rates from other companies.*

- *I had strike guards at my old house, which I'm not sure I can have here; if I could, I want them.*
- *I know our house could use more insulation, but I don't think this is something Duke should have to take responsibility for.*
- *I would like a program that provides the thermostats that can be controlled via a smart phone not using the internet.*
- *I would like some sort of tracking of what the changes are doing and what they're trying to do.*
- *I would like to see something similar to what Lowe's has, it's this thing call IRIS. It's an application to control your home temperature and lights from an app on your phone or computer. I'd like to see more home energy automation, the ability to set up lighting, heating and cooling schedules from any device.*
- *I'd like information and expertise on alternative generation and sourcing for heating, like geothermal. I'm looking into alternative HVAC solutions.*
- *I'd like to see Duke Energy offer or suggest safe, dependable resources for computer and electronic recycling as well as light bulb and battery recycling or disposal.*
- *I'd like to see them come out and have all the trees properly trimmed or cut down away from the power lines.*
- *If they would put their brand name to solar panels, people would go nuts for them. It would be so much free advertising and would take some pressure off of energy generation from coal plants. If they want to market themselves, they should do so like SolarCity does. Either do residential homes or covered parking lots and rooftops; they can generate a lot of energy that way. They want to spend all this money on regulation and substations, but they need to generate the power at point of use. They could use SolarCity's concept as a model.*
- *Install smart meters.*
- *It would be really cool if they could help me pay for solar panels on my roof, some kind of co-op adventure.*
- *Just continue offering rebates and encouraging people to include energy efficiency measures in and around their homes.*
- *Lower prices.*
- *Make energy more expensive at peak hours and at off hours charge less. This would make customers more likely to use energy when there is less demand.*
- *Net metering.*
- *Note on the bill what to do to keep energy costs down.*
- *I suggest that Duke continues all of the rebate programs for all energy efficiency upgrades to homes or businesses.*
- *Offer more LED bulbs.*
- *Offer solar panels.*
- *Provide a discount on programmable thermostats that are not tied to an appliance cycling program.*
- *Provide a recycling program for the light bulbs such as a prepaid return box.*
- *Provide a waste facility in the house, which is a methane producer and digester. Provide solar panels and interface with the grid without extra tariffs or regulations. Help people make a home that doesn't cost anything for power and have Duke pay them.*

- *Provide insulation.*
- *Provide more information on the pricing of gas so people could better understand their gas purchase. Have a program to pre-purchase gas for the winter.*
- *Provide proactive rebates in the fall for customers to prepare their home for a more energy efficient winter. They could also send out information in the spring reminding people to properly adjust their thermostat, or suggest the top five things to do in or around your home each season to improve energy efficiency.*
- *Provide recommendations on brands of energy efficient appliances.*
- *Push landscaping trees around your house; it's a huge energy-saver.*
- *Provide rebates for adding insulation and better windows.*
- *Provide rebates for new windows and adding insulation.*
- *They could make our street lights outside work better.*
- *They could provide a little more friendly assistance for things like solar panels and distributed energy.*

Appendix K: Impact Algorithms

Specialty Bulbs

General Algorithm

Gross Summer Coincident Demand Savings

$$\Delta kW = ISR \times \left[\frac{Watts_{base} - Watts_{ee}}{1000} \right] \times CF \times (1 + WHF_d)$$

Gross Annual Energy Savings

$$\Delta kWh = ISR \times \left[\frac{(Watts \times HOURS)_{base} - (Watts \times HOURS)_{ee}}{1000} \right] \times 365 \times (1 + WHF_e)$$

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
$Watts_{ee}$	= connected load of energy-efficient unit = 12.92
$Watts_{base}$	= connected (nameplate) load of baseline unit(s) displaced = 50.05
HOURS	= Average daily hours of use (based on connected load) = 2.53
CF	= coincidence factor = 0.0914
WHF_e	= HVAC system interaction factor for annual electricity consumption = 0.9942
WHF_d	= HVAC system interaction factor for demand = 1.167

WHF_e - the HVAC interaction factor for annual energy consumption depends on the HVAC system, heating fuel type, and location. The HVAC interaction factors for annual energy consumption were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix. The weights were determined through appliance saturation data from the Home Profile Database supplied by Duke Energy.

Cincinnati, OH

Heating Fuel	Heating System	Cooling System	Weight	WHFe
Other	Any except Heat Pump	Any except Heat Pump	0.0029	1.079
		None	0.0002	0
Any	Heat Pump	Heat Pump	0.0760	0.84
Gas Propane Oil	Central Furnace	None	0.0111	0
		Room/Window	0.7571	1.079
		Central AC		1.079
Electricity	Electric baseboard/ central furnace	None	0.0046	0.55
		Room/Window	0.1433	0.64
		Central AC		0.64
None	None	Any	0.0049	1
Total Weighted Average			**1**	**0.9942**

WHF_d - the HVAC interaction factor for demand depends on the cooling system type. The HVAC interaction factors for summer peak demand were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix.

Cincinnati, OH

Cooling System	Weight	WHFd
None	0.0159	1
All other	0.9841	1.17
Total Weighted Average		**1.167**

Prototypical Building Model Description

The impact analysis for many of the HVAC related measures are based on DOE-2.2 simulations of a set of prototypical residential buildings. The prototypical simulation models were derived from the residential building prototypes used in the California Database for Energy Efficiency Resources (DEER) study (Itron, 2005), with adjustments make for local building practices and climate. The prototype “model” in fact contains 4 separate residential buildings; 2 one-story and 2 two-story buildings. The 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 4 buildings is designed to give a reasonable average response of buildings of different design and orientation to the impact of energy efficiency measures. A sketch of the residential prototype buildings is shown in Figure 79.

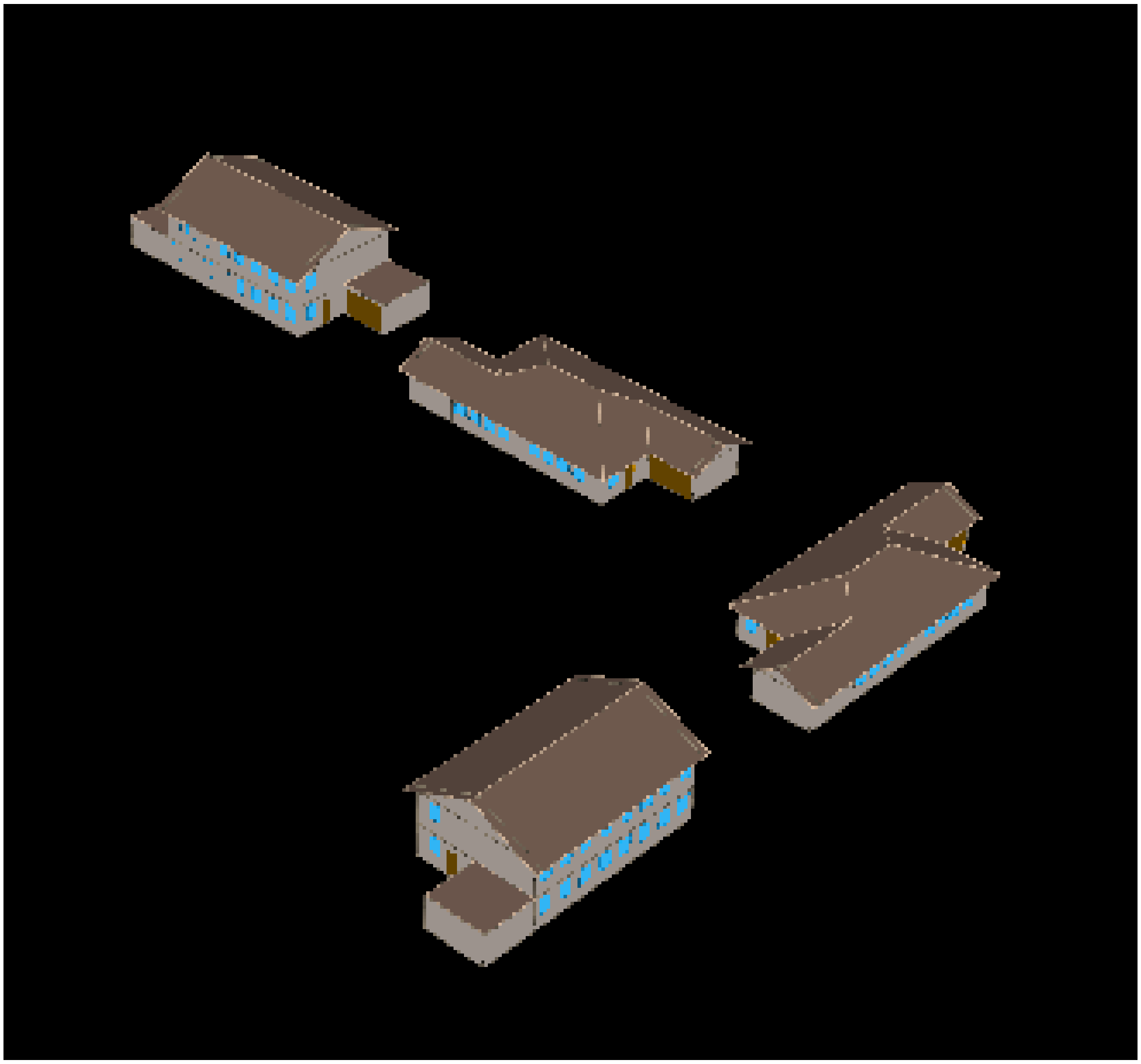


Figure 79. Computer Rendering of Residential Building Prototype Model

The general characteristics of the residential building prototype model are summarized below:

Residential Building Prototype Description

Characteristic	Value
Conditioned floor area	1 story house: 1465 SF 2 story house: 2930 SF
Wall construction and R-value	Wood frame with siding, R-11
Roof construction and R-value	Wood frame with asphalt shingles, R-19
Glazing type	Single pane clear
Lighting and appliance power density	0.51 W/SF mean
HVAC system type	Packaged single zone AC or heat pump
HVAC system size	Based on peak load with 20% oversizing. Mean 640 SF/ton
HVAC system efficiency	SEER = 8.5
Thermostat setpoints	Heating: 70°F with setback to 60°F Cooling: 75°F with setup to 80°F
Duct location	Attic (unconditioned space)
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	26%; evenly distributed between supply and return
Cooling season	Cincinnati – April 27th to October 12th
Natural ventilation	Allowed during cooling season when cooling setpoint exceeded and outdoor temperature < 65°F. 3 air changes per hour

References

Itron, 2005. "2004-2005 Database for Energy Efficiency Resources (DEER) Update Study, Final Report," Itron, Inc., J.J. Hirsch and Associates, Synergy Consulting, and Quantum Consulting. December, 2005. Available at http://eega.cpuc.ca.gov/deer

Appendix L: DSMore Table

Impacts ⇨ / Technology ⇩	Product code	State	EM&V gross savings (kWh/unit)	EM&V gross kW (coincident peak/unit)	EM&V gross kW (non-coincident peak/unit)	Unit of measure	Combined spillover less freeridership adjustment	EM&V net savings (kWh/unit)	EM&V net kW (coincident peak/unit)	EM&V net kW (non-coincident peak/unit)	EM&V load shape (yes/no)	EUL (whole number)
CFL - Indoor Reflector (Recessed)		OH	25.0	0.0030	0.0323	bulb	22.2%	19.4	0.0023	0.0251	yes	8
CFL - Dimmable Reflector (Recessed Dimmable)		OH	41.9	0.0049	0.0541	bulb	22.2%	32.6	0.0038	0.0421	yes	8
CFL - Outdoor Reflector (Recessed Outdoor)		OH	64.6	0.0039	0.0430	bulb	22.2%	50.2	0.0031	0.0334	yes	5
LED - Reflector (Recessed LED)		OH	43.4	0.0039	0.0431	bulb	22.2%	33.8	0.0031	0.0335	yes	12
CFL - Globe		OH	14.4	0.0022	0.0240	bulb	22.2%	11.2	0.0017	0.0186	yes	6
CFL - Candelabra		OH	12.1	0.0014	0.0155	bulb	22.2%	9.4	0.0011	0.0121	yes	7
CFL - Three Way Spiral		OH	34.2	0.0040	0.0438	bulb	22.2%	26.6	0.0031	0.0340	yes	7
CFL - Dimmable Spiral		OH	38.0	0.0045	0.0493	bulb	22.2%	29.5	0.0035	0.0384	yes	7
CFL - Capsule (A Line)		OH	22.1	0.0026	0.0288	bulb	22.2%	17.2	0.0020	0.0224	yes	9
LED - Capsule (A Line LED)		OH	24.5	0.0029	0.0315	bulb	22.2%	19.0	0.0022	0.0245	yes	12
Program wide		**OH**	**25.4**	**0.0028**	**0.0306**	**bulb**	**22.2%**	**19.8**	**0.0022**	**0.0238**	**yes**	**8**

APPENDIX L-

Smart $aver Residential –
Multi-Family Evaluation

NAVIGANT

Multifamily Energy Efficiency Program

Evaluation, Measurement, and Verification for Duke Energy Ohio

Prepared for:
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NAVIGANT

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NAVIGANT

NAVIGANT

1. Evaluation Summary

1.1 Program Summary

Duke Energy's Multifamily Energy Efficiency Program provides energy efficient equipment to multifamily housing properties at no cost to the property managers or tenant end-users. It has evolved from the Property Manager CFL Program, with the transition occurring around March 2014. The program is delivered through coordination with property managers and owners. Tenants are provided with notice and informational materials to inform them of the program and potential for reduction in their energy bills. The program consists of lighting and water measures.

- **Lighting measures:** Compact fluorescent light (CFL) bulbs installed in permanent fixtures
- **Water measures:** Bathroom and kitchen faucet aerators, water-saving showerheads, hot water pipe wrap

Franklin Energy is the implementation contractor. Customers (i.e., property managers) have the option to choose self-installation or direct installation through Franklin Energy. Duke Energy informed Navigant that most customers choose the direct install route by Franklin Energy. Duke Energy also informed Navigant that third-party quality control inspections are completed on 20 percent of properties in any given month. Within a selected property, the quantity of units to inspect is based on property size.

1.2 Evaluation Objectives and Program-Level Findings

Navigant was selected by Duke Energy to provide independent Evaluation, Measurement, and Verification (EM&V) for the Multifamily Energy Efficiency Program in the Duke Energy Ohio jurisdiction. EM&V is a term used to describe the process of evaluating a program to assess the impacts as well as the program structure and delivery. For this EM&V effort, the evaluation approach and objectives can be described as follows:

- **Impact evaluation:** To quantify the net and gross energy and coincident demand savings associated with program activity at both the measure level and program level
- **Process evaluation:** To assess program delivery and customer satisfaction

By performing both components of the EM&V effort, Navigant is able to provide Duke Energy with verified energy and demand impacts, as well as a set of recommendations that are intended to aid Duke Energy with improving or maintaining the satisfaction with program delivery while meeting energy and demand reduction targets in a cost-effective manner.

Overall, Navigant found that the Multifamily Energy Efficiency Program is being delivered effectively, customer satisfaction is generally favorable, and the reported measure installations are accurate.

For the evaluation period covered by this report, there were a total of 6,748 housing units at 44 participating properties managed by 26 different property managers or property management companies. The program-level evaluation findings are presented in Table 1 though Table 4. Navigant

NAVIGANT

found the realization rate for gross energy savings to be 95 percent, meaning that total verified gross energy savings were found to be about five percent lower than claimed in the tracking database provided by Duke Energy. The realization rate for gross summer peak demand savings was 102 percent, and the realization rate for gross winter peak demand was 158%. Navigant found the net-to-gross (NTG) ratio to be 0.99, meaning that for every 100 kWh of reported energy savings, 99 kWh can be attributed directly to the program. These findings will be discussed in greater detail throughout this report.

Table 1. Program Claimed and Evaluated Gross Energy Impacts

	Claimed	Evaluated	Realization Rate
Gross Energy Impacts (MWh)	2,073	1,976	95%

Source: Navigant analysis, totals subject to rounding.

Table 2. Program Claimed and Evaluated Gross Peak Demand Impacts

	Claimed	Evaluated	Realization Rate
Gross Summer Peak Demand Impacts (MW)	0.24	0.24	102%
Gross Winter Peak Demand Impacts (MW)	0.32	0.50	158%

Source: Navigant analysis, totals subject to rounding.

Table 3. Program Net Energy Impacts

	MWh
Net Energy Impacts	1,960

Source: Navigant analysis, totals subject to rounding.

Table 4. Program Net Peak Demand Impacts

	MW
Net Summer Peak Demand Impacts	0.24
Net Winter Peak Demand Impacts	0.50

Source: Navigant analysis, totals subject to rounding.

1.3 Evaluation Parameters and Sample Period

To accomplish the evaluation objectives, Navigant performed an engineering review of measure savings algorithms, field verification to assess installed quantities and characteristics, as well as surveys with tenants and property managers to assess satisfaction and decision-making processes. The evaluated parameters are summarized in Table 5. The expected sampling confidence and precision for tenant phone surveys was 90 percent ± 10 percent, and the achieved was 90 percent ± 7 percent. For field

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verification, the expected sampling confidence and precision was 90 percent ± 10 percent, and the achieved was 90 percent ± 18 percent.[1]

Table 5. Evaluated Parameters

Evaluated Parameter	Description	Details
Efficiency Characteristics	Inputs and assumptions used to estimate energy and demand savings	1. CFL wattage 2. CFL operating hours 3. Aerator flow rates (gpm) 4. Showerhead flow rates (gpm) 5. Water temperature (F) 6. Pipe wrap length (ft) 7. Baseline characteristics
In-Service Rates	The percentage of program measures in use as compared to reported	1. CFL, aerator, and showerhead quantities 2. Pipe wrap length
Satisfaction	Customer satisfaction	1. Satisfaction with program 2. Satisfaction with contractor 3. Satisfaction with program measures
Free Ridership	Fraction of reported savings that would have occurred anyway, even in the absence of the program	
Spillover	Additional, non-reported savings that occurred as a result of participation in the program	

This evaluation covers program participation from March 1, 2013 through February 28, 2015. Table 6 shows the start and end dates of Navigant's sample period for evaluation activities.

Table 6. Sample Period Start and End Dates

Activity	Start Date	End Date
Field Verification	May 18, 2015	May 22, 2015
Tenant Phone Surveys	May 6, 2015	May 13, 2015
Property Manager Interviews	May 18, 2015	May 29, 2015

1.4 Evaluation Recommendations

Navigant developed a series of recommendations during the EM&V effort. These recommendations are intended to assist Duke Energy with enhancing the program delivery and customer experience, as well as to support future EM&V activities and possibly increase program impacts. Further explanation for each recommendation can be found later in this report.

[1] Navigant designed the field verification sample to achieve 90/10 confidence and precision using the industry standard coefficient of variation of 0.5. The sample quotas were met as planned, and the final precision was different than expected due to greater than expected variation in the realization rates for CFLs at field sites.

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1. Navigant recommends that Duke Energy should adopt the ex post per unit energy and demand impacts from this evaluation and use them going forward.
2. Navigant recommends that Duke Energy maintain an updated and complete list of contact information for property managers at participating properties.
3. Duke Energy should coordinate with Franklin Energy to ensure that all program measures are being recorded in the tracking data. During field verification, Navigant's technicians discovered the possibility that some program measures had not made it into the tracking database and associated impacts may have gone unreported.
4. Navigant recommends that Duke Energy ask Franklin Energy to record characteristics of the equipment removed during the retrofit process. This would provide valuable information to ensure that baseline equipment characteristics are accurate. This recommendation is most relevant for CFLs as there is more potential uncertainty in the baseline.
5. Duke Energy may want to revise the installation practice for CFLs to exclude recessed or "can light" fixtures. A common end-user complaint was that the CFLs were too dim. Navigant's field technicians found several instances of CFLs being installed in recessed fixtures where they cannot provide the same amount of lumens as some baseline lamps that are designed to provide directional lighting output.
6. Navigant recommends that no more than the first three feet of cold water inlet pipes be insulated for the water heater pipe wrap measure.
7. Duke Energy should consider adding LEDs to the program.
8. Duke Energy may want to consider alternative means of disposing of the equipment that is removed from participant housing units during retrofit. It is Navigant's understanding that all removed equipment is disposed of onsite. There may be opportunities for recycling that could improve customer experience and possibly recover some costs.

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2. Program Description

2.1 Design

The Multifamily Energy Efficiency Program is designed to provide energy efficiency to a sector that is often underserved or difficult to reach via traditional, incentive-based energy efficiency programs. This market can be difficult to penetrate because multifamily housing units are often tenant-occupied rather than owner-occupied, meaning that the benefits of participation may be realized by the tenant whereas the incremental costs of participating in the program are absorbed by the owner.

Duke Energy's Multifamily Energy Efficiency Program provides energy efficient equipment to multifamily housing properties at no cost to the property managers or tenant end-users. It has evolved from the Property Manager CFL Program, with the transition occurring around March of 2014. The program is delivered through coordination with property managers and owners. Tenants are provided with notice and informational materials to inform them of the program and potential for reduction in their energy bills. The program consists of lighting and water measures.

- **Lighting measures:** Compact fluorescent light (CFL) bulbs installed in permanent fixtures
- **Water measures:** Bathroom and kitchen faucet aerators, water-saving showerheads, hot water pipe wrap

2.2 Implementation

Franklin Energy is the implementation contractor for the program. To recruit participants, Franklin Energy conducts onsite visits, in combination with internet searches, and SalesGenie[2] lists, to identify properties, property managers, or property management companies that it believes are likely to participate. Franklin Energy then sends an outreach team of energy advisors to coordinate with property managers and explain the program delivery and benefits. This is considered an Energy Assessment. This is also an opportunity for energy advisors to determine the type of measures along with associated quantities that can be installed. Franklin Energy indicated that property managers can be hesitant at first because they may not comprehend that the equipment will be installed at no cost to them. Another potential delay in committing to the program is the need for the property manager to get approval to participate from their corporate office.

Once a property has been fully assessed and a service agreement has been signed, the project is handed over to a different group at Franklin Energy to schedule the installations. The installation crew performs the work as scheduled, while displaying Duke Energy branded clothing, badges, and vehicle decals as directed. The installation crews record the quantities and locations of installed measures for each housing unit via a tablet device, which are eventually entered into a tracking database.

[2] SalesGenie is a business and consumer lead generation tool that sales and marketing professionals can use to search for targeted leads, get contact names and phone numbers, and view detailed information. The tool also provides marketing and data solutions designed to help businesses reach their intended audiences more effectively.

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When energy efficient program measures are installed, Franklin Energy removes the existing or baseline equipment and generally disposes of it onsite. If the property management previously requested to keep the existing equipment, Franklin Energy will package it up and leave it behind with property management or maintenance personnel. In general, Franklin Energy does not record specific information about the efficiency characteristics of the equipment being removed, although Franklin Energy indicated they are experimenting with the idea of doing so.[3]

There can be logistical complications associated with performing these types of retrofits at multifamily housing properties. Franklin Energy indicated that some units may be skipped at a property due to safety issues, lack of access to equipment, pet barriers, or refusal from tenants.

Franklin Energy indicated that they have internal and external forms of quality control (QC) to ensure consistent measure installation. On the internal side, a Franklin Energy supervisor may accompany installation crews to ensure quality work. On the external side, third-party inspections are conducted on a least five percent of participating housing units each year. The QC inspections are required to happen within 22 business days of installation. If a property is selected for a QC inspection, at least 20 percent of the units at the property are targeted for inspection. This third-party inspection is handled by Thorpe Services in the Duke Energy Ohio (DEO) jurisdiction.

During each month of QC inspections, Franklin Energy is provided with a discrepancy report that indicates when measures were missing, installed incorrectly, or if there were missed opportunities. Franklin Energy attempts to address the discrepancies, and subsequently updates the tracking data to reflect the QC findings. The tracking data is ultimately provided to Duke Energy, and subsequently to Navigant for EM&V.

[3] During the property assessment phase, Franklin Energy determines that housing units selected for participation contain lower efficiency light bulbs (incandescents) and standard aerators and showerheads.

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3. Key Research Objectives

As outlined in the Statement of Work, the key research objectives were to conduct impact and process evaluations, as well as a net-to-gross (NTG) analysis. The evaluation covers both lighting and water measures.

The primary purpose of the evaluation, measurement, and verification (EM&V) assessment is to estimate net annual energy and demand impacts associated with participation from March 1, 2013 through February 28, 2015.[4] Secondary objectives include the following:

- Estimate net and gross impacts by measure
- Perform detailed review of deemed savings estimates for each measure, and provide updates if necessary
- Assess the installed quantities and efficiency characteristics of program measures
- Evaluate the strengths and weaknesses of current program processes and customer perceptions of the program offering and delivery
- Recommend improvements to program rules and processes that support greater savings, enhanced cost-effectiveness, and improved customer satisfaction
- Update measure life assumptions, if applicable

Key impact and process research questions to be explored include:

- Is the program achieving targeted energy and demand savings at the measure level?
- How do customers learn about the program, and can participation be increased?
- How is the persistence of savings impacted by participant removal of measures installed through the program?
- Are there opportunities for additional measure offerings through the program?
- Provide the effect on baseline lamp wattage from EISA, including projected annual degradation of baseline lamp wattage for the next 2 to 5 years.

[4] During this time period, the program went through a transition from the Property Manager CFL program to the Multifamily Energy Efficiency Program. Navigant performed impact analysis and tenant satisfaction surveys using tracking data from both programs. The process evaluation and accompanying process related recommendations are primarily focused on the Multifamily Energy Efficiency Program and the current implementation contractor, Franklin Energy.

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4. Impact Evaluation

4.1 Impact Results

The program-level results are shown in Table 7. These results were calculated by multiplying the measure quantities found in the tracking database by the verified energy and demand savings estimated by Navigant for each measure. The net impacts were found by multiplying the gross impacts by the NTG ratio of 0.99. The NTG methodology and results are discussed in detail in Section 5 of this report.

Table 7. Summary of Program Impacts

	Energy (MWh)	Summer Coincident Demand (MW)	Winter Coincident Demand (MW)
Verified Gross Impacts	1,976	0.24	0.50
Verified Net Impacts	1,960	0.24	0.50

Source: Navigant analysis

A summary of each measure's contribution to program savings and realization rate between reported savings and verified savings is shown in Table 8. Compact Fluorescent Light (CFL) bulbs account for more than 70 percent of the energy savings. By dividing the total verified savings by the total reported savings in the tracking data in Table 8, Navigant calculates a gross realization rate of 95 percent for energy savings at the program level. The realization rate for summer coincident demand is 102 percent at the program level, as shown in Table 9. The realization rate for winter coincident demand is 158 percent, as shown in Table 10. These realization rates include adjustments to the estimated savings for each measure which will be discussed during the remainder of this report. On a measure level, the largest adjustments were made to the savings for bathroom faucet aerators due to differences between the estimated per-person hot water usage in the deemed savings assumptions and Navigant's updated research.[5]

[5] The deemed savings for bathroom faucet aerators were based on water use assumptions from the 2012 version of the Illinois Technical Reference Manual. Navigant found that the 2015 version of that TRM had a significant adjustment downward for the water usage assumption. Furthermore, Navigant used estimates from the DOE's Building America Benchmark which were similar to the 2015 version of the Illinois TRM.

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Table 8. Distribution of Program Energy Savings by Measure

Measure	Measure Count from Tracking Data	Total Ex Ante Savings from Tracking Data (MWh)	Share of Total Savings from Tracking Data	Total Verified Ex Post Gross Savings (MWh)	Realization Rate
CFLs	32,568	1,488	72%	1,464	98%
Bathroom Faucet Aerators	1,285	186	9%	75	41%
Kitchen Faucet Aerators	845	102	5%	99	97%
Showerheads	754	202	10%	256	127%
Pipe Wrap (ft)	1,600	94	5%	82	87%
Total	**37,052**	**2,073**	**100%**	1,976	95%

Source: Navigant analysis

Table 9. Distribution of Summer Coincident Demand Savings by Measure

Measure	Total Savings from Tracking Data (MW)	Share of Total Savings from Tracking Data	Total Verified Ex Post Gross Savings (MW)	Realization Rate
CFLs	0.192	80%	0.189	99%
Bathroom Faucet Aerators	0.015	6%	0.010	66%
Kitchen Faucet Aerators	0.008	3%	0.013	159%
Showerheads	0.016	7%	0.021	130%
Pipe Wrap (ft)	0.008	3%	0.009	126%
Total	**0.239**	**100%**	**0.243**	102%

Source: Navigant analysis

Table 10. Distribution of Winter Coincident Demand Savings by Measure

Measure	Total Savings from Tracking Data (MW)	Share of Total Savings from Tracking Data	Total Verified Gross Savings (MW)	Realization Rate
CFLs	0.254	79%	0.433	170%
Bathroom Faucet Aerators	0.021	7%	0.014	68%
Kitchen Faucet Aerators	0.012	4%	0.019	161%

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Showerheads	0.023	7%	0.029	129%
Pipe Wrap (ft)	0.011	3%	0.009	89%
Total	**0.32**	**100%**	**0.50**	158%

Source: Navigant analysis

4.1.1 Other Key Findings

In addition to the impact results summarized in Table 7 through Table 9, Navigant would like to point out some key findings discovered during the impact evaluation that ultimately affected the final results:

- Overall, program measures were installed and operating as reported. For most measures, the in-service rate (ISR) was higher than Duke Energy's estimate of 95 percent.
- Navigant used Duke Energy's estimates for baseline measure characteristics when calculating verified savings. It was challenging to evaluate the baseline measure characteristics in most cases, because participants generally could not provide much detail about the pre-retrofit characteristics of their measures, especially with water measures.
- Navigant's field crews discovered the possibility that not all program measures installed at the properties were accounted for in the program tracking data. For example, at two properties, the property management person who escorted Navigant's field crews was surprised to find that certain housing units were not in our database. This indicates that some installations may be missing from the tracking data. Additionally, at one property Navigant's crews were directed to a number of CFLs that had been installed throughout the management office area and were not reported in the tracking database. At a small number of housing units, the showers contained the exact same model of showerhead as the program model, even though the unit was not identified in the tracking data. The verified savings presented in this impact evaluation do not incorporate additional measures that may have been installed in housing units that were not in the database. Navigant's sampling plan and field verification were designed to assess the measures and housing units that were included in the tracking data provided by Duke Energy.
- More than half of the water heater pipe wrap was installed on the cold water inlet pipes. This point is discussed in more detail later in this report.
- At every property in the sample for onsite field verification, property managers indicated that some portion of housing units are vacant at any given time. This suggests that not all measures installed are generating savings. Navigant did not account for vacant units in this impact analysis, but future efforts could be developed to assess vacancy rates at participating properties.

4.2 Impact Evaluation Methodology

Navigant's methodology for evaluating the gross and net energy and demand impacts of the program included the following components:

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1. Detailed review of deemed savings estimates including: engineering algorithms, key input parameters, and supporting assumptions.
2. Onsite field verification to assess measure characteristics and in-service rates (ISRs)
3. Net-to-gross (NTG) analysis
4. Incorporating supplemental impact findings from tenant surveys

4.2.1 Detailed Review of Ex Ante Deemed Savings

Navigant reviewed the ex ante savings and supporting documentation used to estimate ex ante program impacts. For the compact fluorescent lighting measure, Navigant believes the deemed savings are well-documented in the previous EM&V report and that the algorithms and assumptions used to estimate savings are reasonable. For water measures, Navigant reviewed separate documents that described the assumptions and algorithms used to estimate impacts for water measures.

The deemed savings for the 13 watt CFLs are shown in Table 11 below. The baseline lamp is assumed to be a 60 watt incandescent.

Table 11. Ex Ante Savings and Parameters for CFLs

Program measure	kWh savings	Non-coincident kW savings	Coincident kW savings	Coincidence factor	Average baseline wattage	EE wattage	Average daily hours of use for baseline lamps	Average daily hours of use for CFLs
13 watt CFL	45.7	0.0536	0.0059	0.11	59.73	13	2.74	2.76

Navigant was able to trace all of these findings to the previous EM&V report provided by Duke Energy. The impacts were calculated using the following algorithms:

Equation 1. Energy Savings Algorithm for CFLs

$$kWh\ savings = ISR\ x \left[\frac{(Watts_{base}\ x\ HOU_{base}) - (Watts_{EE}\ x\ HOU_{EE})}{1000}\right] x\ 365\ x\ (1 + HVAC_c)$$

Equation 2. Coincident Demand Savings Algorithm for CFLs

$$kW\ savings^6 = ISR\ x \left[\frac{Watts_{base} - Watts_{EE}}{1000}\right] x\ CF\ x\ (1 + HVAC_d)$$

[6] To calculate winter coincident demand savings, the HVAC interaction factor, $HVAC_d$, is subtracted instead of added. This conservative assumption accounts for a mix participants who will have electric heat pumps for heating, as well as those who may use auxiliary electric heating to supplement gas during winter coincident peak periods.

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Where the parameters are defined as:

ISR = in-service rate
$Watts_{base}$ = wattage of baseline lamp removed
$Watts_{EE}$ = wattage of CFL lamp installed
HOU_{base} = daily operating hours of baseline lamp removed
$HOUs_{EE}$ = daily operating hours of CFL lamp installed
$HVAC_C$ = HVAC interaction factor for energy
$HVAC_D$ = HVAC interaction factor for demand
CF = coincidence factor

Duke Energy provided Navigant with the ex ante savings assumptions for water measures shown in Table 12. For each water measure, Duke Energy provided a description of the base case, which included the assumed flow rate of the existing showerhead and faucet aerators, and the assumption that water heater pipes were uninsulated. Duke Energy also provided a supplemental document that demonstrated the algorithms and assumptions used to estimate impacts from water measures.

Table 12. Ex Ante Gross Savings for Water Measures in Provided by Duke Energy

Measure	Annual energy savings (kWh)	Annual Non-coincident demand savings (kW)	Annual summer coincident demand savings (kW)	Annual winter coincident demand savings (kW)
Faucet Aerators MF Direct 0.5 GPM - bath	206	0.0235	0.0165	0.0233
Faucet Aerators MF Direct 1.0 GPM - bath	145	0.0166	0.0116	0.0164
Faucet Aerators MF Direct 1.0 GPM - kitchen	121	0.0138	0.0097	0.0137
Faucet Aerators MF DIY 0.5 GPM - bath	163	0.0186	0.0130	0.0184
Faucet Aerators MF DIY 1.0 GPM - bath	115	0.0131	0.0092	0.013
Faucet Aerators MF DIY 1.0 GPM - kitchen	96	0.0109	0.0076	0.0108
LF Showerhead MF Direct 0.5 GPM	537	0.0612	0.0428	0.0606
LF Showerhead MF Direct 1.0 GPM	402	0.0459	0.0321	0.0454
LF Showerhead MF Direct 1.5 GPM	268	0.0306	0.0214	0.0303
LF Showerhead MF DIY 0.5 GPM	424	0.0484	0.0339	0.0479
LF Showerhead MF DIY 1.0 GPM	318	0.0363	0.0254	0.0359
LF Showerhead MF DIY 1.5 GPM	212	0.0242	0.0169	0.024
Pipe Wrap MF Direct	59	0.0067	0.0047	0.0066
Pipe Wrap MF DIY	46	0.0053	0.0037	0.0052

4.2.2 Onsite Field Verification

Navigant performed onsite field verification at 77 housing units across nine properties. Field verification efforts were designed to assess the measure characteristics as reported in the tracking data and to assess measure parameters that can be used to verify inputs and assumptions used to estimate energy and

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demand savings for individual measures. Table 13 shows a summary of the parameters assessed by Navigant during field verification, and Table 14 shows the field verification sample.

Table 13. Parameters Evaluated During Field Verification

	CFLs	Faucet Aerators	Water-saving Showerheads	Hot Water Pipe Wrap
Installed quantity	x	x	x	x
Installed wattage	x			
Flow rates (gpm)		x	x	
Water heating system characteristics		x	x	x
Water Temperatures		x	x	x
Pipe insulation R value				x
Pipe length				x
Measure location	x	x	x	x
Baseline information (where available)	x	x	x	x

Table 14. Field Verification Sample

Program Measure	Number of Housing Units in Sample	Number of Measures Reported in Sample
CFLs	66	306
Bathroom Faucet Aerators	32	40
Kitchen Faucet Aerators	31	31
Showerheads	33	33
Pipe Wrap	16	94 ft

Source: Navigant analysis

A summary of findings from field verification is included in Section 4.3.

4.2.3 Tenant Surveys

Navigant incorporated supplemental findings from 122 tenant phone surveys to inform the impact analysis where applicable. The findings from the tenant surveys will be addressed later in this report.

4.3 Impact Evaluation Findings

The impact evaluation findings for lighting measures and water measures are discussed separately.

4.3.1 Compact Fluorescent Light Bulbs

Table 15 shows a summary of Navigant's ex post, verified findings for CFLs. The energy savings per bulb decreased slighted from the 45.7 kWh provided in the deemed savings to 44.9 kWh. To calculate

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verified energy and demand impacts, Navigant assessed the parameters that were used in the algorithms to estimate ex ante savings. Table 16 lists all parameters used to calculate ex post savings.

Table 15. Summary of CFL findings

	Ex Post	Ex Ante
In-Service Rate[1]	96.4%	98.7%
Daily Operating Hours	2.76	2.76
Gross Energy Savings Per Bulb (kWh)	44.9	45.7
Gross Summer Coincident Demand Savings Per Bulb (kW)	0.0058	0.0059
Gross Winter Coincident Demand Savings Per Bulb (kW)	0.0301	N/A

1. *Navigant did not account for vacant housing units, so the actual number of CFLs in use may be lower.*

Source: Navigant analysis

Table 16. Calculation parameters for ex post CFL impacts

Program measure	ISR	Average baseline wattage	EE wattage	Average daily hours of use for baseline lamps	Average daily hours of use for CFLs	Summer coincidence factor	Winter coincidence factor	Energy HVAC interaction factor	Demand HVAC interaction factor[a]
13 watt CFL	96.4%	60	13	2.74	2.76	0.11	0.32[b]	-0.0058	0.167

a. The demand HVAC interaction factor is added for summer coincident demand impacts, and subtracted for winter. Navigant also adjusted the interaction factor for winter demand to account for 50% of participants having gas heating per the 2013 Duke Energy Residential Appliance Saturation Survey.

b. Source: *Coincidence Factor Study, Residential and Commercial & Industrial Lighting Measures*, prepared for: New England State Program Working Group

4.3.1.1 In-Service Rate

At the 66 housing units inspected by Navigant that had CFLs, there were a total of 306 reported program CFLs in the tracking database. During the inspections, Navigant found 305 CFLs. It is important to note that not all of the 305 verified CFLs were found in the locations reported. Some housing units had fewer 13 watt CFLs than reported, and a small percentage had more 13 watt CFLs than reported.[7]

[7] For sites that had more 13 watt CFLs than reported, the field crews attempted to ascertain which lamps were program measures and which were preexisting or had been installed after the fact by the tenant. When tenants were not present, the field crew used their best judgment based on available tracking data information to determine whether or not to count the extra lamps as additional, non-reported program lamps.

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Additionally, during phone surveys with tenants, about 15 percent of respondents indicated having removed program CFLs. Most of these removed only one CFL, but two respondents had removed three or more. The predominant reason for removing CFLs was burnout. The total number of removed CFLs for phone survey participants was 29 out of a total reported number of 557. This indicates that about 6 percent of CFLs were removed by participants.

Navigant used a weighted average to combine the ISR from field verification (100 percent) with the ISR from phone surveys (94 percent) to calculate a final ISR of 96 percent.

4.3.1.2 Wattage

Navigant assessed the wattage of all CFLs inspected during the onsite verification and found them to be 13 watts as reported. Navigant believes the current baseline assumption of approximately 60 watts is appropriate given the industry standards and our experience with other programs. During field verification visits, only seven tenants were able to identify the type of lamp removed prior to the CFL installation. Five of the seven identified the baseline lamp as a 60 watt incandescent.

4.3.1.3 HVAC Interaction and Coincidence Factors

Navigant reviewed the ex ante assumptions for HVAC interaction factors and summer coincidence factors and believes these assumptions are appropriate and should continue to be used going forward. Navigant assumed an 80 percent coincidence factor for winter demand savings because the peak period occurs at hour 20 during January and it is likely that most lights will be on during that time. The deemed savings provided by Duke Energy did not include estimates for winter coincident demand savings.

4.3.1.4 Lighting Hours of Use

The hours of use for CFLs are an important parameter input to the energy savings algorithm, and also a source of uncertainty. The scope and budget of this evaluation did not support a full metering study to quantify operation hours. Navigant assessed the lighting operation hours via the following methods:

1. Performed extensive review of the previous estimates for deemed savings
2. Performed a literature review to assess estimates from secondary sources
3. Collected self-report data from program participants during field verification visits and tenant phone surveys

Table 17 shows a comparison of estimated CFL operating hours from several sources. The previous assumptions used for ex ante savings were based on a self-report results from customer phone surveys, which were then corrected for self-reporting bias by using the results of a different study.[8] The previous evaluation found a self-report estimate of 4.03 hours per day prior to correcting for self-report bias, which is similar to the 3.4 found by Navigant during the interviews with onsite participants. Navigant believes it is appropriate to correct for the bias to over-report hours of use. Our experience has shown that self-reported hours can be 20 percent to 40 percent higher than actual hours of use. For that reason,

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Navigant believes the current ex ante assumption of 2.76 should be retained to estimate savings for this program.

Table 17. Comparison of CFL Operating Hours

Estimated Daily CFL Usage Hours	Method	Source
2.76	Customer self-report, bias corrected	TecMarket Works, previous EM&V study for Property Manager CFL Program for DEO[8]
2.21	Metering study	Navigant metering study for similar multifamily program in Southwestern U.S.
1.5-1.6	Meta data analysis	U.S. Department of Energy *Residential Lighting End-Use Consumption Study: Estimation Framework and Initial Estimates* (2012)[9]
3.4	Customer self-report, non-bias corrected (collected during onsite field verification)	Navigant's results from surveys with tenants during DEO onsite verification visits
5.8	Customer self-report, non-bias corrected (collected during tenant phone surveys)	Navigant's results from phone surveys with tenants[a]

a. *Approximately 25 percent of phone survey respondents reported using their CFLs between 8 and 24 hours per day. This is far higher than any value encountered in the literature, and Navigant does not believe these results are reliable. When those respondents are removed, the self-reported operating hours is 3.9.*

Source: Navigant analysis

4.3.1.5 Effect of Baseline Wattage Requirements for EISA

It is important to address the topic of CFL baseline in more detail. The Energy Independence and Security Act (EISA) was enacted to increase the availability of reduced wattage lighting options, and hence shift the lighting market toward higher efficiency. In theory, this would eventually cause the program CFL baseline to eventually shift to a lower wattage as 60 watt incandescents become less-prominent. There is still much uncertainty surrounding the impact and timeline that EISA will have on the baseline, especially given that it still isn't clear whether EISA standards are or will be enforced in the next 2 to 5 years.

Navigant believes that EISA standards should be applied to new construction applications or replace-on-burnout scenarios. However, the Multifamily Energy Efficiency Program is primarily a retrofit program targeting existing homes in Ohio. Therefore, Navigant believes the current baseline will be appropriate until at least 2016. Between 2016 and 2020, Navigant believes that it will be appropriate to use a blended baseline that includes a mix of 60 watt incandescents and most likely 40 watt incandescents. Table 18 shows the blending schedule and accompanying baseline wattage recommended by Navigant. This

[8] *Process and Impact Evaluation of Duke Energy's Residential Smart $aver: Property Manager CFLs in Ohio*, TecMarket Works, 2013.

[9] http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2012_residential-lighting-study.pdf

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schedule is an estimate and Navigant believes that Duke Energy can address the baseline uncertainty by requiring the implementation contractor to collect information about the lamps removed during the installation of program CFLs.

Table 18. Blended Baseline Wattage for CFL Measure

Year	Blending (ratio of 60w incandescent to 40w)	Baseline Wattage
2016	80/20	56
2017	60/40	52
2018	40/60	48
2019	20/80	44
2020	100% 40 watt incandescent	40

Source: Navigant analysis

4.3.2 Water Flow Regulation Measures

For field verification of program water measures, Navigant collected information to validate the efficiency characteristics of the equipment. This included verifying the reported number of measures and measuring actual flow rates of the retrofit equipment.

4.3.2.1 In-Service Rate

The ISRs for water measures are shown in Table 19. These were calculated using a weighted average of results from the onsite field verification inspections and the tenant phone surveys.

Table 19. In-Service Rates for Water Measures

Measure	ISR
Kitchen aerators	97%
Bathroom aerators	99%
Showerheads	98%
Pipe wrap	83%

Source: Navigant analysis

4.3.2.2 Energy Savings

Navigant performed a detailed review of documentation for deemed savings assumptions and calculations as provided by Duke Energy. The evaluation team confirmed key assumptions from secondary literature, and supplemented inputs with data gathered during field verification. To calculate verified savings for aerators and showerheads, Navigant used a standard engineering equation taken shown in Equation 3, Equation 4, and Equation 5. Navigant subsequently applied inputs collected during field verification or assumptions as listed below in Table 20. The resulting estimates for impacts of aerators and showerheads are presented in Table 21.

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Equation 3. Algorithm for Estimating Energy Savings for Faucet Aerators

$$kWh\ savings\ for\ faucet\ aerators = ISR \times \left[\frac{(GPM_{base} - GPM_{low}) \times T_{home/day} \times 365\frac{days}{yr} \times DF \times (T_{out} - T_{in}) \times 8.3\frac{Btu}{gal \cdot °F}}{\#_{faucets} \times 3412\frac{Btu}{kWh} \times RE}\right]$$

Equation 4. Algorithm for Estimating Energy Savings for Low Flow Showerheads

$$kWh\ savings\ for\ low\ flow\ showerheads = ISR \times \left[\frac{(GPM_{base} - GPM_{low}) \times T_{home/day} \times N_{showers/day} \times 365\frac{days}{yr} \times (T_{out} - T_{in}) \times 8.3\frac{Btu}{gal \cdot °F}}{\#_{showers} \times 3412\frac{Btu}{kWh} \times RE}\right]$$

Equation 5. Algorithm for Estimating Coincident Demand Savings for Aerators and Showerheads

$$\Delta kW_{peak} = \Delta\, kWh/yr \times CF/365$$

Table 20. Input Parameters and Assumptions for Aerator Savings Calculations

Input	Definition	Value	Source
ISR	In-service rate	Refer to Table 19	Navigant field verification and phone surveys
GPM_{base}	Baseline flow rate	Aerators 2.2 Shower 2.5	Deemed savings assumptions from Duke Energy
GPM_{low}	Retrofit flow rate	Aerators 1 Shower 1.5	Deemed savings assumptions from Duke Energy[a]
$T_{home/day}$	Avg hot water use per day per home (minutes)	Kitchen 5.6 Bath 2.9 Shower 10.1	Building America Benchmark
$N_{showers/day}$	Number of showers per person per day	1	Navigant assumption
DF	Percent of water going down drain	Kitchen 75% Bath 90%	Navigant assumption
T_{out}	Temp of water flowing from faucets (F) Temp of water flowing from showerheads (F)	93[b] 105	Navigant field verification Duke Energy deemed savings documentation
T_{in}	Temp of water entering water heater (F)	67	Navigant field verification
#faucets/showers	Number of faucets in home (used to distribute minutes of use between different faucets)	Kitchen 1 Bathroom 1.25 Shower 1	Program data
RE	Recovery efficiency of water heater	0.98	Ohio TRM

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CF (aerators)	Coincidence Factor	Summer 0.048 Winter 0.069	Building America Benchmark
CF (showerheads)	Coincidence Factor	Summer 0.03 Winter 0.042	Building America Benchmark

a. *Navigant measured flow rates during onsite field verification and they were lower than the reported flow rates for the measures installed. However, this was likely due to calcification or water pressure characteristics and suggests that baseline flow rates may also have been lower. Because we did not measure flow rates for baseline units, we chose to use the reported flow rates in both cases.*

b. *The actual measured hot water temperature was 120F. For analysis purposes, Navigant assumed that customers use water at a temperature of 93 degrees, or the average of 120F and 67F.*

Table 21. Verified Estimates of per Unit Impacts for Aerators and Showerheads[10]

Measure	Annual Energy Savings per Unit (kWh)		Annual Summer Coincident Demand Savings per Unit (kW)		Annual Winter Coincident Demand Savings per Unit (kW)	
	Ex Post	Ex Ante	Ex Post	Ex Ante	Ex Post	Ex Ante
Kitchen aerator (1.0 GPM)	117	121	0.0154	0.0097	0.0221	0.0137
Bathroom aerator (1.0 GPM)	59	145	0.0077	0.0116	0.0111	0.0164
Low flow showerhead (1.5 GPM)	339	268	0.0279	0.0214	0.0390	0.0303

Source: Navigant analysis

4.3.3 Water Heater Pipe Wrap

During field verification, Navigant found that more than half of the water heater pipe wrap was installed on the cold water inlet pipe to the water heater. Figure 1 shows a photo taken during field verification. The pipes with blue rings at the bottom are cold water inlet pipes. Industry standards are to install pipe wrap on all hot water pipes, and only the first three feet of the cold water pipe.[11] Therefore, Navigant did not count savings from pipe wrap of greater than three feet installed on cold water pipes.

[10] The program offers aerators and showerheads at other flow rates. However, the tracking data indicated that 100 percent of the water measures installed during the period covered by this evaluation cycle were the flow rates shown in Table 21Table 21, so a verified savings are shown here for only those measures. A full list of savings is shown in Section 8.

[11] http://www.energy.gov/energysaver/projects/savings-project-insulate-hot-water-pipes-energy-savings

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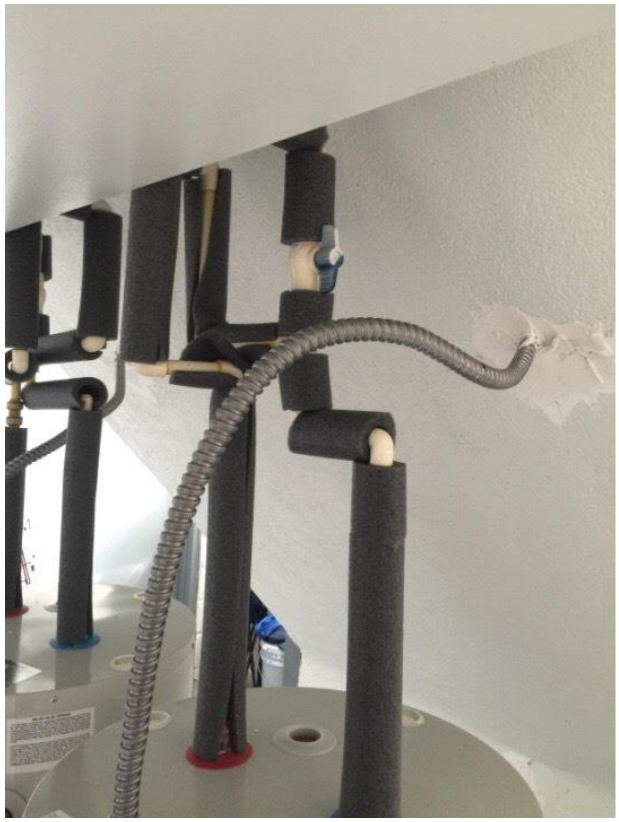
Figure 1. Field Photo Showing Water Heater Pipe Wrap



Source: Navigant

The deemed savings provided by Duke Energy indicate that water heater pipe wrap results in 59 kWh of energy savings per linear foot. This is higher than Navigant has seen in other sources, including the Ohio technical reference manual which provides an example showing savings to be 26.6 kWh/ft.[12] The average length of pipe insulation per water heater during Navigant's onsite field verification was nearly five feet, indicating a total savings of nearly 300 kWh per water heater. Field verification crews found that all water heaters in the verification sample were small and served individual housing units. This makes it unlikely that actual savings are as high as 300 kWh for each water heater. However, the measure only accounts for five percent of program savings and there is significant uncertainty in the ability to estimate savings. For this reason, Navigant applied the ISR from our field verification to the deemed savings provided by Duke Energy.

[12] http://s3.amazonaws.com/zanran_storage/amppartners.org/ContentPages/2464316647.pdf

Table 22. Verified Impacts for Water Heater Pipe Wrap

Measure	Annual Energy Savings per Unit (kWh)	Annual Summer Coincident Demand Savings per Linear Foot (kW)	Annual Winter Coincident Demand Savings per Linear Foot (kW)
Ex Post	51	0.0059	0.0059
Ex Ante	62	0.0071	0.0066

Source: Navigant analysis

4.3.4 Measure Life

Navigant reviewed the measure life assumptions for all program measures and compared them to other sources from secondary literature research. The evaluation team believes all program measure lives are appropriate and not in need of an update.

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5. Net-to-Gross Analysis

Navigant conducted an NTG analysis to estimate the share of program savings that can be attributed to participation in or influence from the program. Table 23 shows the results of Navigant's NTG analysis. Navigant anticipated low free ridership and spillover given that the program is structured to offer energy efficient equipment at no cost to multifamily housing units, which are typically not owner-occupied. The results shown here are in line with expectations. It is important to note that all free ridership came from the CFL measure, as no property managers in the sample indicated prior plans to install water measures. Navigant chose to present a program-level NTG ratio rather than measure level due to the limited sample size of property managers and the fact that it is difficult to estimate spillover by measure. Navigant believes it is more appropriate to present the NTG ratio in aggregate.

Table 23. NTG Results

Estimated Free Ridership	2.4%
Estimated Spillover	1.6%
Estimated NTG	0.99

Source: Navigant analysis

Other key findings include the following:

- Some property managers indicated that they had been planning to install compact fluorescent lights (CFLs) at their properties as replacements for aging bulbs on an as-needed basis prior to participating in the program. This finding is suggestive of free ridership. However, this likely would have occurred over an extended period of time rather than at that large scale enabled by program participation, so the free ridership effect is reduced.
- Navigant field crews discovered that measure installations at some housing units may not have been recorded in the tracking database. Unreported housing units or alternate locations are not included in the NTG analysis. Navigant designed our verification efforts to focus on housing units reported in the tracking database (although we did include additional measures found in those units).

5.1 Overview of Net-to-Gross Methodology

As indicated in the evaluation plan, Navigant used a survey-based, self-report methodology to estimate free ridership and spillover for the Multifamily Energy Efficiency Program. A self-report approach is outlined in the Universal Methods Protocol (UMP), and Navigant has previously used this method to estimate a NTG ratio for the multifamily sector of the Home Energy Improvement Program offered in the DEP jurisdiction. Navigant primarily targeted property managers for the NTG surveys, because they

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are the decision makers for participation in the program.[13] Navigant also incorporated supplemental data gathered during tenant phone surveys into the analysis.

5.1.1 Definitions of Free Ridership, Spillover, and NTG Ratio

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

Free ridership is the share of the gross savings that is due to actions participants would have taken anyway (i.e., actions that were not induced by the program). This is meant to account for naturally occurring adoption of energy efficiency measures. The Multifamily Energy Efficiency Program and most other Duke Energy programs cover a wide range of energy efficiency measures and are designed to advance the overall energy efficiency market. However, it is likely that, for various reasons, some participants would have wanted to install some high-efficiency measures even if they had not participated in the program or been influenced by the program in any way.

Spillover captures program savings that go beyond the measures installed through the program. Also called market effects, the term spillover is often used because it reflects savings that extend beyond the bounds of the program records. Spillover adds to a program's measured savings by incorporating indirect (i.e., non-incentivized) savings and effects that the program has had on the market above and beyond the directly incentivized or directly induced program measures.

The overall NTG ratio accounts for both the net savings at participating projects and spillover savings that result from the program but are not included in the program's accounting of energy savings. When the NTG ratio is multiplied by the estimated gross program savings, the result is an estimate of energy savings that are attributable to the program (i.e., savings that would not have occurred without the program). The NTG formula is shown in Equation 6:

Equation 6. Net-to-Gross Formula

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

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

5.1.2 Estimating Free Ridership

Data to assess free ridership was gathered through the self-report method using a series of survey questions asked to the property managers at participating properties. The survey assessed free ridership using both direct questions, which aimed to obtain respondent estimates of the appropriate free

[13] Navigant recognizes that some property managers may have been instructed to participate by higher-level decision makers at the corporate level. Although we do not think this was the case very often, we do think that the local property managers were still privy to the decision making process.

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ridership rate that should be applied to them, and supporting or influencing questions, which could be used to verify whether the direct responses were consistent with participants' views of the program's influence.

Each respondent to the survey provided perspectives on the measures that they had installed through the program. The core set of questions addressed the following three categories:

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

Free ridership scores were calculated for each of the three categories.[14] Navigant then calculated a weighted average from each respondent based on their share of sample energy savings, and divided by

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[14] Scores were calculated by the following formulas:

- Likelihood: The likelihood score is 0 for those that "definitely would NOT have installed the same energy efficient measure" and 1 for those that "definitely WOULD have installed the same energy efficient measure." For those that "MAY HAVE installed the same energy efficient measure," the likelihood score is their answer to the following question: "On a scale of 0 to 10, where 0 is DEFINITELY WOULD NOT have installed and 10 is DEFINITELY WOULD have installed the same energy efficient measure, can you tell me the likelihood that you would have installed the same energy efficient measure?" If more than one measure was installed in the project, then this score was also multiplied by the respondent's answer to what share they would have done.
- Prior Planning: If participants stated they had considered installing the measure prior to program participation, then the prior planning score is the average of their answers to the following two questions: "On a scale of 0 to 10, where 0 means you 'Had not yet planned for equipment and installation' and 10 means you 'Had identified and selected specific equipment and the contractor to install it,' please tell me how far along your plans were" and "On a scale of 0 to 10, where 0 means 'Had not yet budgeted or

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

5.1.3 Estimating Spillover

The basic method for assessing participant spillover was an approach that asked a set of questions to determine the following:

- **Whether spillover exists at all.** These were yes-or-no questions that asked, for example, whether the respondent incorporated energy efficiency measures or designs that were not recorded in program records and did not receive any rebates from DEO.
- **The savings that could be attributed to the influence of the program.** Participants were asked to list the extra measures they installed, and the evaluation team assigned a savings value. See below for the method of assigning savings.
- **Program attribution**. Estimates were derived from a question asking the program importance on a 0 to 10 scale. Participants were also asked how the program influenced their decisions to incorporate additional energy efficiency measures.

If respondents said no, they did not install additional measures, they were assigned a 0 score for spillover. If they said yes, then Navigant estimated the energy spillover savings on a case-by-case basis. It is important to note that although free ridership questions were only asked of property managers, Navigant surveyed both property managers and tenants for spillover.[15]

5.1.4 Combining Results Across Respondents

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

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considered payment' and 10 means 'Already had sufficient funds budgeted and approved for purchase,' please tell me how far along your budget had been planned and approved."

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

[15] The reason for not assessing free ridership at the tenant level is because tenants generally participated in the program via their property managers rather than personal choice. It is possible that tenants would have installed the same measures themselves, but Navigant does not believe they should be considered free riders to the program because the timing of those installations would have been difficult to evaluate and tenants would still have the ability to install CFLs in non-retrofitted fixtures. If a tenant already had equivalent measures in place, it is unlikely that the implementer would have replaced them with program measures.

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- Individual respondents, by evaluating the responses to the relevant questions and applying the rules-based approach discussed above.
- The program as a whole, by taking a weighted average of the individual results based on each respondent's share of reported energy savings.

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

5.2.1 Review of Data Collection Efforts for Attribution Analysis

Surveys were conducted with decision makers to provide the information to estimate free ridership, and thus, NTG ratios. A total of five property managers were surveyed. These five property managers managed 11 of 44 total properties in the program. This sample represents 25 percent of the total properties, 40 percent of the total housing units, and 41 percent of the total reported energy savings, as shown in Table 24.

Table 24. Property Manager Sample Representation

	Program Total	Sample Total	% of Program
Properties	44	11	25%
Property managers	26	5	20%
Housing units	6,748	2,681	40%
CFLs	32,568	9,988	31%
Bathroom faucet aerators	1,285	905	70%
Kitchen faucet aerators	845	566	67%
Showerheads	754	462	61%
Pipe wrap	1,600	1,296	81%
Total Energy Savings			**41%**

Source: Navigant analysis

5.2.2 Free Ridership Results

As described above, surveyed participants responded to a series of questions intended to elicit explicit estimates of free ridership, as well as ratings of program influence. Estimates are based on questions regarding the likelihood, scope, and timing of the investments in energy efficiency if the respondent had not participated in the program. For the Multifamily Energy Efficiency Program, free ridership was estimated at 2.4 percent, which is a relatively low value as anticipated by Navigant. All free ridership came from the CFL measure, as no property managers in the sample indicated prior plans to install water measures.

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Navigant developed the free ridership estimate presented above based on responses to a variety of questions that related to survey respondents' intentions prior to participating in the program and to the influence of the program itself. Below are summaries by scoring component.

Prior Planning: Two of the respondents did not have any prior plans for installing any of the energy efficient measures. The other three respondents indicated that they did have plans, but that their plans were not very far along. These results indicate low free ridership.
Program Importance: Respondents stated that the program was very important in having the measures installed. One respondent stated that "To get the material and labor for free made it a no-brainer. Tenants realize savings, although there are no direct economical savings to us [the property manager or management]. We couldn't pass up this offer." A high program importance indicates very low free ridership.

Likelihood: Respondents were asked in the absence of the program, if they would have had at least some of the work done. All respondents said they would have had at least some of the measures installed. When asked what percent they would have done, responses ranged from 0 percent for some measures to 100 percent for other measures, averaging at 25 percent. This does indicate some free ridership, since some participants would have done the measures even without the program. However, in the "Timing" section, customers are asked about when they would have done the installations.

Timing: Some respondents stated they would have done the installation at the same time as they did with the program, while some respondents stated they never would have done the installations. The average timing was between one and two years, indicating a low level of free ridership.

In summary, respondents indicated that the program was very important in their decisions to have the energy efficient measures installed. Some indicated that they did have some prior plans to install the measures, but their plans were not very far along. About one-third had a high likelihood of installing the measures without the program, and on average, respondents would have done the installation between one and two years after the program installation. These results indicate very low free ridership overall. The evaluation team estimated free ridership for the program at 2.4 percent of program reported savings.

5.2.3 Spillover Results

One of the five survey property managers indicated that the program influenced him/her to install additional, non-incentivized energy efficiency measures at the property. This respondent indicated that the property management company installed CFLs in the remaining fixtures in their units that had not been retrofitted by program CFLs, and that they also installed about 40 outdoor CFLs. The respondent indicated that the total quantity of non-program CFLs was nearly equal to the quantity of program CFLs. Navigant credited spillover savings to this property by calculating savings for the same number of program CFLs, and assigning a de-rating factor to the savings to account for the fact that the non-program CFLs would have been installed in lower use fixtures. Navigant also incorporated the fact that 40 percent of tenants surveyed said they already had CFLs or LEDs in the fixtures that hadn't been retrofitted through the program.

In addition to the one property manager reporting spillover, a small number of tenants reported installing a small number of CFLs or LEDs after participating in the program. Navigant believes the spillover contribution from these respondents is negligible.

Navigant calculated the total spillover to be 1.6 percent.

5.2.4 NTG Results

The NTG ratio was calculated as written in Equation 7:

Equation 7. Net-to-Gross Ratio

$$NTG = 1 - free\ ridership + spillover = 1 - 0.024 + 0.016 = 0.99$$

This suggests that for every one kWh reduced from program measures, about 0.99 kWh of savings can be directly attributed to the program.

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6. Process Evaluation

Navigant conducted a process evaluation of the Multifamily Energy Efficiency Program to assess program delivery and customer satisfaction. The process findings summarized in this section are based on the results of customer surveys with 122 program participants, detailed surveys with five property managers representing 11 properties, an interview with the Duke Energy Program Manager, an interview with the Franklin Energy Program Manager, and a high level review of the program documents and functionality. The property manager interviews and tenant surveys were also used to inform the NTG analysis.

6.1 Key Findings

- The program appears to be effectively addressing many key challenges that are inherent to delivering energy efficiency programs to non-owner-occupied multifamily housing facilities.
- About 80 percent of property managers learned about this program through outreach by a program representative. This onsite marketing approach seems to be a successful way of gaining participants. Most tenants learned of this program through their property managers.
- Property managers listed saving money via no cost measures and contracted installation as the primary reason for participating in the program.
- 45 percent of tenants indicated they noticed savings on their electric bill since the installation of the measures.
- Nearly 90 percent of tenants stated that the program CFLs were installed in the light fixtures used most in the home. Incandescents were listed as the most commonly removed type of bulb.
- A majority of program participants were satisfied with the program. On a scale of 0 to 10, where 0 indicates “not satisfied at all” and 10 indicates “extremely satisfied”:
    - Over 75 percent of participants indicated 8-10 for satisfaction with the overall program
    - Over 85 percent of participants indicated 8-10 for satisfaction with the installer’s quality of work
    - Over 70 percent of participants indicated 8-10 for satisfaction with Duke Energy
- High satisfaction ratings by tenants were often associated with money savings as the primary benefit. Low satisfaction ratings were often associated with complaints about the equipment.
- Satisfaction was higher for CFLs than for showerheads and aerators.
- During the tenant phone surveys, several participants expressed dissatisfaction with the low water pressure in their showers and sinks. Additionally, some property managers indicated that they had received tenant complaints about low water pressure.

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6.2 Documentation Review

Navigant requested program documentation and tracking data to conduct a complete review of current processes. For the most part, the documentation was informative and easy to follow. The educational brochures were simple and to the point. The program tracking data was sufficient to identify the installation location and quantities of installed measures for each tenant at the participating properties. However, Navigant did identify one area where documentation could be improved to aid in the evaluation, measurement, and verification (EM&V) process:

1. There were several gaps in the property manager contact information provided to Navigant by Duke Energy. This made it difficult to identify the proper contact person for interviews and site visits at some of the program properties. Duke Energy should encourage the implementation contractor to maintain a complete contact list for all property managers.

6.3 Interviews with Key Program Management Staff

Navigant conducted interviews with program staff from Duke Energy and Franklin Energy to understand and assess program delivery and daily operations. Program staff from both organizations were responsive and helpful. The interviews focused on the marketing process, measure installation, customer satisfaction, data collection, and possible areas for growth or improvement. These interviews provided Navigant with some insight about how to focus efforts for data collection and with some ideas for questions to include in the customer satisfaction surveys. Other findings from the interviews are incorporated into descriptive text throughout this memo.

6.4 Property Manager Interviews

The evaluation team conducted interviews with property managers from the participating properties to assess decision-making (which will ultimately feed into the NTG analysis), satisfaction with the program, and to recruit for onsite inspections as part of the impact analysis. The evaluation team interviewed five property managers who were responsible for 11 properties representing over 13,000 measures. The properties managed by these interviewees account for approximately one-third of all measures installed in the program during the evaluation cycle.

Overall, property managers indicated that their experience with the program was favorable. There are distinct challenges when dealing with a large number of tenant-occupied housing units, and it would be difficult to appease all customers equally. Some key findings from the property manager interviews are listed below:

- Property managers expressed high satisfaction with the free program measures and free installation by an external contractor.
- One property manager indicated that the program allowed the management company to provide "a great service to our residents by saving them money" on utility bills, and another indicated that the equipment was considered "an amenity for the tenants to realize savings."
- One property manager indicated that several tenants had expressed dissatisfaction with the program due to low water pressure from the new showerheads and dim lighting from the CFLs.

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This same property manager also indicated dissatisfaction that the old equipment was thrown into the trash at the property, and a large number of the removed light bulbs spilled and were broken on the ground.

- One property manager indicated that tenants are removing program showerheads and light bulbs and installing their own.

6.5 Overall Marketing and Outreach

Customer outreach is a key driver to program participation. Franklin Energy indicated that they have a specific outreach team that recruits and coordinates with property managers to facilitate enrollment in the program. Franklin indicated that they provide the property managers with brochures and education that summarizes the energy and non-energy benefits (such as tenant satisfaction) of the program. Sometimes it may take some extra effort to convince hesitant property managers that the program is not a sales gimmick. Navigant recognizes the importance of marketing and outreach with regards to continued participation and satisfaction, so several questions in the tenant survey and property manager interviews were included to address this.

Table 25 and Figure 2 show how tenants and property managers learned about the program. Tenant participants were asked to indicate all of the sources through which they learned about the program, and three-quarters indicated they had learned about the program through property managers as would be expected given the program model. Tenants also indicated having received notice via a Duke Energy mailing or bill stuffer. Property managers indicated that they were approached in-person by a program representative, or received a mail or email with program details.

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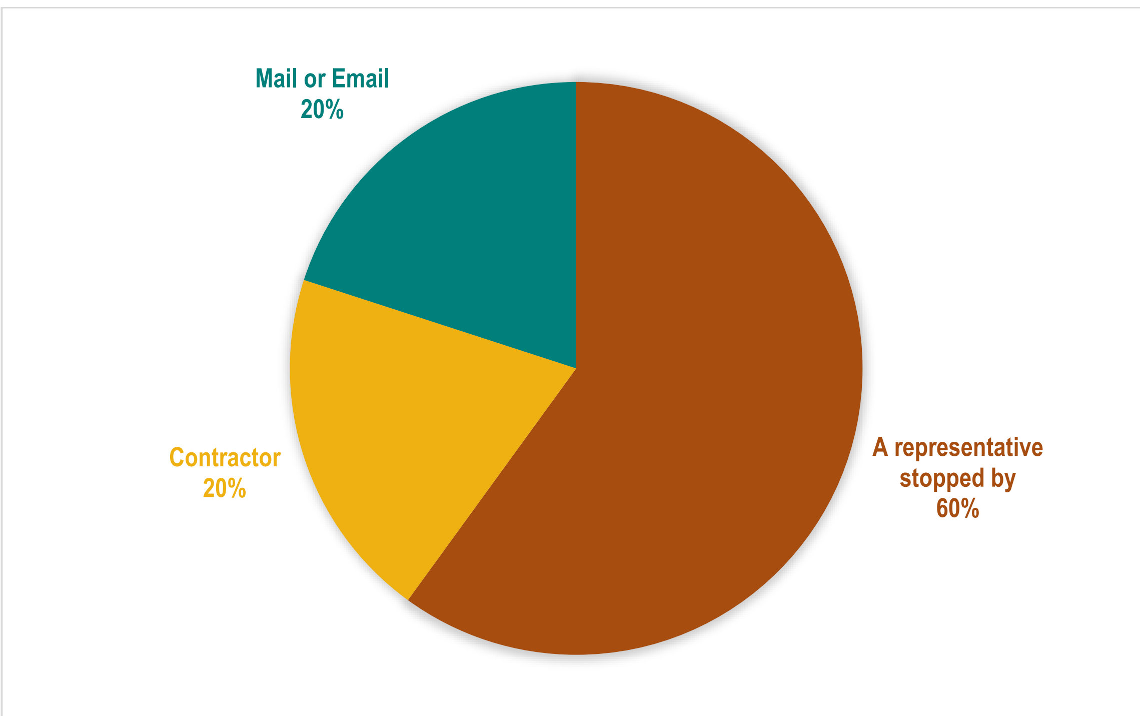
Table 25. How Tenants Learned About the Program

How Tenants Learned About the Program (n=122)	
Through property manager	72%
Duke Energy mailing	9%
Duke Energy bill stuffer	7%
Don't know	3%
Through family, friend or neighbor	2%
Duke Energy website	2%
Duke Energy email	2%
Participation in other Duke Energy Programs	1%
Television	1%
Other	1%
Through printed material or outreach materials sent by the Program	1%

Source: Navigant analysis

Figure 2. How Property Managers Learned About the Program



Source: Navigant analysis

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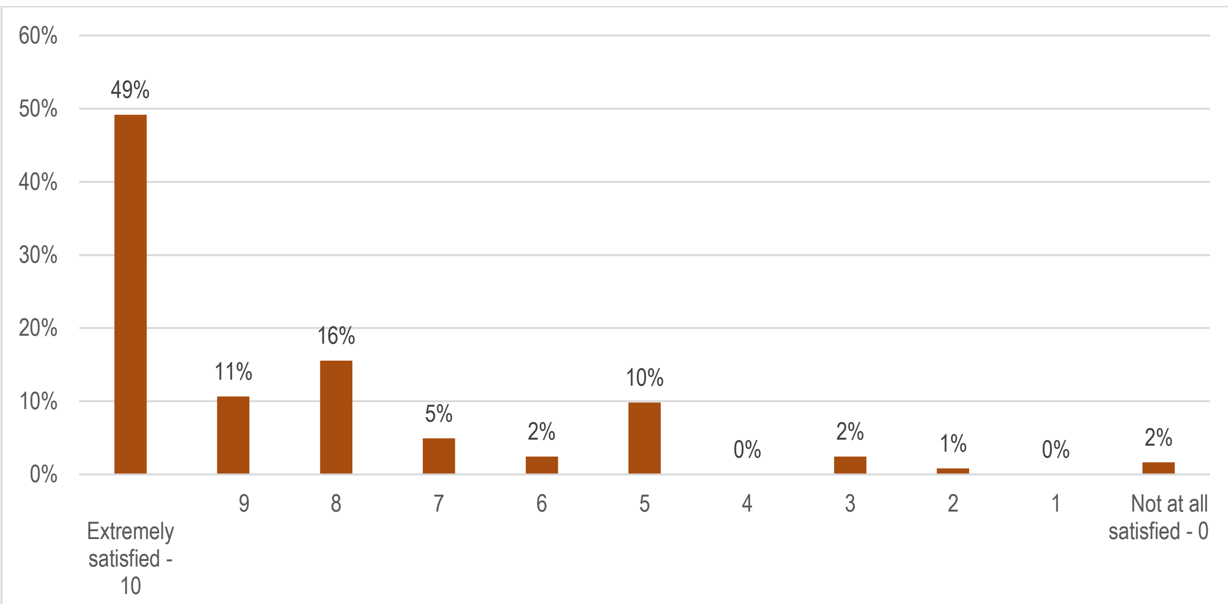
6.6 Tenant Surveys

Navigant conducted phone surveys with 122 residential tenants to assess program satisfaction. The surveys contained a number of questions to assess satisfaction with program participation, satisfaction with new equipment, as well as some questions to assess measure baseline and any measures removed by the tenant after participation.

Customer satisfaction with the program is high. On a scale of 0 to 10, where 0 indicates "not satisfied at all" and 10 indicates "extremely satisfied." 49 percent of customers rated they were "Extremely satisfied;" with 76 percent of customers indicating an 8, 9 , or 10 satisfaction rating as shown in Figure 3. Participants who ranked their overall satisfaction low did so because they disliked the products or did not experience any energy savings.

Figure 3. Tenant Satisfaction with Overall Program Experience (n=122)



Source: Navigant analysis

Customer satisfaction with the contractor quality of work was also high, as shown by Figure 4.

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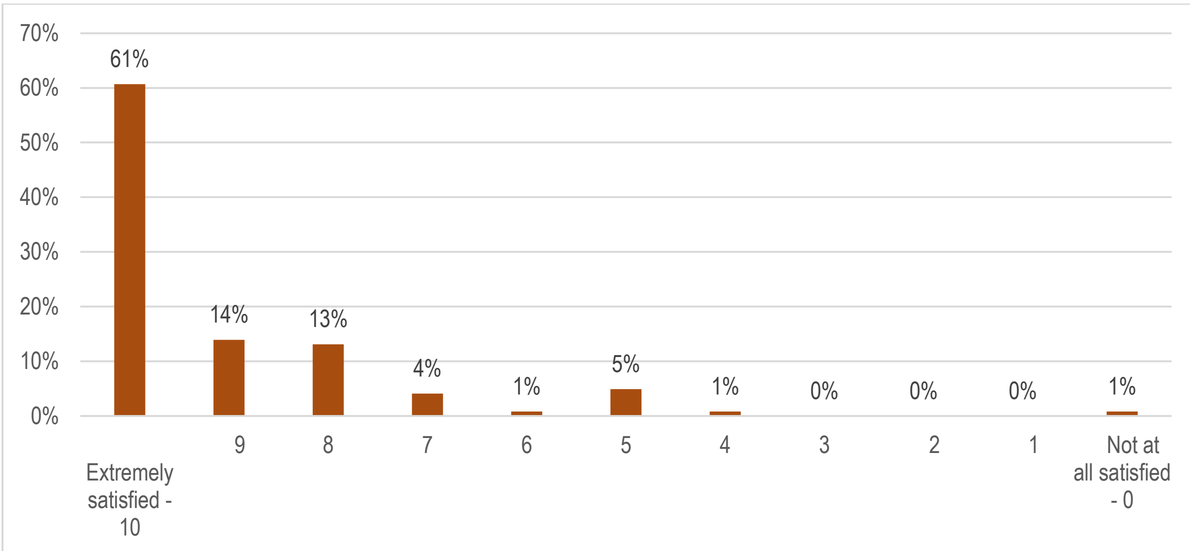
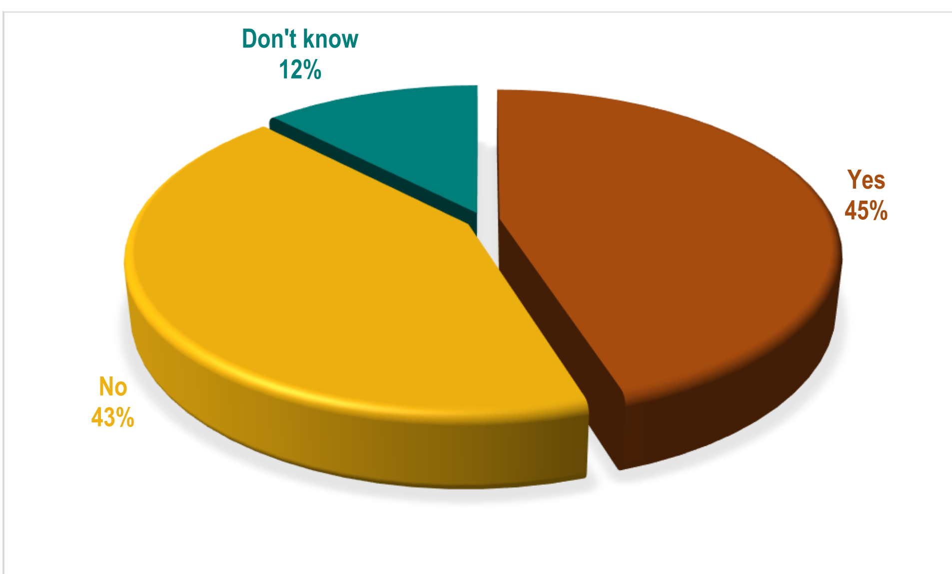
Figure 4. Tenant Satisfaction with Contractor's Quality of Work (n=122)



Source: Navigant analysis

As shown in Figure 5, about 45 percent of participants noticed a decrease in their energy bills after the new measures were installed.

Figure 5. Participants Who Noticed a Decrease in Their Energy Bill After Installing Program Measures (n=122)



Source: Navigant analysis

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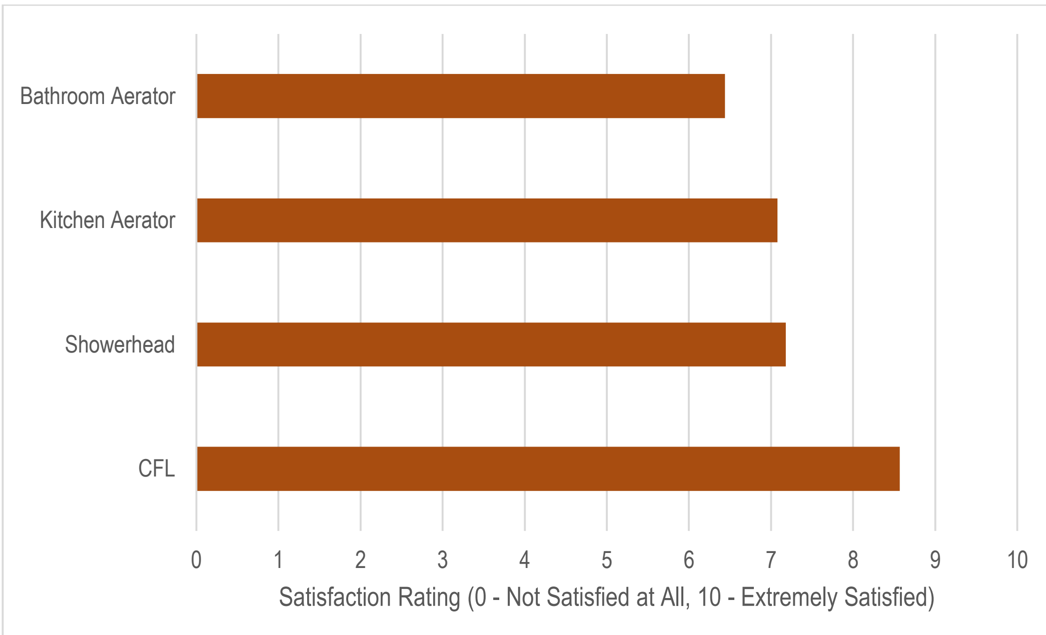
While a majority of participants were satisfied with the new measures, some were not. Navigant asked the participants to rate their satisfaction for each measure installed at their home. Average satisfaction ratings ranged from as high as 8.57 out of 10 for CFLs, to as low as 6.44 out of 10 for bathroom faucet aerators as shown in Figure 6.

Figure 6. Tenant Satisfaction Rating for Each Measure



Source: Navigant analysis

A small percentage of tenants removed the installed measure as shown in Figure 7. Of the measures that were installed, 15 percent of tenants removed one or two of their CFL light bulbs. Of those who removed CFLs, 80 percent stated that the bulb had burned out. This was surprising to Navigant because the measures were installed between March of 2013 and February of 2015, meaning that the burnout rate might be higher than expected for residential CFLs. Participants indicated bathroom faucet areators and showerheads were removed because of poor water pressure and kitchen faucet areators were removed because of low pressure or excess water spray.

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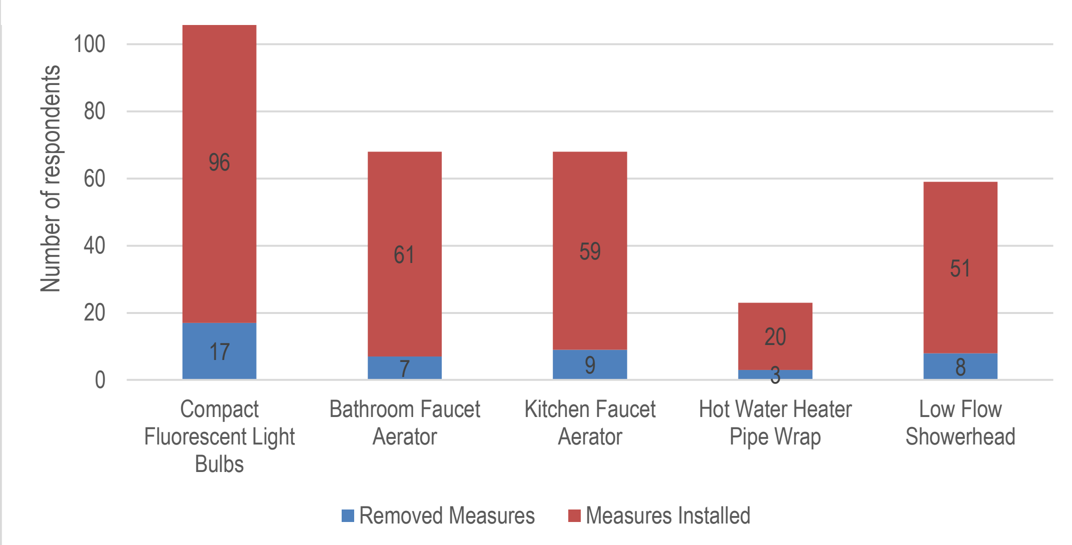
Figure 7. Participants Who Removed Any Installed Measures



Source: Navigant analysis

6.6.1.1 Participant Suggestions

Navigant also included a question in the tenant satisfaction survey that allowed respondents to offer suggestions for improving the program. About one-fourth of the respondents offered suggestions, which were as follows:

- Several respondents asked for a better quality of equipment, including the quality of CFLs, showerheads, and aerators
- One participant asked for LEDs instead of CFLs
- One respondent asked for participation to not be "forced"
- One participant asked for better notification of installation date and time
- A few participants suggested other measures, including: additional light bulbs, HVAC equipment, thermostats, UV coating on doors/windows

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7. Conclusions and Recommendations

Navigant's findings in this report suggest that Duke Energy's Multifamily Energy Efficiency Program is being delivered and tracked effectively in the Ohio jurisdiction. Customer satisfaction is generally high, and the program measure installations appear to be tracked appropriately. Navigant presents the following list of recommendations that may help improve program delivery and impacts:

1. **Navigant recommends that Duke Energy should adopt the per unit energy and demand impacts from this evaluation and use them going forward.** The engineering analysis and data collection described in this report provide support for updating the estimated impacts for each program measure.
2. **Navigant recommends that Duke Energy maintain an updated and complete list of contact information for property managers at participating properties.** Ideally, this list would include a name of the principal contact at the site, and a more complete set of email addresses if possible. Duke Energy did provide phone numbers and the property management company name for most properties, but some of the contact information was missing which made it somewhat challenging to recruit participants for field verification and property manager surveys.
3. **Duke Energy should coordinate with Franklin Energy to ensure that all program measures are being recorded in the tracking data.** During field verification, Navigant's technicians discovered the possibility that some program measures had not made it into the tracking database. These findings were based on the verbal indications of onsite maintenance personnel, as well as the discovery of unreported equipment that was identical to program equipment.
4. **Navigant recommends that Duke Energy ask Franklin Energy to record characteristics of the equipment removed during the retrofit process.** Although this could be a cumbersome process, it would provide valuable information to ensure that baseline equipment characteristics are accurate when calculating measure-level impacts. This recommendation is most relevant for CFLs as there is more potential uncertainty in the baseline.
5. **Duke Energy may want to revise the installation practice for CFLs to exclude recessed or "can light" fixtures.** A common end-user complaint was that the CFLs were too dim. Navigant's field technicians found several instances of CFLs being installed in recessed fixtures where they cannot provide the same amount of lumens as some baseline lamps that are designed to provide directional lighting output.
6. **Navigant recommends that no more than the first three feet of cold water inlet pipes be insulated for the water heater pipe wrap measure.** The U.S. Department of Energy recommends only insulating the first three feet of cold water inlet pipes. Beyond that, savings are likely negligible. During field verification, Navigant found that over half of the reported water heater pipe wrap was installed on cold water pipes (with about 10 percent to 15 percent being greater than three feet from the water heater on the cold water side).
7. **Duke Energy should consider adding LEDs to the program.** Because of EISA, the baseline for the 13 watt CFL measure will eventually reach 40 watts instead of 60 watts. This will diminish

the cost-effectiveness of program CFLs. LED options may provide increased savings and improved customer satisfaction.

8. **Duke Energy may want to consider alternative means of disposing of the equipment that is removed from participant housing units during retrofit.** It is Navigant's understanding that all removed equipment is disposed of onsite. There may be opportunities for recycling that could improve customer experience and possibly recover some costs.

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8. Measure-Level Inputs for Duke Energy Analytics

Navigant used the findings from field verification, surveys, and review of Duke Energy's deemed savings to estimate an updated set of deemed savings for Duke Energy to use for tracking program activity. Table 26 provides the measure-level inputs that can be used by Duke Energy Analytics for estimates of future program savings.

Table 26. Gross Measure-Level Impacts

Measure	Annual Energy Savings Per Unit (kWh)	Annual Summer Coincident Demand Savings Per Unit (kW)[1]	Annual Winter Coincident Demand Savings Per Unit (kW)[2]
Faucet Aerators MF Direct 0.5 GPM - bath	83.22	0.011	0.022
Faucet Aerators MF Direct 1.0 GPM - bath	58.75	0.008	0.011
Faucet Aerators MF Direct 1.0 GPM - kitchen	116.81	0.015	0.022
Faucet Aerators MF DIY 0.5 GPM - bath	63.30	0.008	0.017
Faucet Aerators MF DIY 1.0 GPM - bath	44.68	0.006	0.008
Faucet Aerators MF DIY 1.0 GPM - kitchen	90.34	0.012	0.017
LF Showerhead MF Direct 0.5 GPM	678.10	0.056	0.078
LF Showerhead MF Direct 1.0 GPM	508.57	0.042	0.059
LF Showerhead MF Direct 1.5 GPM	339.05	0.028	0.039
LF Showerhead MF DIY 0.5 GPM	519.50	0.043	0.060
LF Showerhead MF DIY 1.0 GPM	389.62	0.032	0.045
LF Showerhead MF DIY 1.5 GPM	259.75	0.021	0.030
Pipe Wrap MF Direct	51.48	0.006	0.006
Pipe Wrap MF DIY	46.50	0.005	0.005
13W CFLs	44.94	0.0058	0.0133

1. *The summer coincident period for DEO is defined as weekdays in July, hour ending 17.*
2. *The winter coincident period for DEO is defined as weekdays in January, hour ending 20.*

Source: Navigant analysis

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Appendix A. Detailed Survey Results

This appendix contains additional results from the property manager interviews and tenant surveys. It is meant as a supplement to other sections of the report.

A.1 Property Manager Interviews

Navigant conducted in-depth interviews with five property managers. As shown in Table 24, the sample of five property managers represented 11 properties and accounted for 41 percent of program savings. This section presents details of the interviews. The responses to each question shown are paraphrased to maintain confidentiality and summarize the key points.

Table 27. How did you learn about the Duke Energy Multifamily Energy Efficiency Program?

Respondent(s)	Response
1	Duke Energy mail or email
2	Informed by maintenance supervisor
3,4,5	Approached by a program representative

Source: Navigant analysis

Table 28. What were the primary reasons to participate in the program?

Respondent(s)	Response
1	To save money on the installs over doing them in-house
2	To provide great service to our tenants
3	To save money for our tenants, and due to the quick implementation
4	To save water
5	To savings money for our tenants and to save on having to do installs in-house

Source: Navigant analysis

Table 29. On a scale of 0 to 10, with 0 being "not satisfied at all" and 10 being "extremely satisfied", how satisfied are you with your overall program experience?

Respondent(s)	Response
1, 2, 5	10
3	8
4	0

Source: Navigant analysis

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Table 30. On a scale of 0 to 10, with 0 being "not satisfied at all" and 10 being "extremely satisfied", how satisfied are you with the tenant notification and program materials?

Respondent(s)	Response
1, 2, 4, 5	10
3	7

Source: Navigant analysis

Table 31. On a scale of 0 to 10, with 0 being "not satisfied at all" and 10 being "extremely satisfied", how satisfied would you say your tenants are with the new energy efficient equipment?

Respondent(s)	Response
1	8, the only complaint is that it takes a while for the CFLs to reach full brightness
2	10, there were a few select residents who opted out due to having their own lighting
3	5, have received some complaints about the inconvenience of installs
4	*CFLs and bathroom aerators* – 10 with no complaints *Showerheads* – 0 because residents are not happy with the equipment and the fact that the contractor took their old showerheads away *Kitchen aerators* – 0 because residents have complained that the aerators spray too wide and cover the counter tops
5	*CFLs and pipe wrap* – 10 *Bathroom and kitchen aerators* - 7

Source: Navigant analysis

Table 32. On a scale of 0 to 10, with 0 being "not likely at all" and 10 being "very likely", how likely are you to recommend the Multifamily Energy Efficiency Program to other property managers?

Respondent(s)	Response
1	10 – already have
2	10
3	9
4	0 – because of dissatisfaction
5	9

Source: Navigant analysis

Table 33. Prior to participating in the program, had you considered installing the same energy efficient equipment at your facility?

Respondent(s)	Response
1, 4	No
2	Yes

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3, 5	CFLs – Yes Water measures – No

Source: Navigant analysis

Table 34. Did your experience with the program influence you to incorporate any additional energy efficiency equipment for which you did not receive a Duke Energy program rebate?

Respondent(s)	Response
1	Yes – additional CFLs
2,3,4,5	No

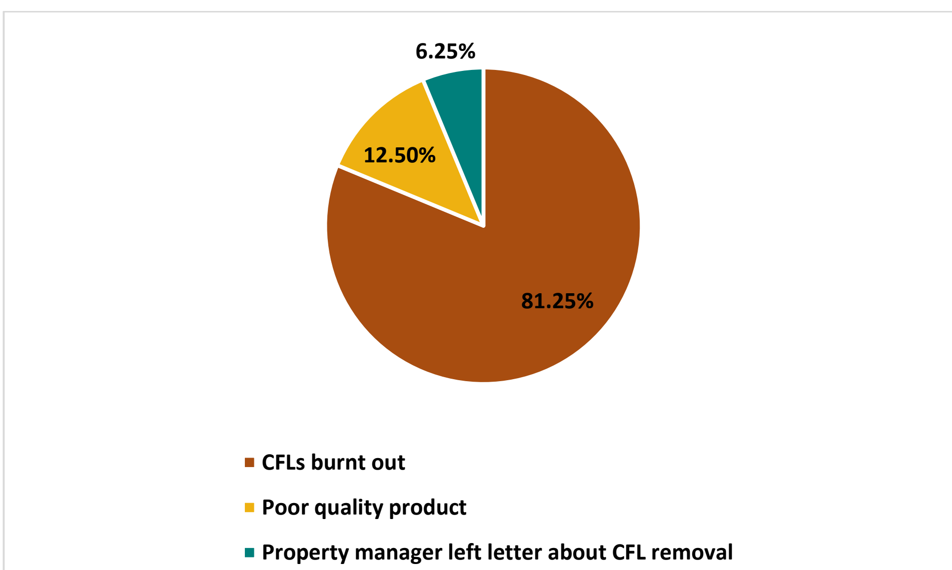
Source: Navigant analysis

A.2 Tenant Satisfaction Surveys

Satisfaction surveys were conducted with 122 program participants. Many of the results are presented in Section 6.6 of the main report, and this section serves as a supplement.

Figure 8 shows the reasons why tenants removed CFLs, the most common being burnout. For water measures, the most common reason for removal was low water pressure, although fewer measures had been removed.

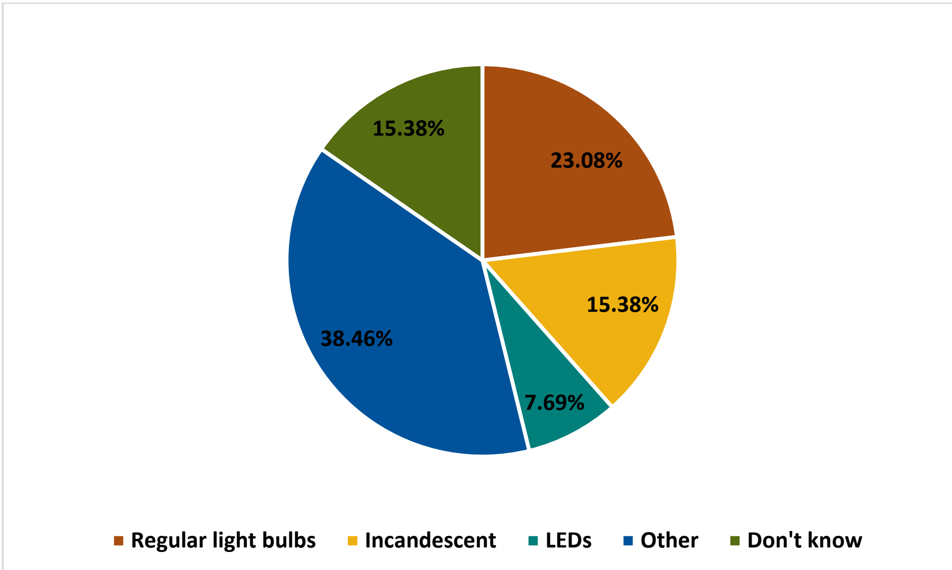
Figure 8. Reasons Why Tenants Removed CLFs (n=16)



Source: Navigant analysis

Figure 9 shows the types of light bulbs that tenants reported as being installed in the non-retrofitted fixtures in their homes. An important supplement to this figure is that 90 percent of tenants reported that program CFLs were installed in the fixtures used most in their homes, which demonstrates that the program is effective in reaching the fixtures with greatest savings potential. Additionally, more than 70 percent of tenants reported that they were very likely to install CFLs in their home in the future.

Figure 9. Type of Bulbs Found in Non-Retrofitted Fixtures



Source: Navigant analysis

As noted earlier, overall tenant satisfaction with the program was very high, with an average rating of 8.40 on a scale of 0 to 10 with 10 be very satisfied. However, six of the 122 tenants reported a satisfaction of five or less with the program for the following reasons:

- Dislike products (n=3)
- No money savings (n=3)

Tenants also reported a few suggestions for improving the program:

- Improve the quality of CFLs (n=6)
- Improve the low flow showerhead (n=5)
- Improve the quality of products (n=3)
- Improve the kitchen faucet aerator (n=3)
- Provide LEDs instead of CFLs (n=2)
- Check the HVAC and thermostats (n=1)

APPENDIX M-

Power Manager Process Evaluation

Final Report

Process Evaluation of the 2014 Power Manager Program in Ohio

Prepared for
Duke Energy
139 East Fourth Street
Cincinnati, OH 45201

February 17, 2015

Submitted by

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Executive Summary

Significant Findings from Participant Surveys

The participant survey summarized in this section was conducted after the cooling season, and is designed to cover program-level topics such as awareness, enrollment and household demographics that are not related to specific Power Manager activation events. Event surveys were conducted during the cooling season and are designed to provide accurate data on event-related behavior by interviewing participants within 27 hours of activation events and comparable high-temperature days without events; however, there were no regular activation events in Ohio during the 2014 cooling season, so event and non-event surveys are not presented in this year's evaluation.

- Nine out of ten participants surveyed (91%) report that they were involved with the decision to participate in the Power Manager Program, while equal percentages of respondents said they were not involved (4%) or that their activation device had been installed by a previous occupant (4%).
- Saving money (63%) is the most-mentioned reason for participants joining the program, followed by helping to avoid power outages (25%), receiving bill credits (18%) and helping the environment (18%).
- Nearly two-thirds of Ohio customers (65%) do not know how much they receive in bill credits for participating in the program. Among those who were able to answer the question, responses ranged from $0 to $1,000 per year; the median estimate is $25, the mean is $67 and the mode is $50. A significant percentage (49%) are not sure if they have received bill credits for 2014 and an additional 31% are sure that they did not receive bill credits; only 20% confirmed that they are aware of receiving bill credits during 2014. However some customers would not have received these credits until the November billing cycle, thus at the time of the survey they would have been correct to state that they had not received credits.
- Only 34% of participants were able to answer the question about how many activation events to expect per summer; however among this minority of customers, 85% correctly indicated that Power Manager is activated "as needed" based on the demand for electricity.
- Only 24% of participants are certain that their Power Manager device has been activated since they joined the program. When customers who are aware of event activations were asked to estimate the total number of events which occurred in 2014, nearly half (47%) say they don't know. Among those who were able to offer an estimate, the average response is 0.75 events and the median is zero events. There was a single one-hour test event in 2014, so in aggregate the minority of customers who are aware of events do have an accurate perception of the number of device activations this year.
- Only three surveyed participants are certain there was at least one event during the 2014 season, and all three reported that they were at home during the event. Among these customers, two (67%) reported a decline in comfort ratings during the event; one of these participants blamed Power Manager activation for their decline in comfort, while the other blamed rising temperatures.

- Only 15% of respondents say they are unclear about how the program works. Among those who have questions about the program, only one customer (8%) actually contacted Duke Energy for more information. This participant rated their satisfaction with the Duke Energy representative they spoke with at “10 out of 10”, the highest possible rating.
- Two-thirds (65%) of Power Manager participants indicate that they would be interested in a similar program that would cycle water heaters or other equipment and 13% are not sure. Among the 22% who are not interested, the predominant reason is that they have inappropriate water heaters for such a program (e.g., natural gas, on-demand, shared with other tenants).
- Participants are very satisfied with the Power Manager program. Overall, customers rate their satisfaction at an average of 8.9 on a ten-point scale where “10” is most satisfied. Using a five-point Likert scale[1], three-quarters (76%) give the highest possible “very satisfied” response. When asked to rate their likelihood of recommending Power Manager to others, their mean rating is 8.5 on a ten-point scale.
- Overall satisfaction with Duke Energy is also high among Ohio participants with a mean rating of 8.6 on a ten-point satisfaction scale.

[1] A Likert scale is a psychometric response scale used to ascribe quantitative values to a qualitative concept, such as agreement with a statement or satisfaction with a program. A Likert scale is a non-comparative scaling technique which is unidimensional (only measures a single trait) as well as bipolar and symmetrical (has a defined midpoint and equivalent extreme values).

Introduction and Purpose of Study

The purpose of this process study was to evaluate participant behavior, awareness of, and satisfaction with Duke Energy's Power Manager® Program as it was administered in Ohio.

Summary of the Evaluation

The evaluation was conducted by TecMarket Works and Matthew Joyce. The survey instruments were developed by TecMarket Works. The customer survey was administered and analyzed by TecMarket Works and Matthew Joyce.

Researchable Issues

1. Determine what percentage of program participants are aware of the occurrence of individual program events.
    - There was a single, one-hour test event in Ohio during the 2014 cooling season, thus awareness of program events cannot be determined this year because no regular events occurred.

2. Determine whether customer comfort or discomfort during a Power Manager event is affecting participant behavior.
    - There was a single, one-hour test event in Ohio during the 2014 cooling season, thus customers' response to program events cannot be determined this year because no regular events occurred.

3. Determine overall participant satisfaction with the Power Manager program.
    - In the participant survey, respondents' mean overall satisfaction rating for Power Manager is 8.9 on a ten-point scale where "10" means very satisfied. See *Thermostat Settings* on page 27.

4. Determine whether recommendations could be made to improve the program's design or operations.
    - Based on the findings of this evaluation, TecMarket Works concludes that the Power Manager program in the Ohio System is well-designed and operated. There are no recommendations based on the 2014 evaluation.

Description of Program

Duke Energy offers the Power Manager (PM) voluntary residential demand response program to their customers who are homeowners who have central air conditioning (AC) units with outside compressors that can be controlled by Duke Energy's load control technology. During the months of May through September on non-holiday weekdays, Duke Energy may cycle PM participants' ACs off and on for a period of time.

The PM program allows customers to select a target load reduction of either 1.0 kW or 1.5 kW. During an event, ACs on the 1.5 kW option would be cycled off for a few minutes longer over a 30 minute period than the 1.0 kW ACs. Customers with more than one central AC unit must have all units controlled in order to participate.

There are two types of events that may be implemented for PM, economic and emergency. Economic events may be called by Duke Energy when energy demand and/or prices are so high that curtailing energy use during this period would allow Duke Energy to save money, with the savings passed on to customers in the form of Power Manager incentives. Emergency events can be called by the PJM Regional Transmission Organization when high energy usage on hot days or other conditions threaten the reliability of the transmission system. For such an event, participants' ACs would be cycled off and on for the duration of the Power Manager emergency event.

Power Manager participants are allowed to opt out of one event per calendar month, by notifying Duke Energy 24 hours in advance through a toll free number.

At the time of enrollment, customers choose whether to have the AC cycled to achieve a 1.0 kW or 1.5 kW reduction. They are given a one-time incentive of $25 for choosing the 1.0 kW option and $35 for choosing the 1.5 kW option. For each event, participants are given an incentive depending upon the price of energy that day and the duration of the event, with a guaranteed minimum incentive each season of $5 for participants in the 1.0 kW option and $8 for participants in the 1.5 kW option. This incentive is given, through a bill credit, even if no events are called. In the cases where customers have more than one AC unit, incentives are given for each AC unit (all AC units must be enrolled). The incentives appear as a credit on their Duke Energy bill statement within the next month or two.

Participants who sign up but become reluctant to continue participating at these levels of reduction may be offered a 0.5 kW option in an effort to retain them on the program.

Program Participation

Power Manager Program	Participation Count for 2014
Customers	EOM Sept. 2014 = 45,344
Devices	EOM Sept. 2014 = 47,960

Methodology

Overview of the Evaluation Approach

Participant Surveys
TecMarket Works developed a customer survey for the Power Manager Program participants, which was implemented in October and November of 2014 after participants experienced control events during the summer of 2014.

The complete survey was conducted with a random sample of 80 Power Manager participants in Ohio. The responses from the 80 surveyed participants are included in the analysis for all questions which they were able to complete. These participants were surveyed by TecMarket Works. The survey can be found in *Appendix A: Participant Survey Instrument*.

Event and Non-Event Surveys
TecMarket Works normally conducts surveys throughout the cooling season to measure the effect of Power Manager activation events on program participants. However, during the 2014 cooling season there was a single, one-hour PJM test event in Ohio, and no regular activation events occurred. Therefore the results of Event and Non-Event surveys are not being reported this year, since the only activation event of the season was an atypical test event.

It is not possible to know how many activation events or high temperature non-event days will occur in a given territory until the cooling season has ended, since the conditions which trigger Event and Non-Event surveys are largely determined by the weather, and the weather cannot be accurately predicted more than a few days in advance. Seventy-four Non-Event surveys were conducted in Ohio throughout the summer of 2014, and 41 Event surveys were conducted following the one-hour PJM test event, so the approach and disposition for Event and Non-Event surveys are summarized in this section of the report, although the results of these surveys are not presented in this evaluation.

TecMarket Works conducts after-event phone surveys (Event surveys) to collect participant information for this evaluation. The survey was maintained in a “ready-to-launch” status until notified of a control event affecting switches used by Duke Energy. The surveys were launched as soon as possible following the end of the control event (at 5 p.m. Eastern) and continued over a 27-hour period with all call attempts made during regular surveying hours (10:00 a.m. to 8:00 p.m. Eastern Daylight Time, Monday through Saturday). For example, if a control event occurred on a Monday, calling hours for that particular event were:

- Monday 5 p.m.-8 p.m. Eastern
- Tuesday 10 a.m.-8 p.m. Eastern

Event surveys followed the PJM test event which occurred on August 26, 2014; TecMarket Works surveyed a total of 41 participants in Ohio.

Before we asked the participants about the event, we inquired if they knew that there was a control event within the last two days so that we could understand if they are able to identify when a control event had occurred. The surveyor then notified the customer that they had just had a control event which had begun at <*start hour of control*> and ended at <*end hour of control*>. This allowed the participants to immediately recall the time period of the event and be able to respond to questions regarding the impact of that event on their use of their air conditioner and allow recollection of other actions taken, as well as the impact of the event on their comfort. Once informed of the event that had just occurred, the survey also assessed satisfaction with the program at the point of an event.

TecMarket Works also called Power Manager participants on hot days without control events to conduct the same survey (with slight wording alterations). This survey was conducted on non-event days when the outdoor high temperature was 90°F or more at Cincinnati's major regional airport located in Covington, Kentucky. On and following the high temperature dates of June 17, June 18, July 22, August 27 and September 5, 2014, TecMarket Works surveyed at total of 74 Power Manager participants in Ohio.

The schedule of Power Manager event days and non-event high temperature days used for this survey in Ohio is shown in Table 1, along with the daily high temperatures recorded at the Cincinnati/Covington airport.[2]

Table 1. Schedule of Event and Non-Event High Temperature Days in Ohio

Event ID	State	Type	Event Date	Event Hours	Date of Survey	High temp CVG
OH-nonevent1	OH	Non-Event	17-Jun-14	NA	17-Jun-14	89
OH-nonevent1	OH	Non-Event	17-Jun-14	NA	18-Jun-14	
OH-nonevent2	OH	Non-Event	18-Jun-14	NA	18-Jun-14	89
OH-nonevent2	OH	Non-Event	18-Jun-14	NA	19-Jun-14	
OH-nonevent3	OH	Non-Event	22-Jul-14	NA	22-Jul-14	91
OH-nonevent3	OH	Non-Event	22-Jul-14	NA	23-Jul-14	
OH-event1	OH	PJM Test Event	26-Aug-14	4:00 to 5 p.m.	26-Aug-14	90
OH-event1	OH	PJM Test Event	26-Aug-14	4:00 to 5 p.m.	27-Aug-14	
OH-nonevent4	OH	Non-Event	27-Aug-14	NA	28-Aug-14	92
OH-nonevent5	OH	Non-Event	5-Sep-14	NA	5-Sep-14	89

[2] High temperatures inTable 1 are taken from historical data at wunderground.com.

Data Collection Methods, Sample Sizes, and Sampling Methodology

Participant Surveys

From the list of customers, 578 participants were called between October 24 and November 12, 2014, and a total of 80 usable telephone surveys were completed yielding a response rate of 13.8% (80 out of 578).

Event and Non-Event Surveys

From the list of customers, 1,099 participants were called between June 17 and September 5, 2014, and a total of 115 usable telephone surveys (41 Events and 74 Non-Events) were completed yielding a response rate of 10.5% (115 out of 1,099). [3]

Expected and achieved precision

Participant Surveys

The survey sample methodology for the full participant survey had an expected precision of 90% +/- 9.1% and an achieved precision of 90% +/- 9.1%.

Event and Non-Event Surveys

No results from these surveys are presented in this evaluation, due to a lack of regular activation events in Ohio during 2014. See *Overview of the Evaluation Approach* on page 7.

Number of completes and sample disposition for each data collection effort

Participant Surveys

The participant survey was conducted using a random sample of 4,992 Power Manager participants in Ohio; there were 80 customers willing to participate in the survey.

Event Surveys

The Event surveys were conducted on and following a Power Manager device activation event that occurred on August 26, 2014 (this activation was a PJM test event). TecMarket Works surveyed a total of 41 Power Manager participants.

Non-Event Surveys

The Non-Event surveys were conducted on and following high temperature dates between June 17 and September 5, 2014. TecMarket Works surveyed a total of 74 Power Manager participants.

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

There is a potential for social desirability bias[4] but the customer has no vested interest in their reported program participation, so this bias is expected to be minimal.

[3] Due to the sampling design of this survey, reporting the number of calls and response rate separately for Event and Non-Event groups would not be accurate. Event and Non-Event survey calls are made using the same participant list, and in some cases calls to the same participants may be attempted for both Event and Non-Event surveys. The only difference between Event and Non-Event participants is whether they are surveyed after an activation event or a high-temperature day without an activation event.

Evaluation Dates

Evaluation Component	Dates of Surveys
Participant Surveys	10/24/14 – 11/12/14
Event and Non-Event Surveys	6/17/14 – 9/5/14

[4] Social desirability bias occurs when a respondent gives a false answer due to perceived social pressure to "do the right thing."

Participant Survey Results

TecMarket Works successfully surveyed 80 randomly selected program participants in Ohio. This section presents the results from these surveys. The instrument can be found in *Appendix A: Participant Survey Instrument*.

The results from the completed phone survey are discussed below. Participant demographics and other descriptive information can be found in *Appendix B: Participant Survey Customer Descriptive Data*.

Program Awareness

A large majority (91.3%) of survey participants reported that they were involved with the decision to participate in the Power Manager Program, as shown in Table 2. Only 3.8% of respondents said they were not involved, and the same percentage indicated that the Power Manager device had been installed by a previous occupant prior to the time they moved in.

Table 2. Were You Involved in the Decision to Participate in Duke Energy's Power Manager Program?

Were you involved in the decision to participate in Duke Energy's Power Manager Program?	**Count**	**Percent (N=80)**
Yes	73	91.3%
No	3	3.8%
It was already installed when I moved in.	3	3.8%
Don’t know	1	1.3%

Four-fifths (80.8%) of customers who participated in their household’s decision to sign up for Power Manager were able to recall how they first heard about the program. Two-thirds of these respondents (68.5%) said that they first learned about the program through mail they received from Duke Energy, while telemarketing calls from Duke Energy were the second-most common method of learning about the program (12.3%). The full range of responses is shown in Table 3 below.

Table 3. How Participants First Learned of the Power Manager Program

What are some of the ways you heard about the Power Manager Program?	**Count**	**Percent (N=73)**
Mail from Duke Energy	50	68.5%
Telemarketing call from Duke Energy	9	12.3%
TV, radio, newspaper	2	2.7%
Duke Energy website	1	1.4%
Internet research	1	1.4%
Don't recall	14	19.2%

Note: Multiple responses were allowed per participant.

Program Enrollment

Reasons for Joining the Program

Participants who were involved in the decision to participate in the program were asked to name the reasons they joined the Power Manager program. Respondents were asked to state their “main reason” and also to name any secondary reasons. By far the most popular reason for joining the program was to save money with a combined total of 63.0% of respondents giving this as a primary or secondary reason. Helping to avoid power outages was the second-most frequently mentioned reason (24.7%), while bill credits and helping the environment are tied as the third-most frequent response (17.8%), as shown in Figure 1. These results differ somewhat from the 2013 survey; in last year’s survey, saving money (39.1%) and saving energy (34.8%) ranked first and second, while bill credits and helping to avoid outages (26.1%) were tied for the third-most mentioned reasons; the most dramatic change is far more participants mentioning in 2014 that they joined the program to save money ($p<.05$ using Student’s t-test).

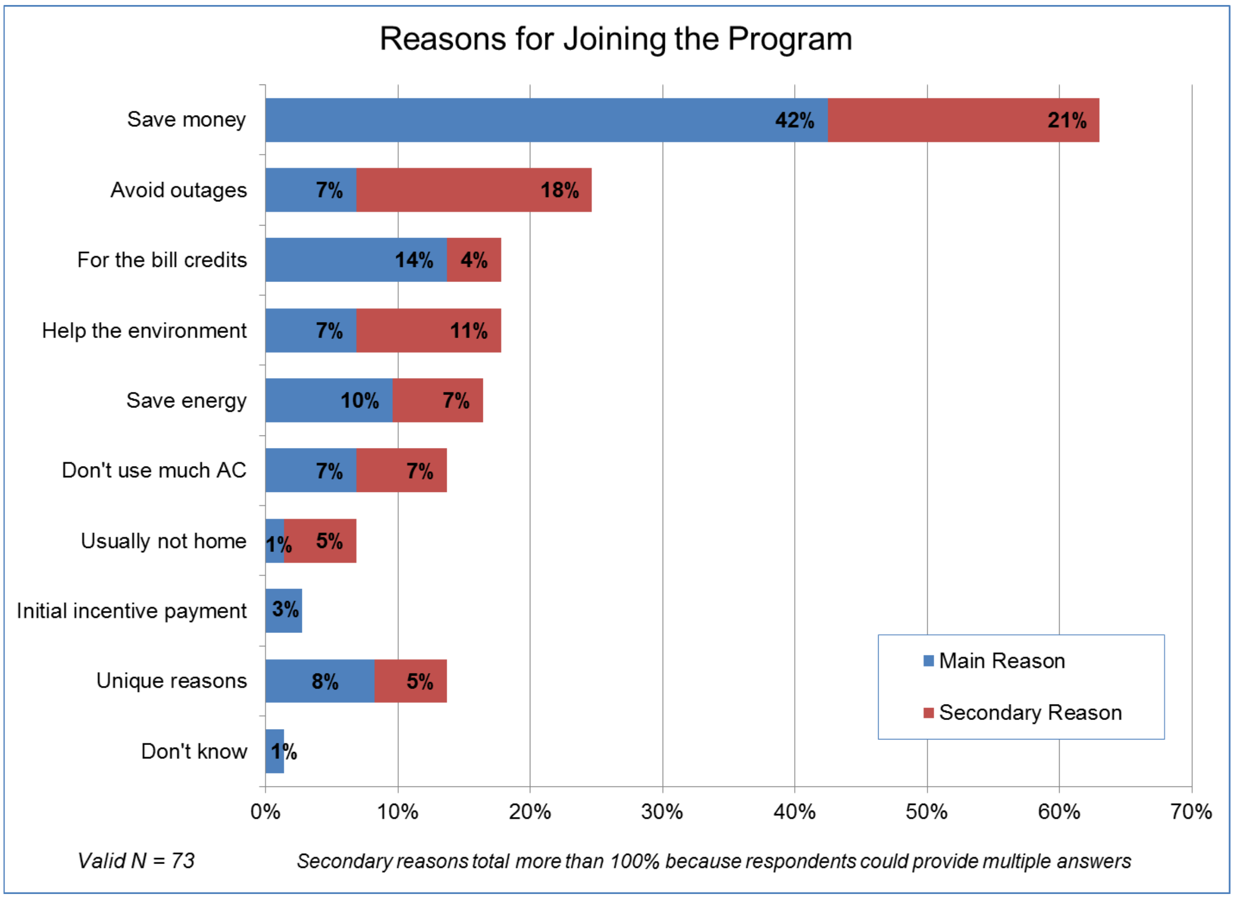

Figure 1. Reasons for Joining the Program

About one participant in six (17.8%) mentioned “helping the environment” as a motive for participating in the program. When asked to explain what they mean by “helping the environment,” most of these respondents mentioned conserving energy (six respondents) or reducing emissions (four respondents). Customers who reported unique reasons for participation cited civic responsibility, anticipating little effect on comfort and family testimonials about the program.

Participant Understanding of the Program

During the time of program enrollment Duke Energy provides new program participants with information about how the program works. When asked if they recalled this information, 71.2% of respondents remembered the explanatory information, while 17.8% could not recall it and 11.1% were unsure. Among customers who recalled this information about how the program works, satisfaction with the explanatory information is high with an average rating of 8.80 on a 10-point scale with "1" being not at all satisfied and "10" being very satisfied. A majority (57.7%) of respondents rated their satisfaction a "9" or "10", compared to just 9.6% giving ratings of "7" or lower (Figure 2). When participants who gave ratings of "7" or lower were asked to explain what could be done to improve this situation, three out of four respondents wanted an annual reminder about how the program works and the fourth wanted a phone call from a Duke Energy representative.

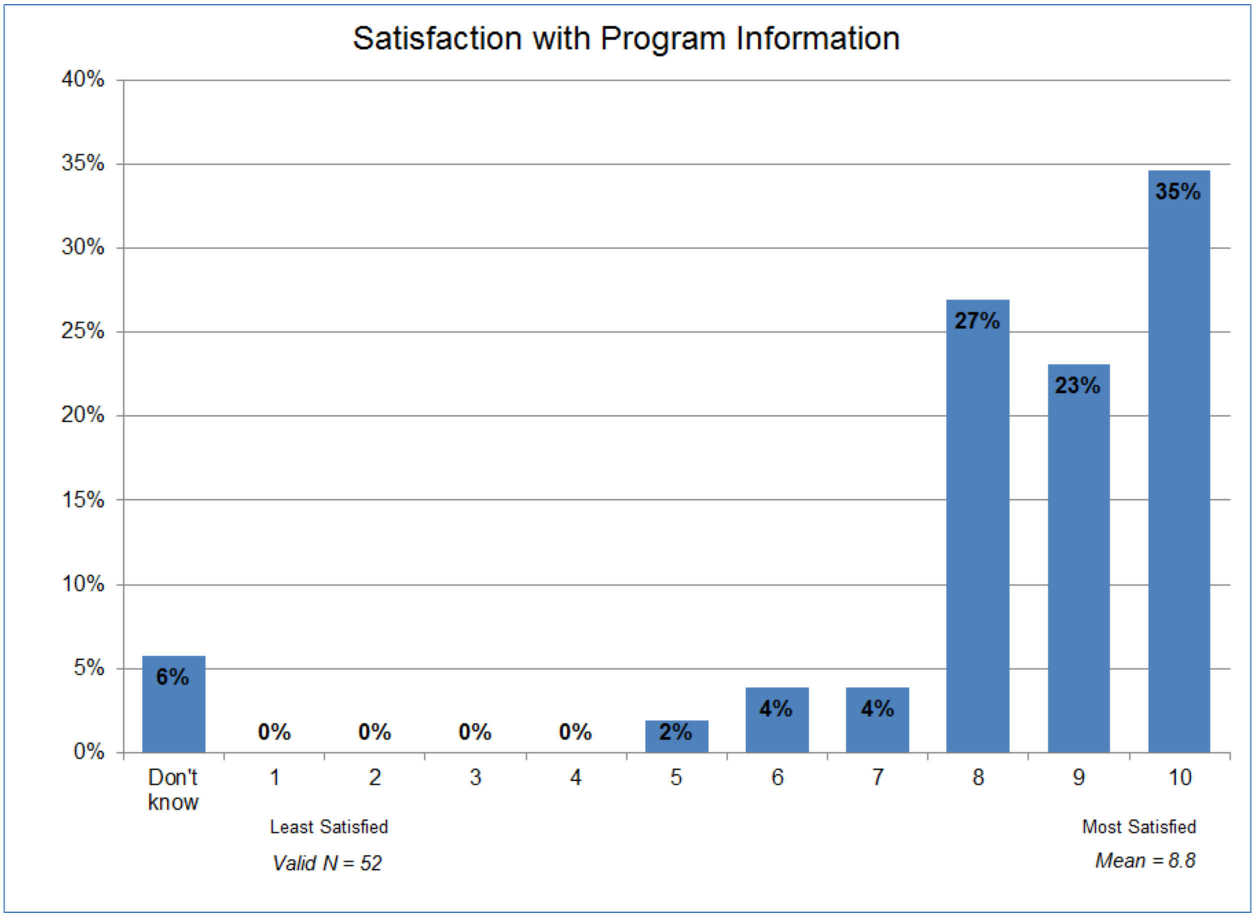

Figure 2. Satisfaction with Program Explanation among Carolina System Customers

Satisfaction with the Enrollment Process

An even higher percentage of Ohio participants indicated that they are satisfied with the program's enrollment process, returning a mean satisfaction rating of 9.43 on the same ten-point scale. In all, 83.6% rated their satisfaction with the enrollment process at “9” or “10”. Only one respondent gave a rating of “7” or lower, explaining: “*I was dissatisfied with the enrollment process because the program was not thoroughly explained. After I enrolled, Duke should have followed up with a phone call to answer questions and quell concerns.*” Figure 3 shows the distribution of satisfaction ratings.

Participants who receive their utility bills from third party companies give the enrollment process a significantly higher mean satisfaction rating (9.58 based on 50 ratings) compared to participants whose utility bills come directly from Duke Energy (9.05 based on 19 ratings; significant at p<.10 using ANOVA).

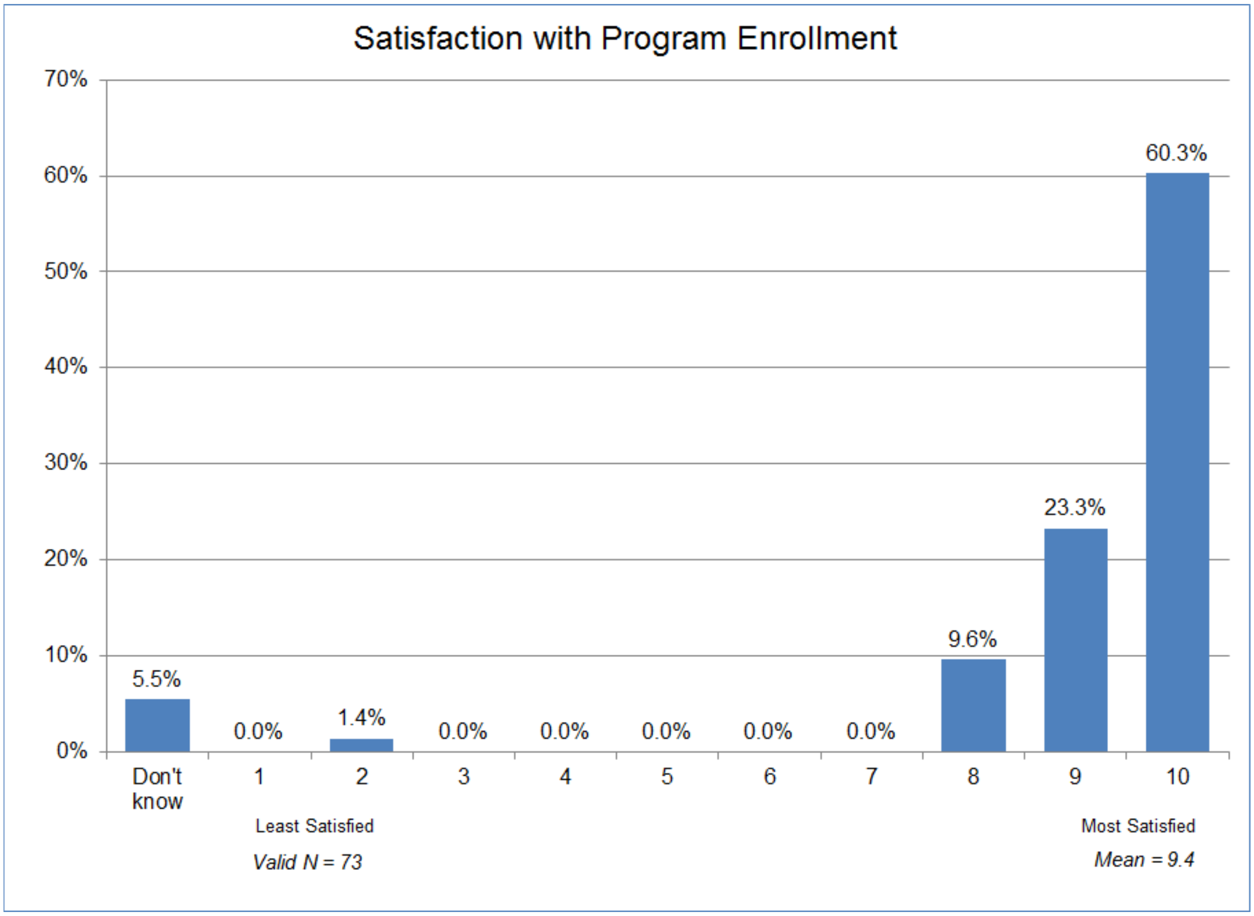

Figure 3. Satisfaction with Program Enrollment

Expectations of Monetary Incentives for Participation

When survey respondents were asked how many dollars they receive in bill credits per year for their participation in the Power Manager program, 67.5% could not provide an estimate, saying they didn’t know. Among the 32.5% who were able to estimate the amount of bill credits they receive, answers varied widely from a low of zero to a high of $1,000. The median estimated annual total for bill credits is $25, the mean is $67 and the mode is $50; the distribution of responses is shown in Table 4. During 2014, there was a single one-hour test event, so participants received the minimum annual bill credits of $5 or $8 depending on their enrollment option.[5]

Table 4. Expected Bill Credits for Participating in Power Manager

What's your best estimate of how many dollars you will receive in yearly bill credits for participating in the program?	**Count**	**Percent (N=80)**
None	2	2.5%
Less than $10	2	2.5%
$10 to $24.99	9	11.3%
$25 to $50	9	11.3%
More than $50	4	5.0%
Don't know	54	67.5%

When participants were asked if they had received any bill credits during 2014 for their participation in the Power Manager program, a significant percentage (48.8%) said that were not sure, and an additional (31.3%) reported that they did not receive any bill credits. In all, only 20.0% of Ohio participants are aware of receiving bill credits during 2014.[6] Customers who receive their utility bills directly from Duke Energy are slightly more likely to confirm that they have received credits in 2014 (28.6%) compared to customers who are billed by third parties (16.9%), though this difference is not statistically significant.

In a follow up question, the 16 participants who recall 2014 bill credits were asked how many times they noticed the bill credits this cooling season: Half (50.0%) reported seeing the credits "once" or "twice," while 37.5% recalled seeing credits at least three times or on "every bill this summer," which could be considered technically correct depending up the timing of their October billing cycle. The full range of times that program participants noticed their bill credits is shown in Table 5.

Table 5. Participant Awareness of Bill Credits Received

How many times have you noticed the Power Manager credits on your bill this summer?	**Count**	**Percent (N=16)**
Once	4	25.0%
Twice	4	25.0%
Three times	2	12.5%
Four or more times	1	6.3%
Every bill this summer	3	18.8%
Other	0	0.0%
Don't know	2	12.5%

[5] Ohio customers who choose the 1.0 kWh option are paid a $25 incentive on sign-up and receive a minimum annual bill credit of $5; customers who choose the 1.5 kWh option are paid $35 on sign-up and receive minimum annual credits of $8.

[6] These credits were reported on October and November billing statements, so some customers would not have seen their bill credits at the time of this survey (interviews concluded on November 12, 2014). Duke Energy confirmed that all surveyed participants have received the appropriate credits on their bills for activation events.

Expectations of Power Manager Events

Surveyed participants were asked how many times Duke Energy said it would activate the Power Manager device on their air conditioners in a summer; only 33.8% said they had specific expectations about the number of activation events to expect per cooling season, while the rest were not sure. Among the 27 participants who were able to answer this question, 85.2% correctly indicated that Power Manager is activated "as needed" based on the demand for electricity (Table 6).

Table 6. Participant Recall of How Often Duke Energy Said It Would Activate the Power Manager Device

How many times per year did Duke Energy tell you it would activate the Power Manager device on your air conditioner?	Count	Percent (N=27)
Activated as needed / when demand is high	23	85.2%
Once per month	2	7.4%
Once per week to once per month	1	3.7%
Once per day for 15 minutes when at peak load	1	3.7%

Understanding the Program and Getting More Information

When queried about their understanding of the program, a minority of survey respondents report that something about the program was unclear to them: Only 15.0% report having questions about how the program works, compared to 73.8% who feel that they have a good understanding of the program and 11.3% who are not sure.

When asked what it was that they were unclear about, some respondents explained that they had remaining questions about the number and timing of activation events and bill credits, but half of these respondents (50.0%) merely expressed a general lack of clarity about how the program works. Table 7 shows the type and frequency of participant questions about the program, while the list below provides verbatim examples to illustrate each category.

Table 7. Participant Understanding of How the Program Works

Topic or issue requiring clarification	Count	Percent (N=12)
How the program works overall	6	50.0%
Frequency and timing of activation events	3	25.0%
Bill credits	2	16.7%
Benefits of the program	1	8.3%

Note: Multiple responses were allowed per participant.

Examples of Participants' Questions about the Program

- *I am unaware of the specifics of the program; Duke Energy could provide more information to customers that inherit the device from the previous homeowners.*
- *I am unclear about pretty much everything regarding the program.*
- *I am unclear about the monthly bill credits.*
- *I am unclear about the number of times per year that Duke Energy activates the device and for how long of an interval it typically does so.*

- *I've forgotten a lot about the program, but when we signed up for it I felt like I knew enough about the program to go ahead and sign up.*

A follow-up question asked participants who are unclear about the program if they have contacted Duke Energy for further information. Only one customer said they had done so (8.3% of those with questions about the program), and they rated their satisfaction with the Duke Energy representative they spoke with at "10 out of 10," the highest possible rating.

Awareness and Response to Activation

A sizeable majority of participants (71.3%) said they are unaware if their Power Manager device has been activated since they joined the program, compared to about a quarter (23.8%) who said they are aware of device activations and 5.0% who indicated they are unsure (Table 8). However there is a large difference between the awareness levels of "Duke Energy customers" (those who receive their bills directly from Duke Energy) and "Non-Duke Energy customers" (those who are billed by other companies): nearly a third of Non-Duke customers (30.5%) claim to be aware of events versus only 4.8% of Duke Energy customers (significantly different at $p<.05$ using Student's t-test).

Table 8. Awareness of Power Manager Activation since Joining the Program

Are you aware of any times when Duke Energy may have activated your Power Manager device since you joined the program?	**Duke Energy Customers (N=21)**	**Non-Duke Energy Customers (N=59)**	**All Participants Surveyed (N=80)**
Yes	4.8%	30.5%	23.8%
No	90.5%	64.4%	71.3%
Don't Know	4.8%	5.1%	5.0%

When the 19 respondents who were aware that their Power Manager device had been activated were asked how they knew this to be the case, a majority (57.9%) cited rising home temperatures while another 31.6% are aware of activations when they notice that their air conditioner "shuts down" (cycles off), as shown in Figure 4. The participant who gave a unique response stated: "*The AC was making the weirdest fan noise ever; a buzzing mechanical noise*."

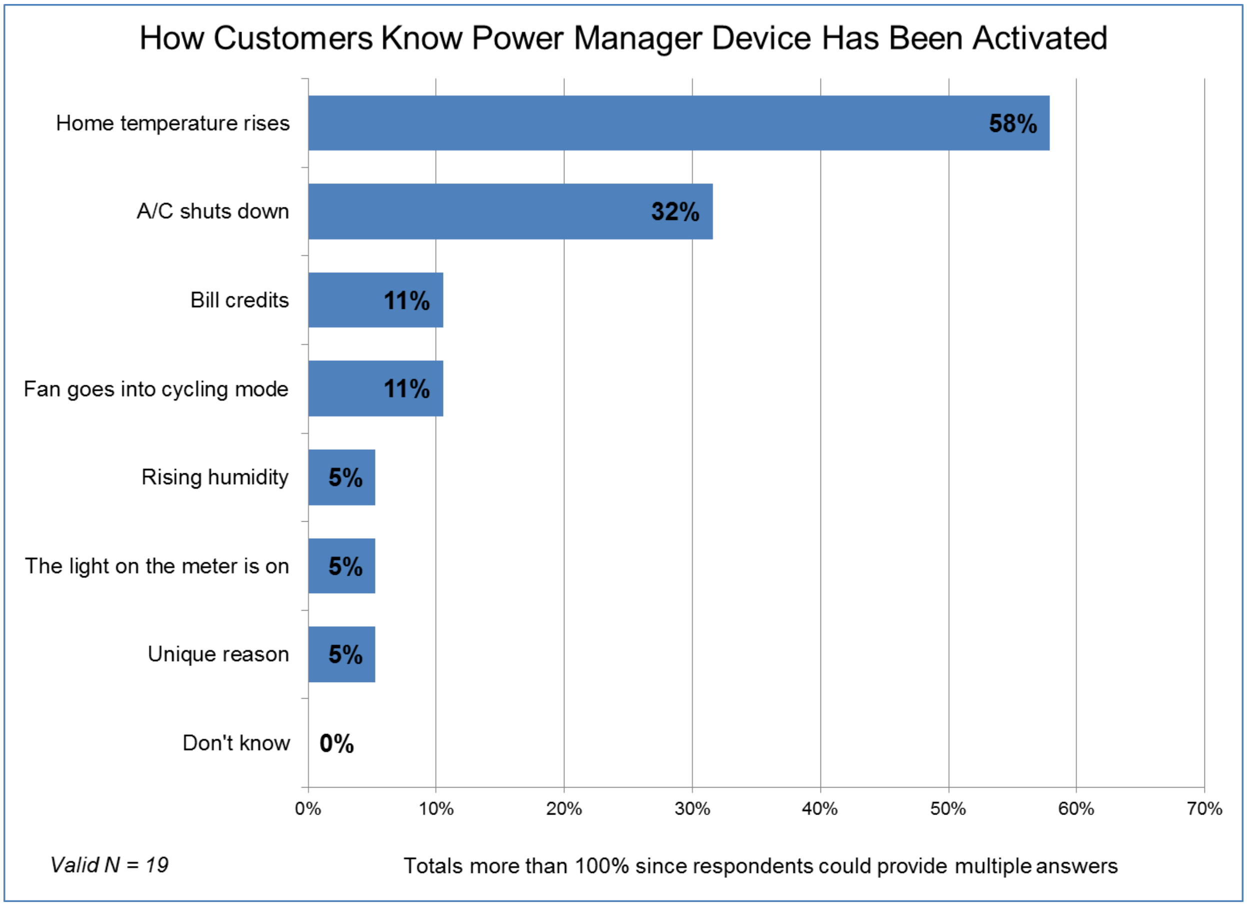

Figure 4. Customer Awareness of Device Activation

Survey participants were asked how many times they believe their Power Manager devices have been activated during 2014; nearly half (47.4%) said that they believe there had been no device activations this year, as shown in Table 9. Another third of participants (36.8%) said that they did not know how many events occurred. Among the three participants who reported a specific number of events for 2014, responses range from “twice” to “four to six times”; among the twelve participants able to estimate the number of events, the mean is less than one activation event and the median is zero events. Overall, these estimates are quite accurate for Ohio participants in 2014, when there was a single one-hour test event during the entire summer (see *Table 1. Schedule of Event and Non-Event High Temperature Days in* Ohio on page 8).

All three of the participants who reported being aware of 2014 activation events are Non-Duke Energy customers (their utility bills are sent by third party companies); the only Duke Energy customer who was aware of their device having been activated since they joined the program said that they “don’t know” if there were any events during 2014.

Table 9. Perceived Number of Power Manager Activations in 2014

During the summer of 2014, about how many times do you believe Duke Energy activated your Power Manager device?	**Count**	**Percent (N=19)**
Zero (no activations)	9	47.4%
Twice	2	10.5%
Four to six times	1	5.3%
Don't know	7	36.8%

All three of the participants who believe that there was at least one activation event during the 2014 season reported that they were at home during at least one of these events, and so were asked follow-up questions about their response to the perceived device activation. The sample size of three participants who reported being at home during 2014 activation events is too small to make any generalizations or statistical conclusions about this subgroup; the key finding is that overall only 3.8% of surveyed participants reported that they were home during activation events, while 96.3% either believed there were no events or were not sure if there were any events.

TecMarket Works asked the respondents who reported being at home during control events to think back to the event time and then to rate their comfort before and during the event using a 1-to-10 scale with "1" being very uncomfortable and "10" being very comfortable. Prior to the event, comfort ratings ranged from "5" to "10", with a mean of 7.0. During the event, comfort ratings dropped to a mean of 6.0, with declines ranging from 0 to 2 points on a ten-point scale (Table 10). The difference between "before" and "during" ratings is not statistically significant, in part due to a very small sample size.

Table 10. Comfort Ratings Before and During Control Events (All Respondents At Home During Event)

	Rating before event (N=3)	**Rating during event (N=3)**	**Change**
Mean	7.0	6.0	-1.0
Median	6.0	4.0	-2.0

Two out of three participants (66.7%) who recall being at home during a 2014 event reported a decline in comfort during the event, which means that in total only 2.5% of 80 Ohio participants surveyed reported a comfort decline during an event in 2014. When these two participants were asked what they believe caused their decline in comfort, one blamed rising temperatures (50%) and the other blamed Power Manager activation (50%). Thus in total, only 1.3% of 80 Ohio participants surveyed blame Power Manager for a decline in comfort during a 2014 activation event.

The three survey respondents who reported being home during at least one device activation event in 2014 were asked to estimate the number of times that they think Power Manager affected their comfort level. One of these participants reported that Power Manager affected their comfort "zero" times in 2014, while the other participants estimated that their comfort was affected "once" and "four times."

The two participants who reported a decline in comfort during a 2014 event were asked how long it took for their comfort level to return to normal after the activation event: One indicated it took less than one hour, while the other said it took three to four hours for their comfort level to return to normal.

The 19 surveyed participants who are aware that their devices have been activated since they joined the program were asked to estimate how many hours the Power Manager device typically controls their air conditioners; their estimates ranged from five minutes to five hours, with a mean estimate of 2.4 hours and a median estimate of 3.0 hours.[7] The distribution of responses is categorized in Figure 5.

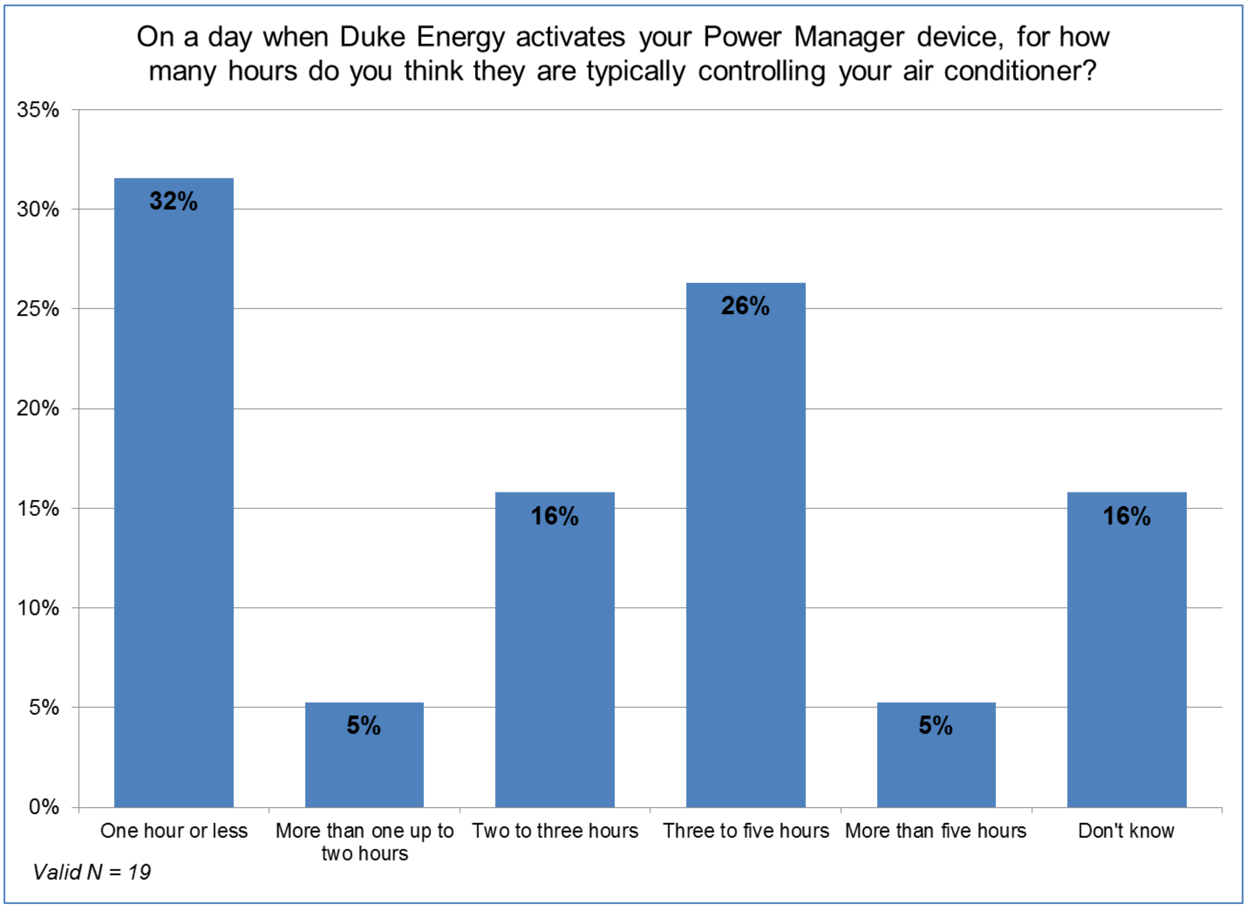

Figure 5. Perception of the Length of Power Manager Activations

The 19 participants who are aware that their devices have been activated since they joined the program were also asked what time of day they think the Power Manager device stops

[7] In Ohio during 2014 there was a single one-hour test event. However estimates in the 2.5 to 3.0 hour range are accurate for event times during summers when there are normal (non-test) activation events.

controlling their air conditioners after a typical activation event. As shown in Figure 6, a majority of program participants (52.6%) gave ending times of either 5:00 p.m. or 6:00 p.m., which aligns with typical event ending times. The range of perceived ending times spans from 4:00 p.m. to 9:00 p.m., and the median response is 6:00 p.m.

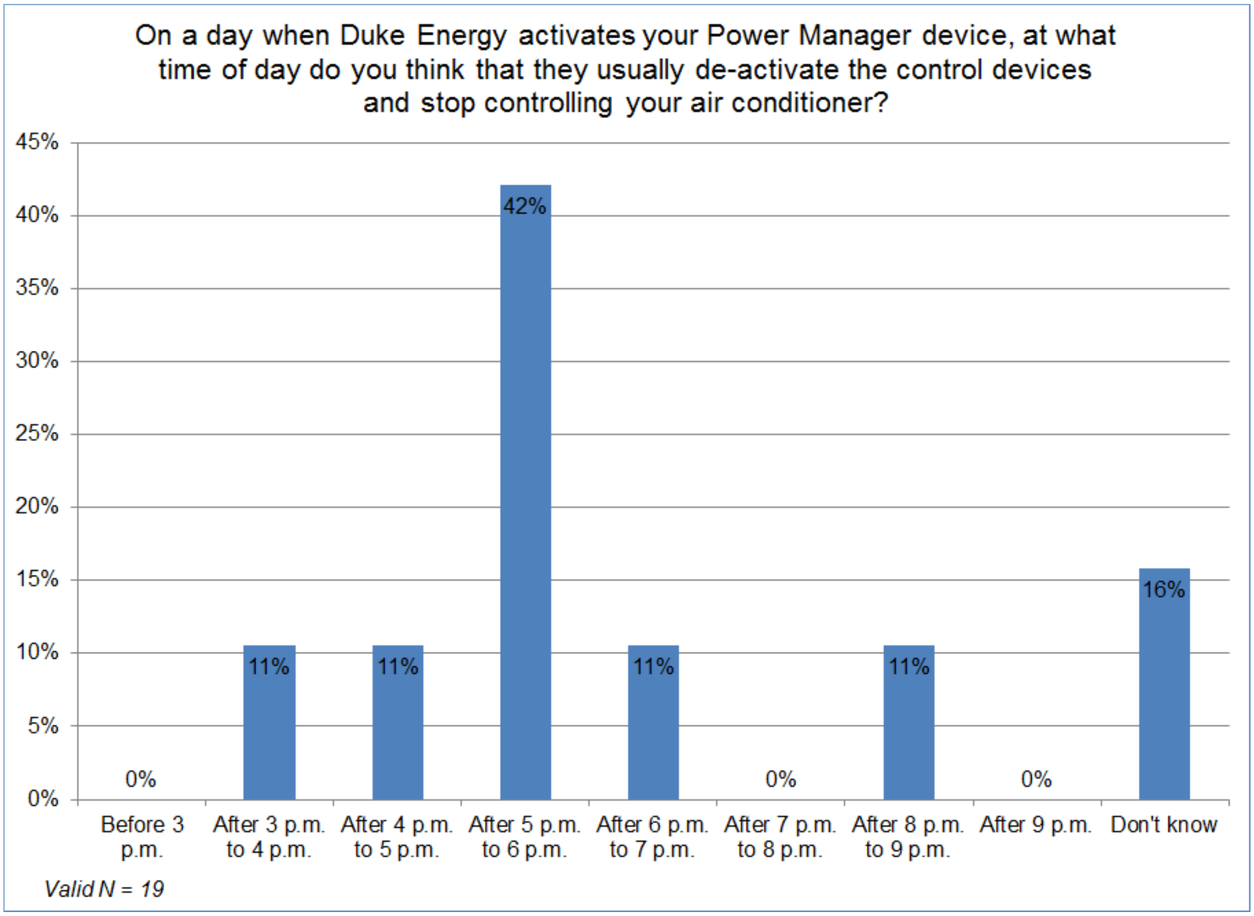

Figure 6. Perception of the Ending Times of Power Manager Activations

Only three surveyed participants reported being at home during a 2014 Power Manager event, so only these three customers were asked what, if any, actions they took in response to the high temperatures that day. One participant who reported a decline in comfort during the event reported that they adjusted their thermostat down from 84 to 79 degrees during the event and then took no further actions. The other participant who reported a decline in comfort turned on fans but did not adjust the thermostat, while the participant who was at home but whose comfort was not affected did not take any action at all (Table 11). Thus overall, only 1.3% of surveyed participants reported setting their thermostat lower during a 2014 activation event.

Table 11. Actions Taken During Power Manager Activation Events in 2014

Participants who were at home during a 2014 event	**Count**	**Percent (N=3)**
Adjusted thermostat settings	1	33.3%
Did not adjust thermostat settings	2	66.7%
Turned on fans	1	33.3%
Wore less clothing	0	0.0%
Opened windows	0	0.0%
Closed blinds / shades	0	0.0%
Turned on room / window AC	0	0.0%
Moved to a cooler part of the house	0	0.0%
Nothing else (continued normal activities)	2	66.7%

Note: Multiple responses were allowed per participant.

Air Conditioner Use and Maintenance

The Power Manager program in Ohio is successfully enrolling participants who routinely use their air conditioners throughout the cooling season and are therefore likely to be affected by Power Manager activation events. All participants surveyed use their air conditioning during the summer (0% use it “not at all”) and more than a third (36.3%) of program participants report using their air conditioners on a daily basis during the cooling season. Only 10.0% say that they reserve air conditioning for only the hottest days of the season (Figure 7).

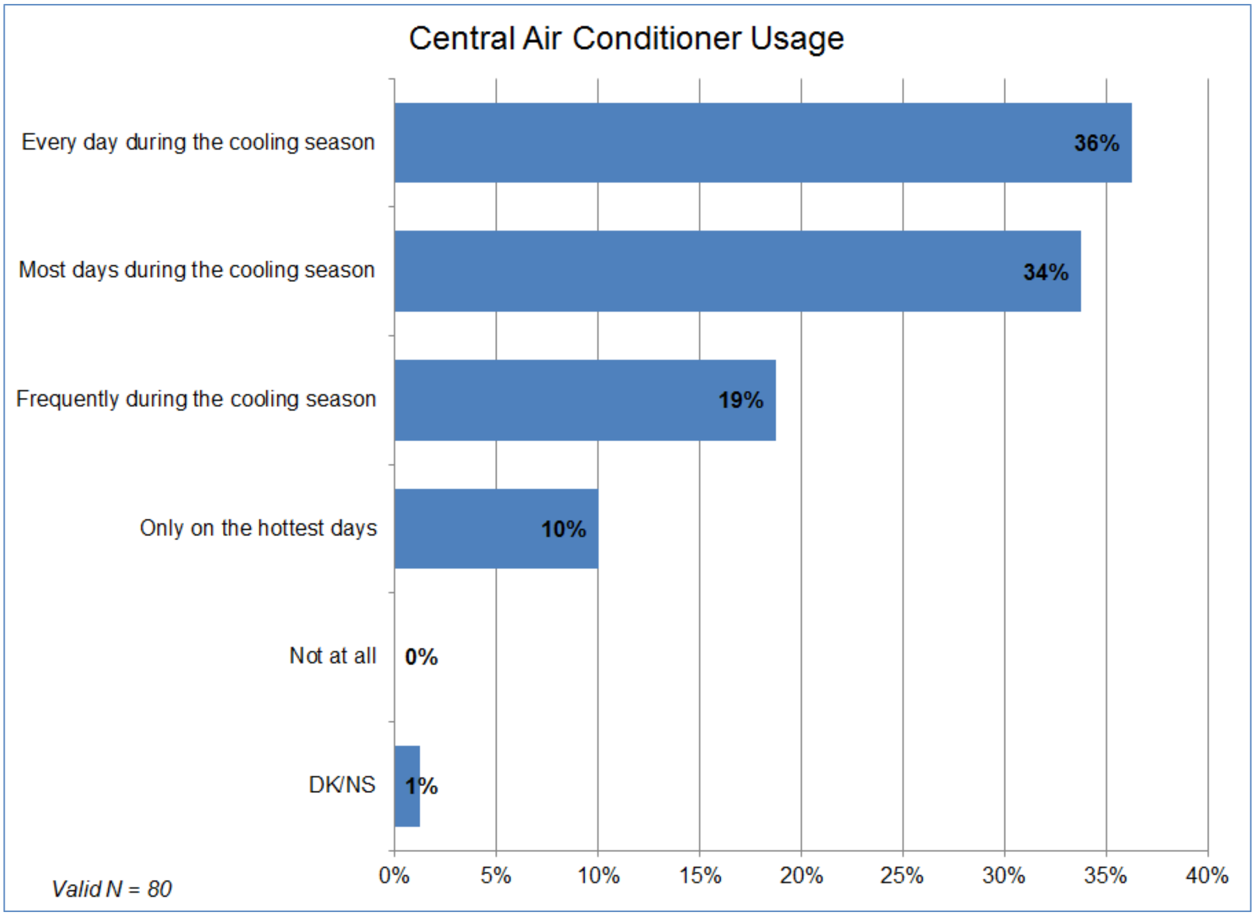

Figure 7. Frequency of Air Conditioner Use

More than two-thirds of participants surveyed (71.3%) report that they use their air conditioners to keep someone comfortable at home during weekday summer afternoons before 6:00 p.m., while virtually all participants (97.5%) use air conditioning to keep someone cool at home after 6:00 p.m.

Table 12. Typical Air Conditioner Usage on Summer Weekdays

Is the air conditioning typically used to keep someone at home comfortable during . . . ?	**Count**	**Percent** (N=80)
Weekday summer afternoons before 6 p.m.	57	71.3%
Summer weekdays after 6 p.m.	78	97.5%

As seen in Table 13, a majority of surveyed participants (70.0%) report having their air conditioners serviced since joining the Power Manager program.

Table 13. Air Conditioner Maintenance

Have you had your air conditioner tuned-up or serviced since you enrolled in the Power Manager program?	**Count**	**Percent** (N=80)
Yes	56	70.0%
No	23	28.8%
Don't know	1	1.3%

Among participants who have had their air conditioners serviced, a majority (51.8%) report that they do not know if their Power Manager device was disconnected during servicing (Table 14), which is not surprising since these services are likely to be performed by a hired professional. Among the minority of customers who know if their device was disconnected or not, more than twice as many respondents report that their device was not disconnected (33.9%) compared to those who report that their device was disconnected (14.3%).

Table 14. Power Manager Device Disconnected During Air Conditioner Maintenance

Was the Power Manager device disconnected while your air conditioner was being serviced?	**Count**	**Percent** (N=56)
Yes	8	14.3%
No	19	33.9%
Don't know	29	51.8%

Among the eight participants who report that their Power Manager devices were disconnected, five (62.5%) are confident that the devices were reconnected, while two customers (25.0%) said their devices were not reconnected, and one (12.5%) was not sure. Overall, this represents at least 3.6% of the participants who had their air conditioners serviced reporting that their devices were not reconnected afterwards (though this rate could be much higher due to half of these participants not knowing whether their devices had been disconnected or not). When the two customers whose devices remained disconnected were asked why their devices had not been reconnected, one participant was unsure while the other said: "*I had my air conditioning unit replaced this summer. The contractor disconnected the Power Manager device and instructed me to call Duke Energy to have the device reconnected. I simply neglected to call Duke to have the device reconnected.*"

Outside Temperatures and Thermostat Settings

Personal comfort levels are necessarily subjective, so Power Manager participants were asked to think of a hot, humid summer day and consider at what outside temperature they begin to feel uncomfortable. Their responses spanned a range from as low as 69° to 72° Fahrenheit up to 91° to 94° Fahrenheit. The median and modal temperature range of discomfort is 85° to 87°. Figure 8 also shows that 15.0% of participants report that they feel uncomfortable when the outdoor temperature is 78° or less, while a mere 3.8% don't begin to feel uncomfortable until the mercury climbs to 91° or higher and all surveyed participants become uncomfortable before the outdoor temperature reaches 95°.

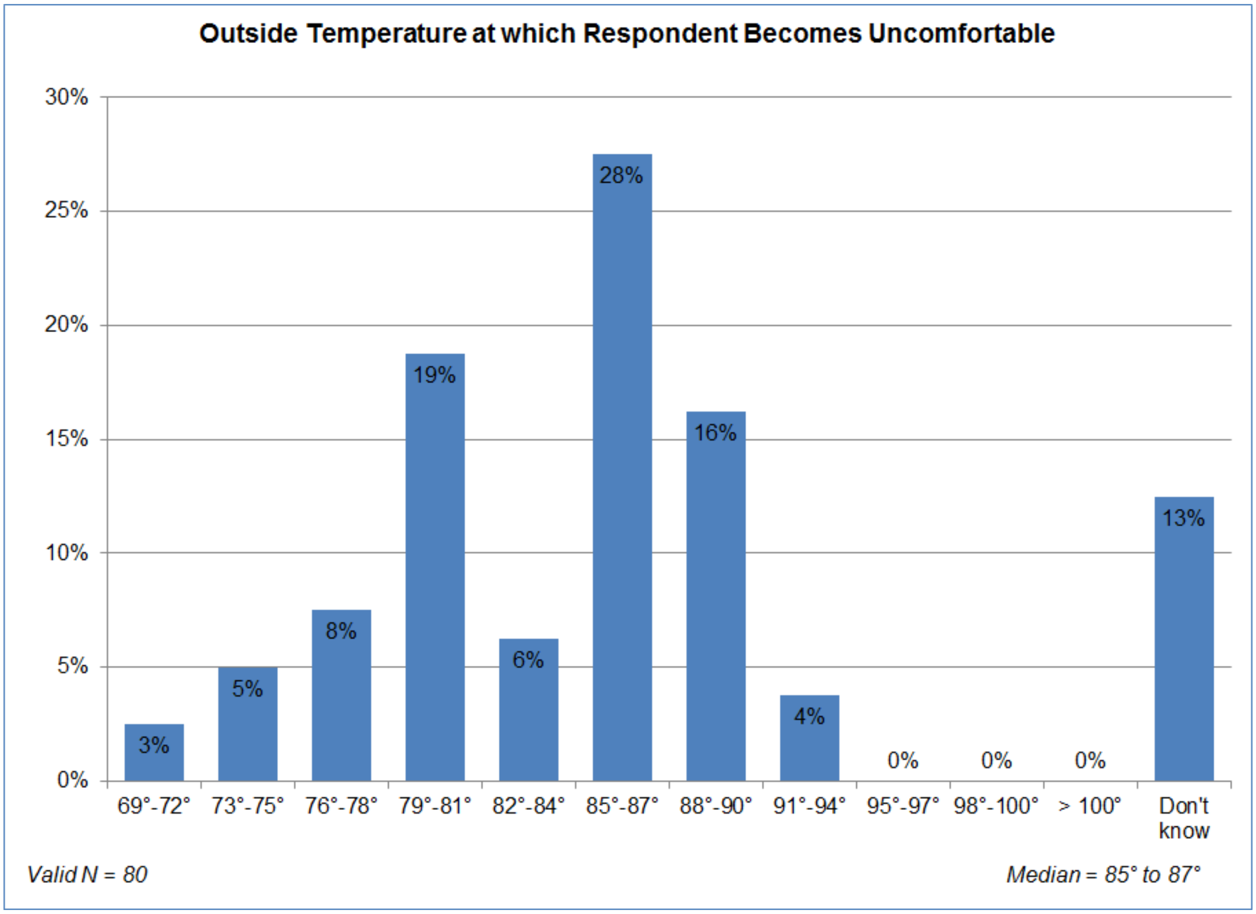

Figure 8. Outside Temperatures at Which Participants Feel Uncomfortably Warm

Participants were also asked for the outside temperature at which they tend to turn on their air conditioners (Figure 9). The median and modal outside temperature range at which air conditioners are turned on is 79° to 81°, which is two categories (about 6°) cooler than the median outdoor temperature at which customers become uncomfortable in their homes.

One participant in eight (12.5%) turn on their AC units when the outdoor temperature is 78° or lower and 17.5% do not turn on cooling until the outdoor temperature rises to 85° or higher. In lieu of giving actual temperatures, another 22.5% of customers said their settings are “programmed into the thermostat.” All Ohio participants surveyed who do not program their thermostats turn on their air conditioning before the outdoor temperature reaches 88°.

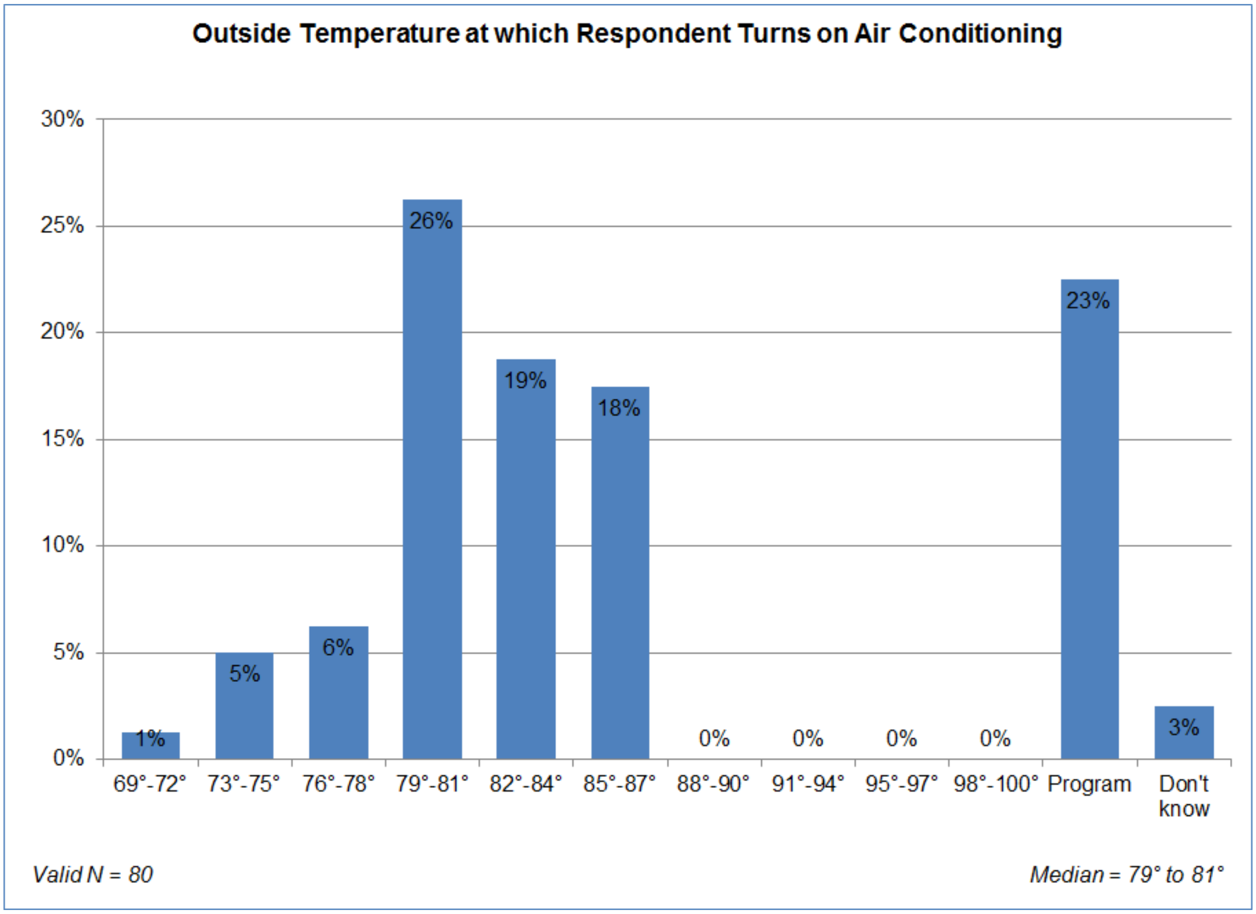

Figure 9. Outside Temperatures at which Participants Turn On Their Air Conditioners

When the temperature points from Figure 8 (discomfort) and Figure 9 (when participants turn on their air conditioners) are compared, it reveals that half (50.0%) of participants turn on their AC units before outdoor temperatures become uncomfortable and 37.9% wait until temperatures have reached the point of discomfort to turn their units on (Figure 10); just 12.1% wait until outside temperatures are higher than the point of discomfort to turn their units on.

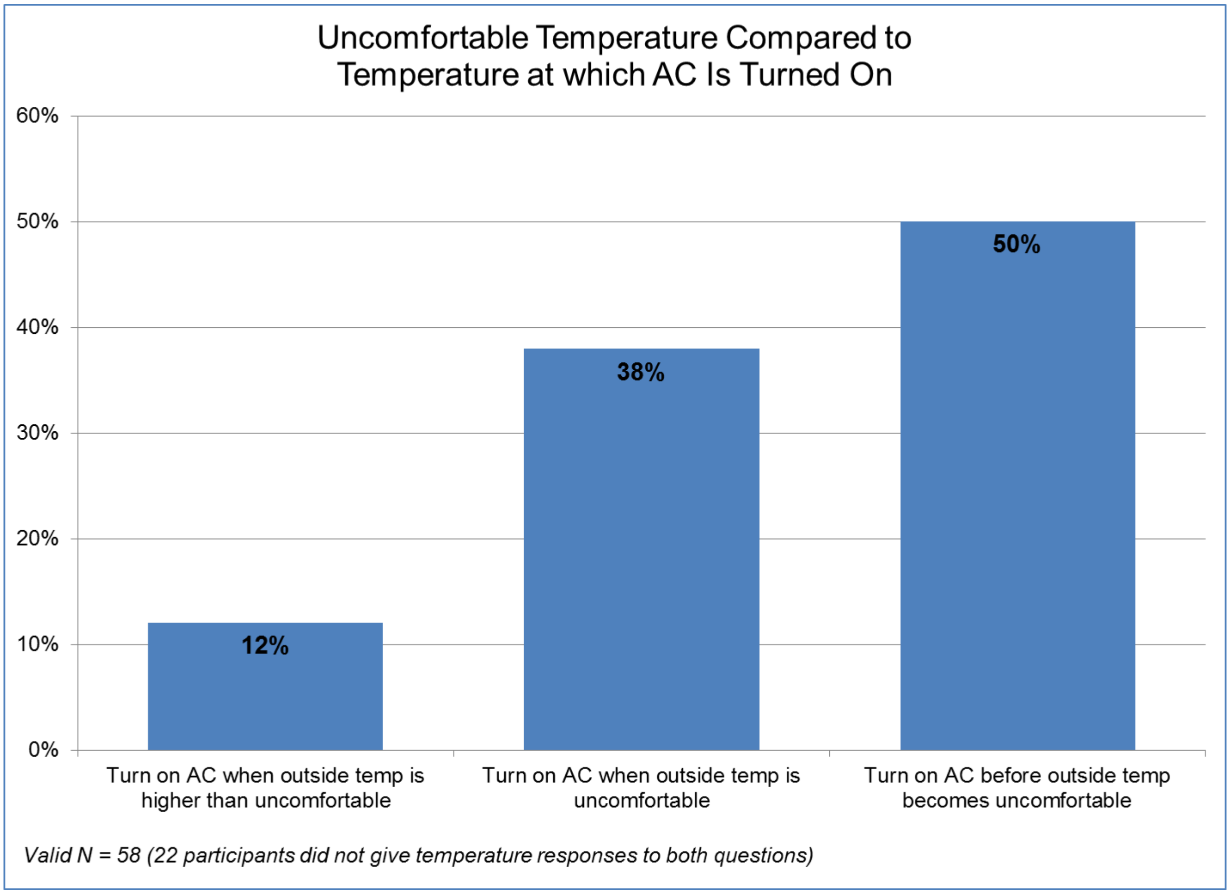

Figure 10. Turning On AC Units When Temperatures Reach an Uncomfortable Level

Eighteen Ohio participants (the 22.5% referenced in Figure 9) did not report a temperature at which they turn on their AC units since the settings are programmed into their thermostats.

These customers were asked a follow-up question regarding when they program their thermostats: Nearly three-quarters (72.2%) indicate that they program their thermostats when the weather gets hot, while 27.8% program their thermostats seasonally (Table 15). This 2014 finding is not significantly different from the 2013 survey, when 58.3% of respondents said they programed their thermostats seasonally.

Table 15. Programmable Thermostats

Do you set your thermostat seasonally or when the weather gets hot?	**Count**	**Percent** (N=18 participants who program thermostats)
I program the thermostat seasonally	5	27.8%
When the weather gets hot	13	72.2%

Thermostat Settings

Figure 11 shows participants' thermostat settings on high temperature weekdays at four time periods throughout the day (6 a.m.-12 p.m., 12 p.m.-6 p.m., 6 p.m.-10 p.m., and 10 p.m.-6 a.m.).

During hot summer weather, temperature settings ranging from 73° to 75° Fahrenheit are favored by 40% of participants throughout the day, while 30% or more set their temperatures to 76° or higher throughout the day. There is not much variation between day parts, although in the evening between 6 p.m. and 10 p.m. participants are less likely set their AC to a temperature of 78° or higher (5.0%) compared to weekday afternoons from noon to 6 p.m. (12.5%; significant at p<.05 using Student's t-test).

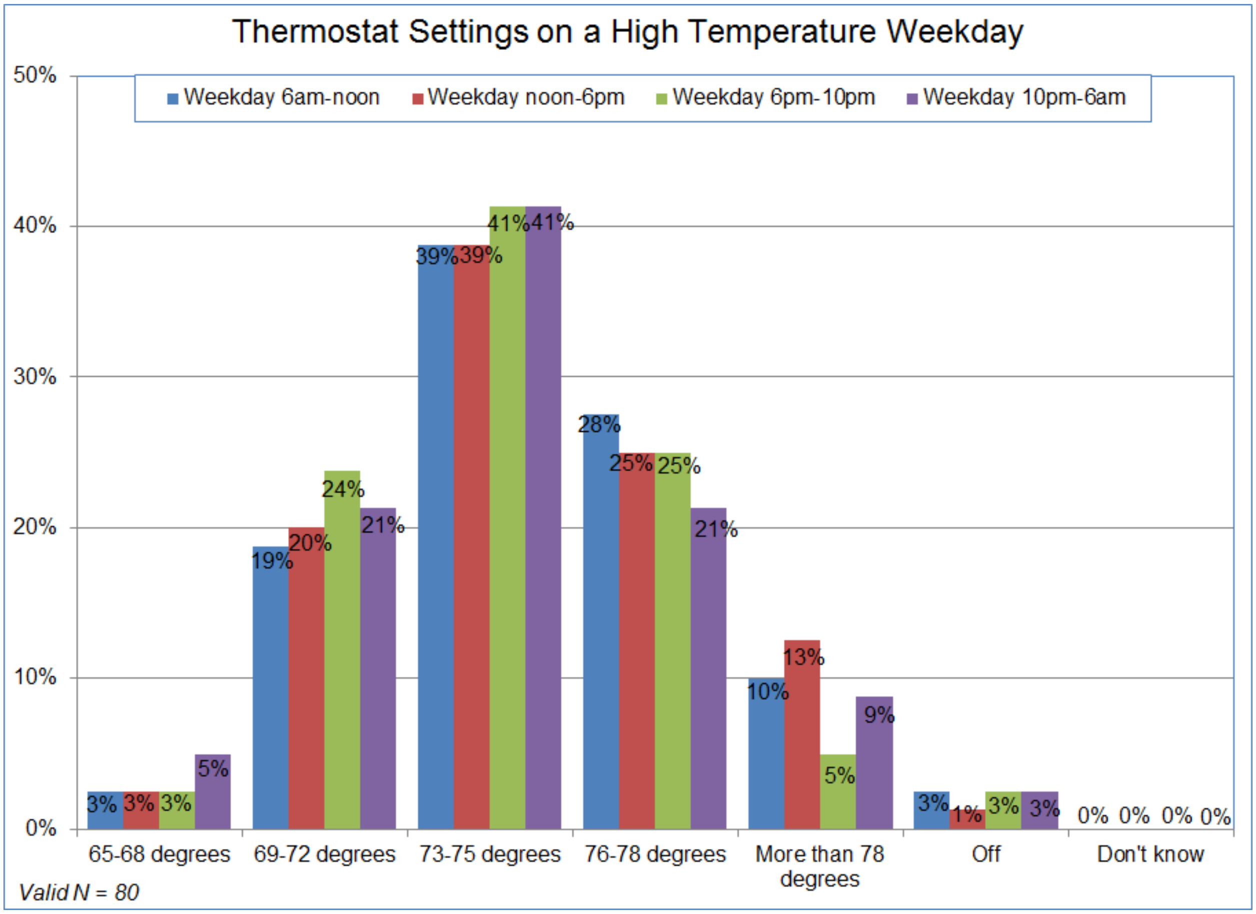

Figure 11. Thermostat Settings on a High Temperature Weekday

As seen in Figure 12, respondents are also asked about their typical temperature settings on a hot weekend day for the same four time periods. On a hot Saturday or Sunday about two-thirds of participants (63.8% or more) use the same temperature settings for each day part that they use during the work week. There are no statistically significant differences in weekend thermostat settings by time of day.

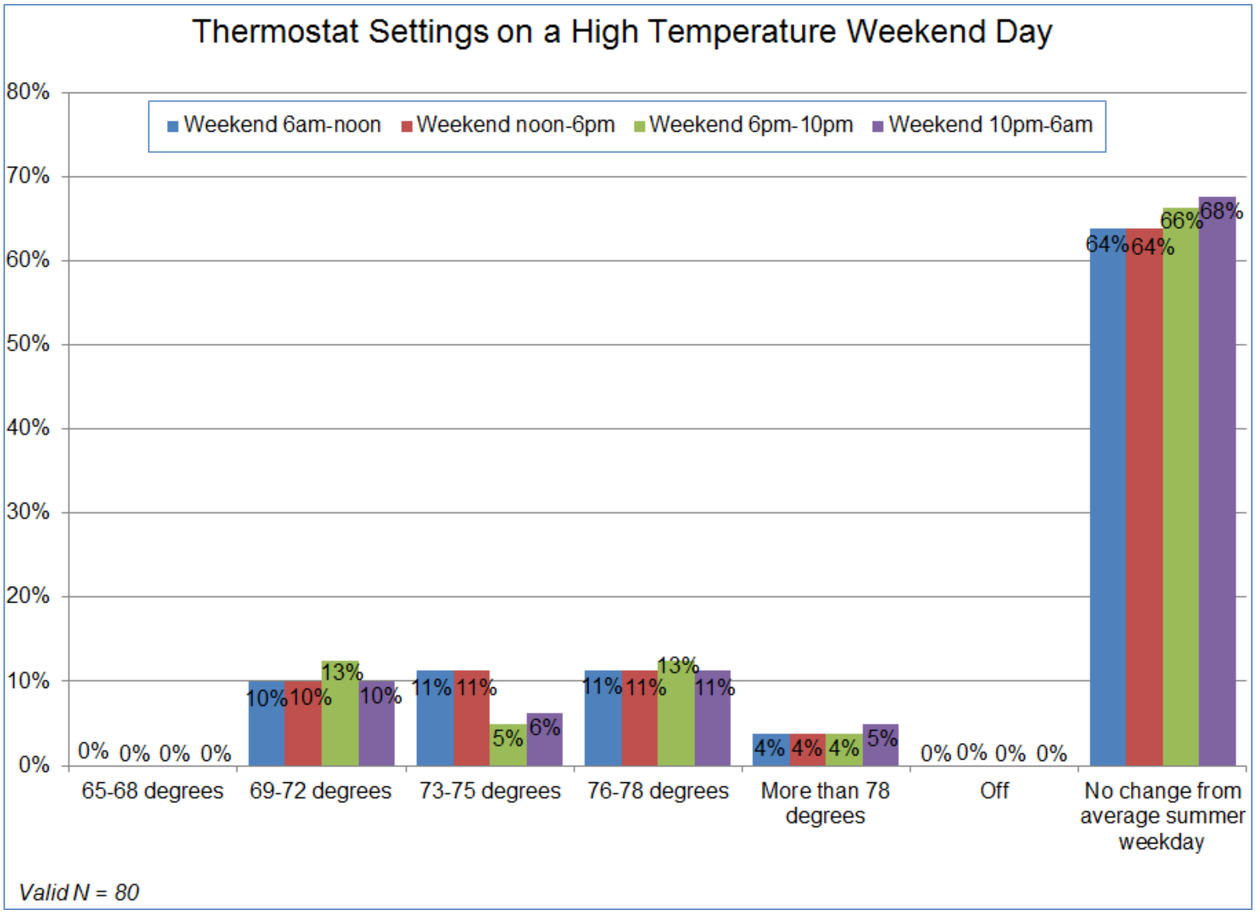

Figure 12. Thermostat Settings on a High Temperature Weekend Day

Nearly all participants surveyed in 2014 keep their thermostat settings the same throughout the entire week[8] (90.0% to 98.7%), as seen in Table 16. Participants are more likely to set their AC to a lower temperature on weekends than weekdays between 6 a.m. and 6 p.m. (7.5% or more compared to 1.3% or less during other times of day; these differences are significant at $p<.05$ using Student's t-test). None of the surveyed participants set their thermostats higher on weekends than weekdays before 6 p.m., and no more than 2.5% set them higher on weekends than weekdays after 6 p.m.

[8] In addition to the 64% to 68% of participants who responded that they do not set their thermostats differently on weekends (seen in Figure 12), another 26% to 31% of participants reported the same specific temperature ranges for a given time of day throughout the week (for example, customers who set their thermostats to 73° to 75° on a *weekday* from 6 p.m. to 10 p.m. who also set their thermostats to the same temperature range on *weekends* from 6 p.m. to 10 p.m.). This analysis compares weekday and weekend temperature settings during equivalent times of day (weekday evening versus weekend evening), not changes in settings between different times of day (morning versus evening).

Table 16. Changes in Thermostat Settings of Power Manager Participants by Days of Week

Time period	Same on weekdays and weekends	Lower AC temperature on weekends	Higher AC temperature on weekends
6 a.m.-12 p.m.	92.5%	7.5%	0.0%
12 p.m.-6 p.m.	90.0%	10.0%	0.0%
6 p.m.-10 p.m.	96.3%	1.3%	2.5%
10 p.m.-6 a.m.	98.8%	0.0%	1.3%

TecMarket Works divided Power Manager participants into two groups: those that turn their air conditioners on to a set temperature and leave it at that temperature all day, every day ("Non-Adjusters"), and those that change their temperature settings ("Adjusters"). Figure 13 shows that only 23.8% of Power Manager participants surveyed in Ohio are Adjusters; this finding differs from 2013, when 42.0% of participants surveyed gave responses that categorized them as Adjusters ($p<.05$ using Student's t-test).

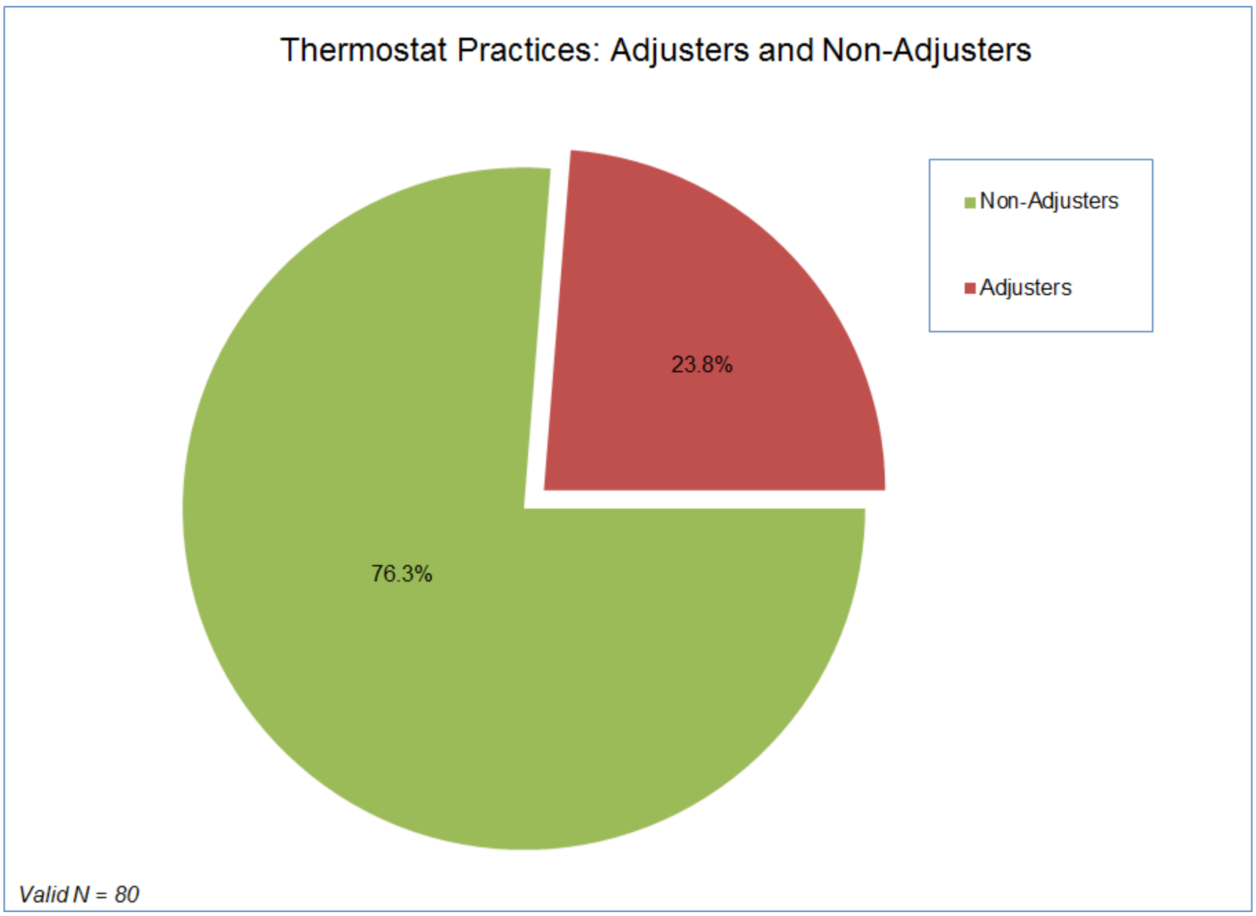

Figure 13. Thermostat Practices of Power Manager Participants

The outside temperatures at which Adjusters and Non-Adjusters become uncomfortable and turn on their air conditioners are shown in Table 17. For both groups, the median range of discomfort is 85° to 87° Fahrenheit. However, Non-Adjusters tend to turn on their cooling units at a lower outdoor temperature: the median temperature range at which Adjusters turn their air conditioning on is 82° to 84°, while for Non-Adjusters the median temperature at which AC units are turned on is 79° to 81°. While Adjusters are by definition making temperature tweaks to their thermostats throughout the week, in aggregate those changes are relatively minor. As a result, both Adjusters and Non-Adjusters maintain similarly consistent median temperature settings of 73° to 75° during evenings after 6 p.m., though for Adjusters the median temperature setting is one category higher at 76° to 78° before 6 p.m.

Table 17. Temperature Points for Non-Adjusters and Adjusters

Median Temperature Settings	Temperature Range in Degrees Fahrenheit	
	Adjusters (N=19)	Non-Adjusters (N=61)
Median temperature of discomfort	85-87°	85-87°
Median temperature to turn AC on	82-84°	79-81°
Median temperature thermostat setting weekdays 6 a.m.-noon	76-78°	73-75°
Median temperature thermostat setting weekdays noon-6 p.m.	76-78°	73-75°
Median temperature thermostat setting weekdays 6 p.m.-10 p.m.	73-75°	73-75°
Median temperature thermostat setting weekdays 10 p.m.-6 a.m.	73-75°	73-75°

As seen in Figure 14, Non-Adjusters have their AC units set at the same temperatures throughout the day (by definition, they do not make temperature adjustments). However Figure 15 shows that from 6 a.m. to 10 p.m., none of the Adjusters have their thermostats set to 68° or lower compared to 10.5% who are setting them that low overnight after 10 p.m. (difference between day parts significant at $p<.10$ using Student’s t-test). Similarly, at least 21.1% of Adjusters have their units set at 78° or higher or turned off during every day part except 6 p.m. to 10 p.m. in the evening, when only 5.3% of Adjusters have their units set this high or turned off (also significant at $p<.10$).

By comparison, just 3.3% of Non-Adjusters ever set their thermostats to 68° or lower, and just 8.2% ever set them at 78° or higher. There are no significant differences between times of day for Non-Adjusters (by definition they do not change their temperature settings during the day).

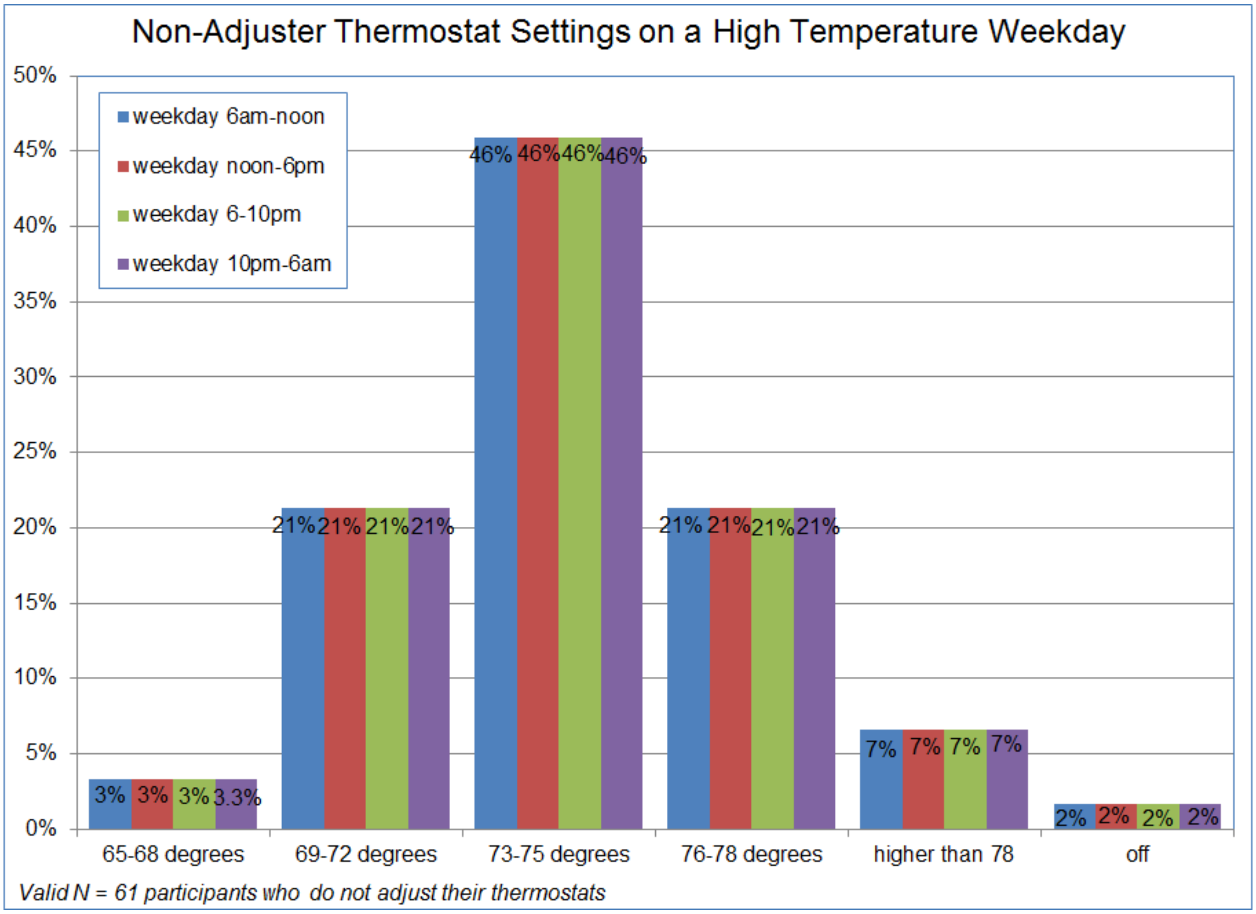

Figure 14. Non-Adjuster Thermostat Settings on High Temperature Weekdays

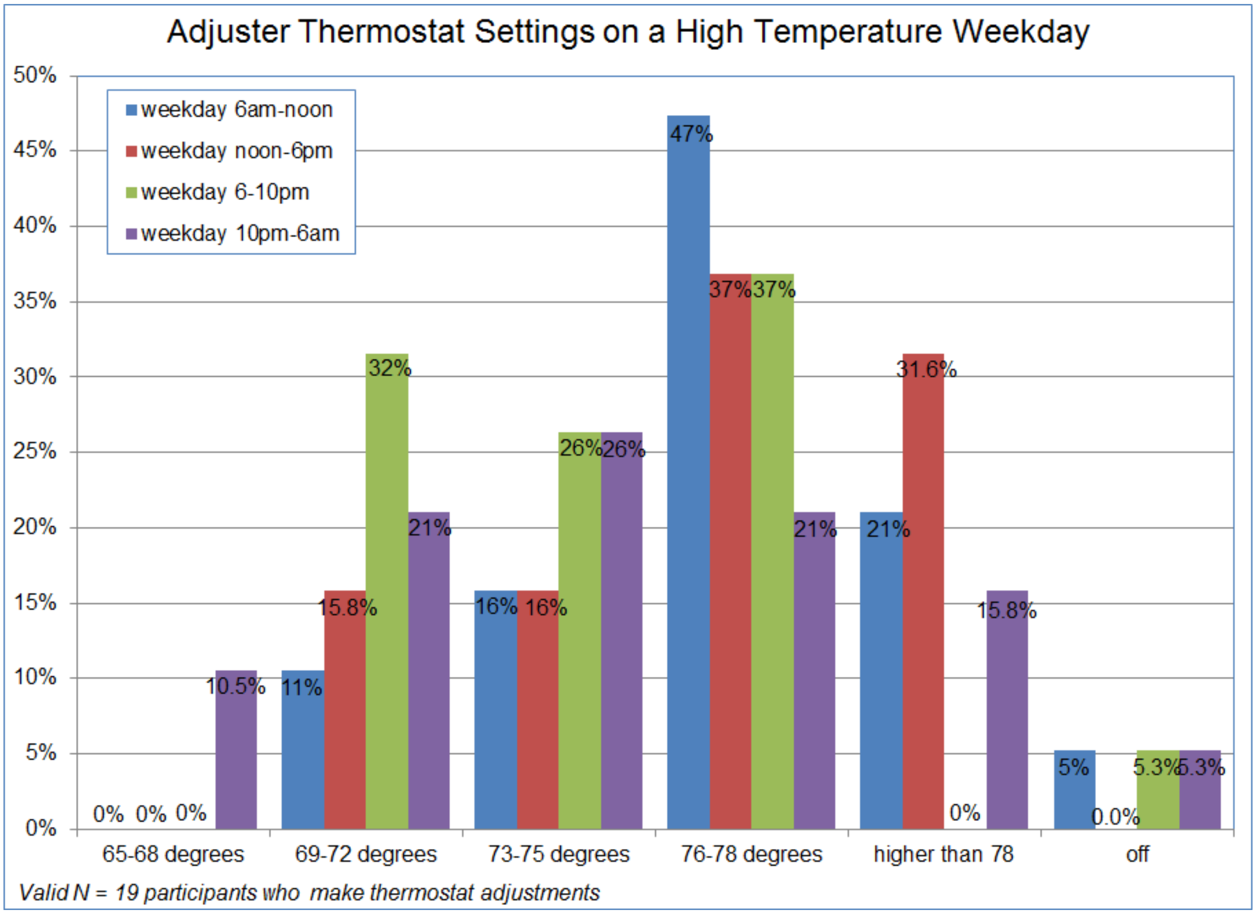

Figure 15. Adjuster Thermostat Settings on High Temperature Weekdays

Table 18 further illustrates that Adjusters are more likely to set their thermostats higher than Non-Adjusters. For most weekday time periods, a higher percentage of Adjusters have set their thermostats to “greater than 78° Fahrenheit” (the highest temperature category) or have their AC units turned off. Roughly a quarter to a third of Adjusters have their thermostats set high or AC units turned off during weekday mornings, afternoons and overnight, though only 5.3% set their temperatures that far back on weekday evenings between 6 p.m. and 10 p.m. By comparison, just 8.2% of Non-Adjusters set their units this high throughout the weekday (differences between groups are significant at p<.10 or better using Student’s t-test for every time period except 6 p.m. to 10 p.m.).

Table 18. Incidence of High Weekday Thermostat Settings by Adjusters and Non-Adjusters

Percent of participants who set thermostat to 78+ degrees or turn off AC during time period on a hot summer day	**Adjusters (N=19)**	**Non-Adjusters (N=61)**
Weekday 6 a.m.-12 p.m.	26.3%	8.2%
Weekday 12 p.m.-6 p.m.	31.6%	8.2%
Weekday 6 p.m.-10 p.m.	5.3%	8.2%
Weekday 10 p.m.-6 a.m.	21.1%	8.2%

Table 19 illustrates a major reason why Non-Adjusters use their air conditioners more than Adjusters: While about half of Adjuster households (52.6%) report using AC to keep someone comfortable in the home on weekdays before 6 p.m., more than three-quarters of Non-Adjusters (77.0%) report using the AC to keep comfortable on weekdays before 6 p.m. (this difference is statistically significant at p<.05 using Student's t-test). After 6 p.m. on weekdays, virtually all Adjusters (94.7%) and Non-Adjusters (98.4%) use their AC to keep comfortable in the home (this difference is not statistically significant).

Table 19. AC Usage to Keep Someone Comfortable At Home on Weekdays for Adjusters and Non-Adjusters

Is the AC typically used to keep someone at home comfortable during…	**Adjusters (N=19)**	**Non-Adjusters (N=61)**
Weekday summer afternoons before 6 p.m.	52.6%	77.0%
Summer weekdays after 6 p.m.	94.7%	98.4%

These finding are very similar to the 2013 analysis of thermostat Adjusters, when these participants were also found to set their thermostats higher during the day when there is less likely to be someone at home.

Satisfaction with the Program

Overall, Ohio participants are quite satisfied with the Power Manager program. When asked to rate their satisfaction on a ten-point scale where "10" means most satisfied, they gave an average rating of 8.95, with 72.5% of survey respondents rating the program either "9" or "10", and only 11.3% giving the program a rating of "7" or less (Figure 16). There are no significant differences between customers who receive their bills directly from Duke Energy (9.11) and those who are billed by third party companies (8.90).

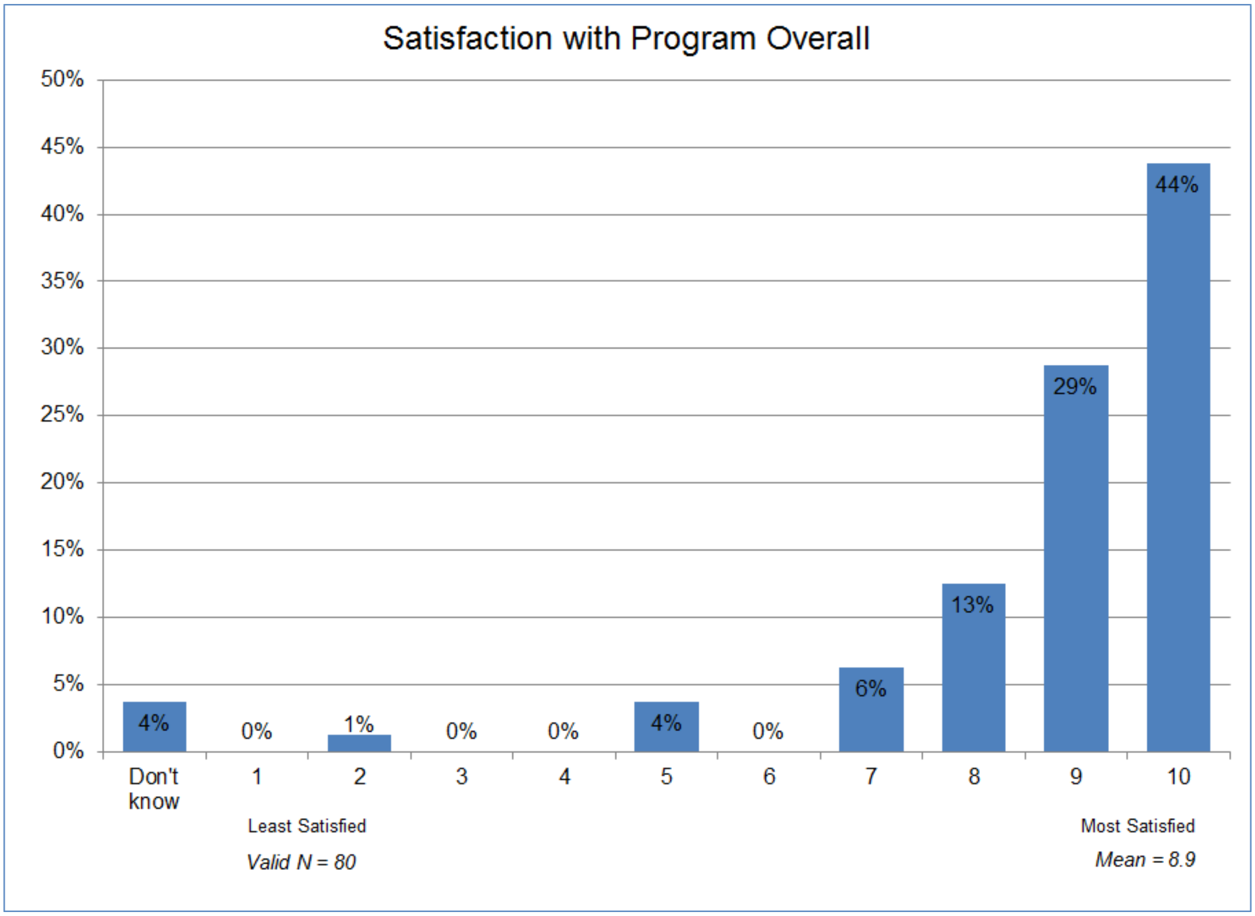

Figure 16. Overall Customer Satisfaction

A follow-up question asked the nine respondents who gave a satisfaction score of "7" or less why they were less than fully satisfied. The most frequently cited reason was that the bill credit amounts were insufficient (n=5), although others mentioned a lack of information about the program (n=2) and frequency of device activation (n=1). One customer gave a unique comment stating "*When I agreed to join the program, I asked to be there when they installed the device and was told that it wouldn't be a problem; then one day when I got home from work the device was already installed.*"

Ohio customers were also asked to rate their satisfaction using a five-point Likert scale, with responses ranging from "very satisfied" to "very dissatisfied". Overall, 91.3% of program participants indicated that they were either "very" or "somewhat satisfied" with the program (Figure 17). Only 1.3% of customers said they were "somewhat dissatisfied" and none (0%) report being "very dissatisfied" (Figure 16).

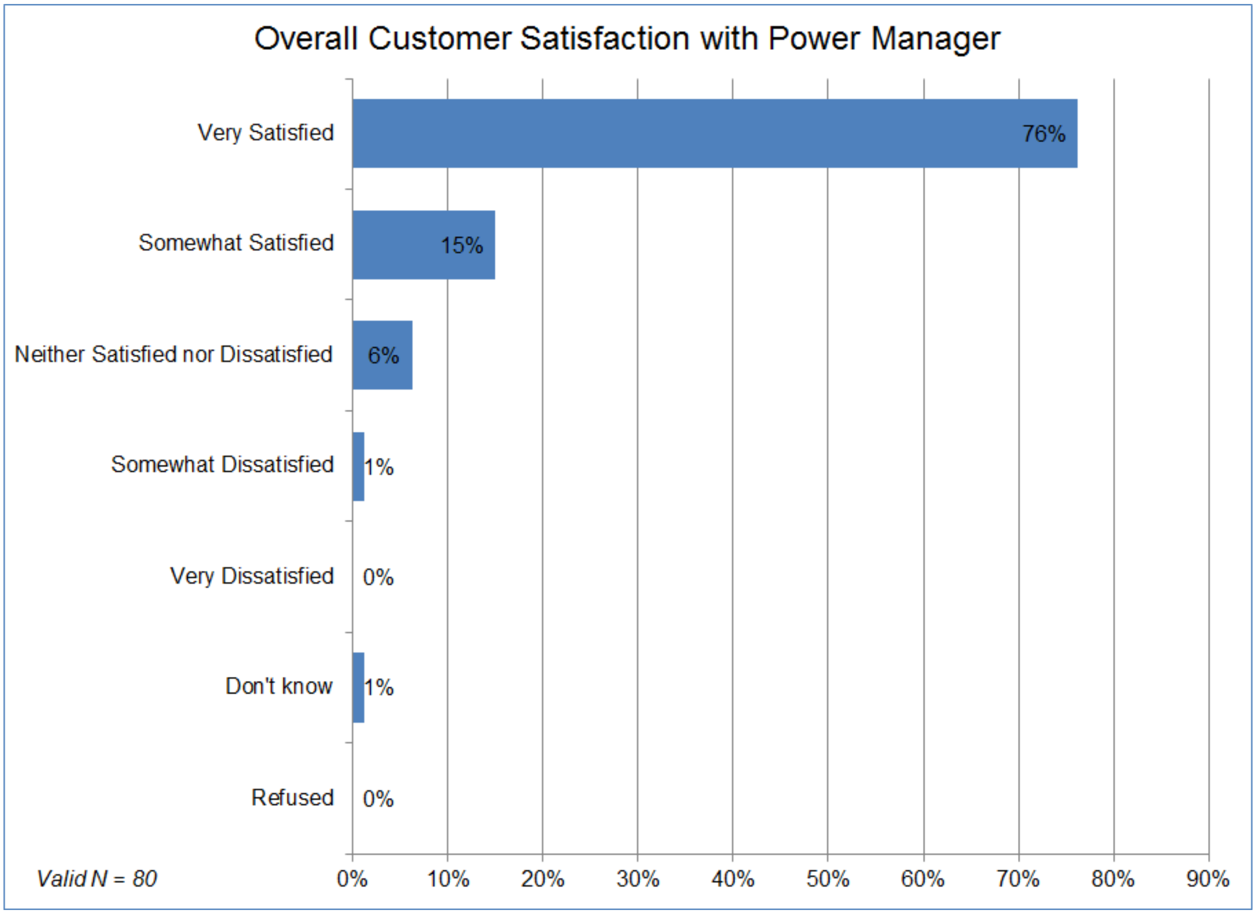

Figure 17. Satisfaction with the Power Manager Program

A follow-up question asked respondents to explain their satisfaction ratings; the responses for participants who were less than "satisfied" are categorized below (some customers mentioned multiple reasons for their lower satisfaction which is why there are more than six responses listed).

<u>**Reasons for Lower Satisfaction with Program**</u>

- Wanted more information about the program (n=2)
- The program doesn't save customers enough money (n=2),
- Can't tell when the device has been activated (n=2)
- The program helps Duke Energy but not customers
- Unique suggestion: "*The Duke Energy website could provide an educational video about Power Manager.*"[9]

Some customers who are "very" or "somewhat" satisfied with the program cite benefits of the program such as saving money and energy, or helping the environment, but the main driver of satisfaction is its "invisibility" to participants. Typical comments along these lines include "*I am very satisfied because we haven't noticed any discomfort; the program is essentially invisible to*

[9] The Duke Energy website does include a video which explains the Power Manager program.

us,“ and “*I am very satisfied with the Power Manager program because I have never noticed if or when the device has been activated; it has not affected my comfort*.” The complete list of verbatim ratings explanations can be found in *Appendix C: Participant Explanations of Satisfaction Ratings*.

Likelihood of Recommending the Program

Participants were also asked to rate the likelihood that they would recommend Power Manager to others on a ten-point scale where “10” means extremely likely and “1” means extremely unlikely. The average rating from Ohio participants is 8.47, with a majority (52.5%) rating their likelihood of recommending the program at either “9” or “10”. Only 17.5% gave ratings of “7” or lower; this distribution is shown in Figure 18.

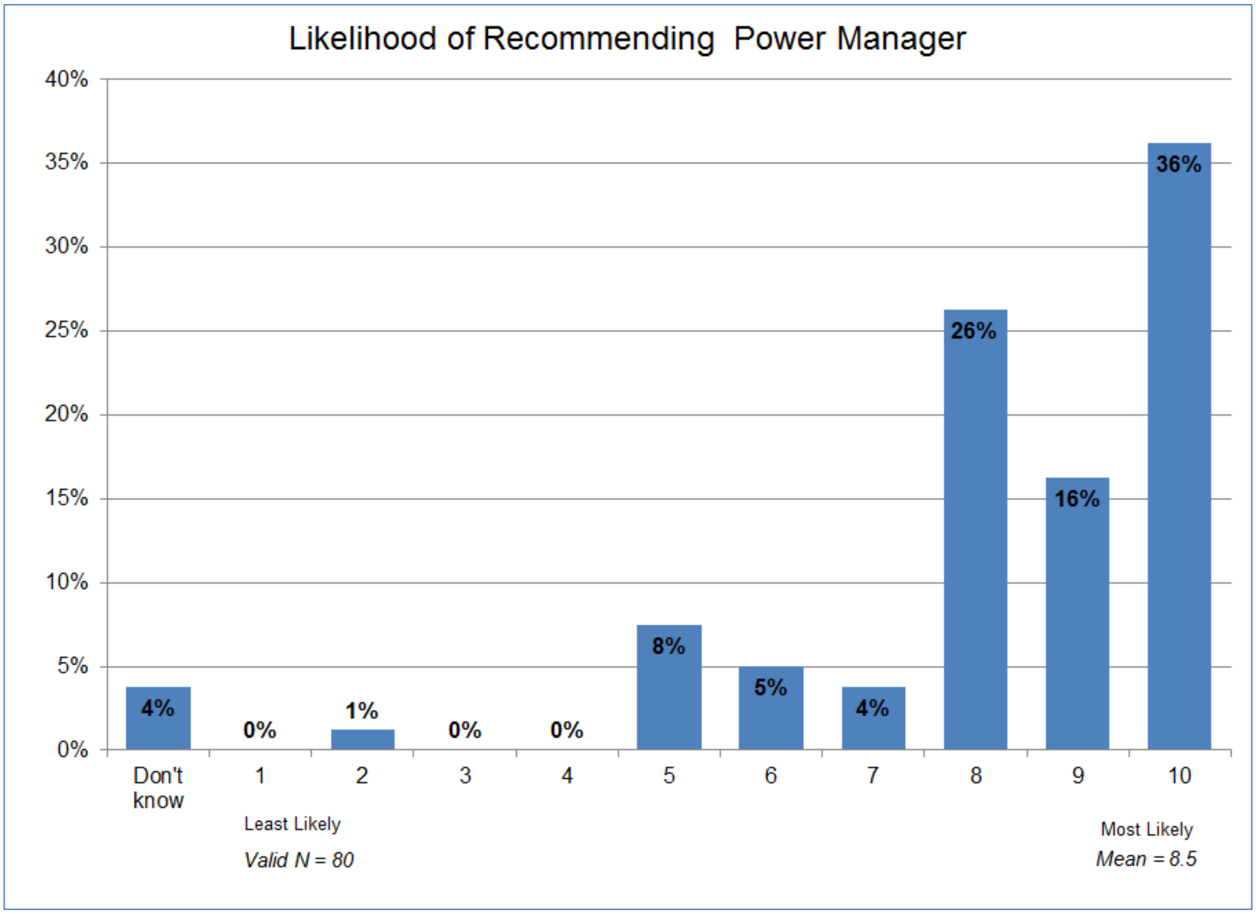

Figure 18. Recommending the Power Manager Program to Others

Participants who gave scores of “7” or lower for recommending the program were asked why they are less likely to recommend the program. Their reasons ranged from neutral remarks, such as not having enough information about the program to recommend it, to personal disinclinations due to a lack of perceived benefit for customers. Their explanations are listed below (some customers mentioned multiple reasons, which have been disaggregated to make categorization clearer).

<u>Reasons for Not Recommending the Program</u>

- Not likely to come up in conversation (n=7)
- Program doesn't seem to benefit customers (n=3)
- Doesn't save much money (n=2)
- I'd need more information first
- I'm ambivalent about the program

Satisfaction with Duke Energy

Overall satisfaction with Duke Energy among Ohio participants is quite strong. Respondents report an average overall satisfaction rating of 8.65 on a ten-point scale where “10” means most satisfied. A majority of respondents (57.5%) rated their satisfaction at a “9” or “10”, while only 10.0% gave scores of “7” or lower. There are no significant differences between customers who receive their bills from Duke Energy directly (8.71) and those who are billed by third party companies (8.62). The full distribution of ratings by participants is presented in Figure 19 below.

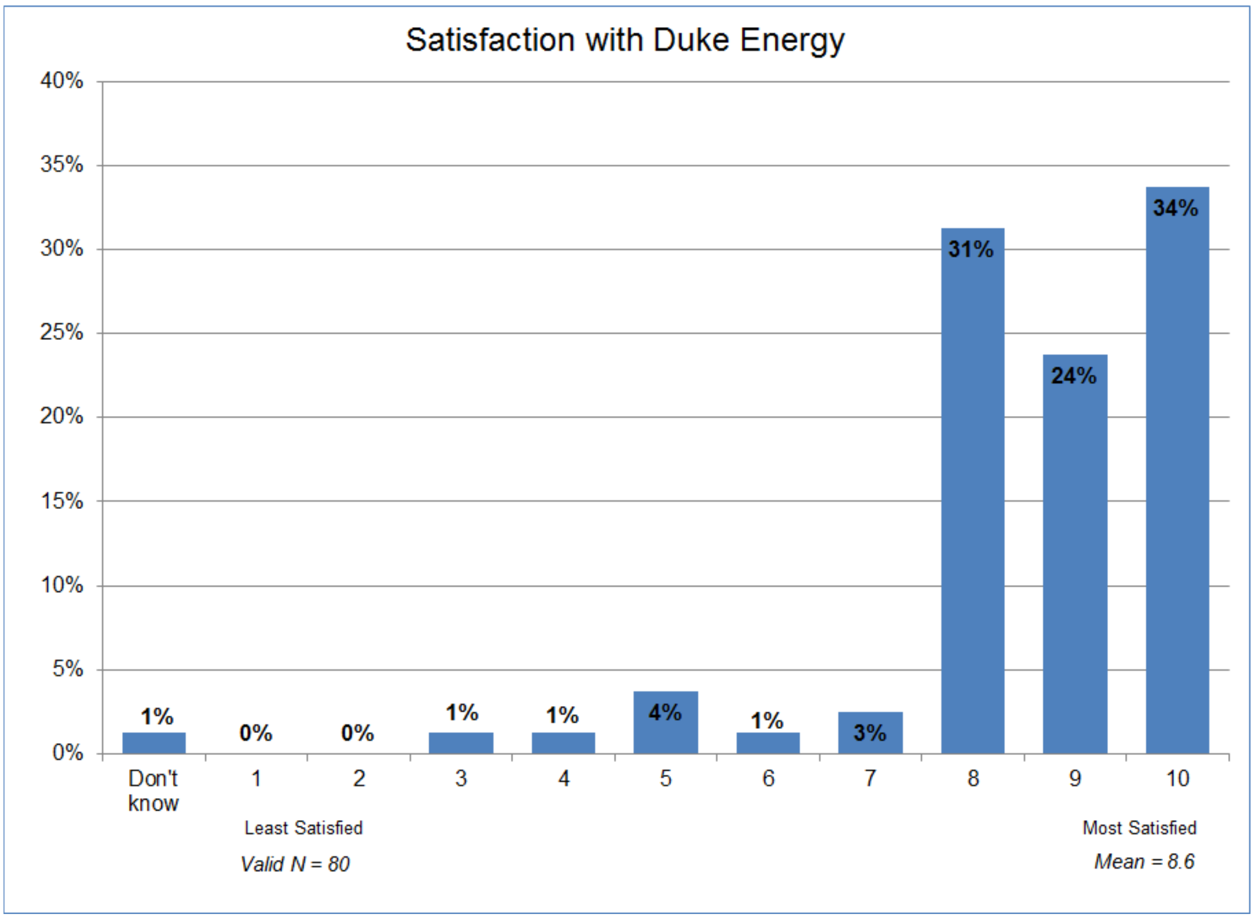

Figure 19. Overall Satisfaction with Duke Energy

Participants who gave a satisfaction score of “7” or lower explained their low ratings with a variety of reasons, including complaints about high bills and energy rates (n=4), followed by mentions of poor customer service (n=2) and power reliability (n=2), and insufficient customer education about the program (n=1).

Ohio participants were also asked to rate their satisfaction with Duke Energy using a five-point Likert scale, ranging from "very satisfied" to "very dissatisfied". Seventy percent (70.0%) of program participants said they were "very satisfied" with Duke Energy and another 18.8% said they were "somewhat satisfied," thus in total 88.8% of participants report being satisfied with Duke Energy (Figure 20). In all, just four customers (5.0%) said they were either "somewhat" or "very dissatisfied". When asked to explain their ratings, these less-than-satisfied customers gave essentially identical reasons to those that were given for low numeric satisfaction ratings (see Figure 19; a complete list of participants' verbatim explanations for their satisfaction ratings can be found in *Appendix C: Participant Explanations of Satisfaction Ratings)*.

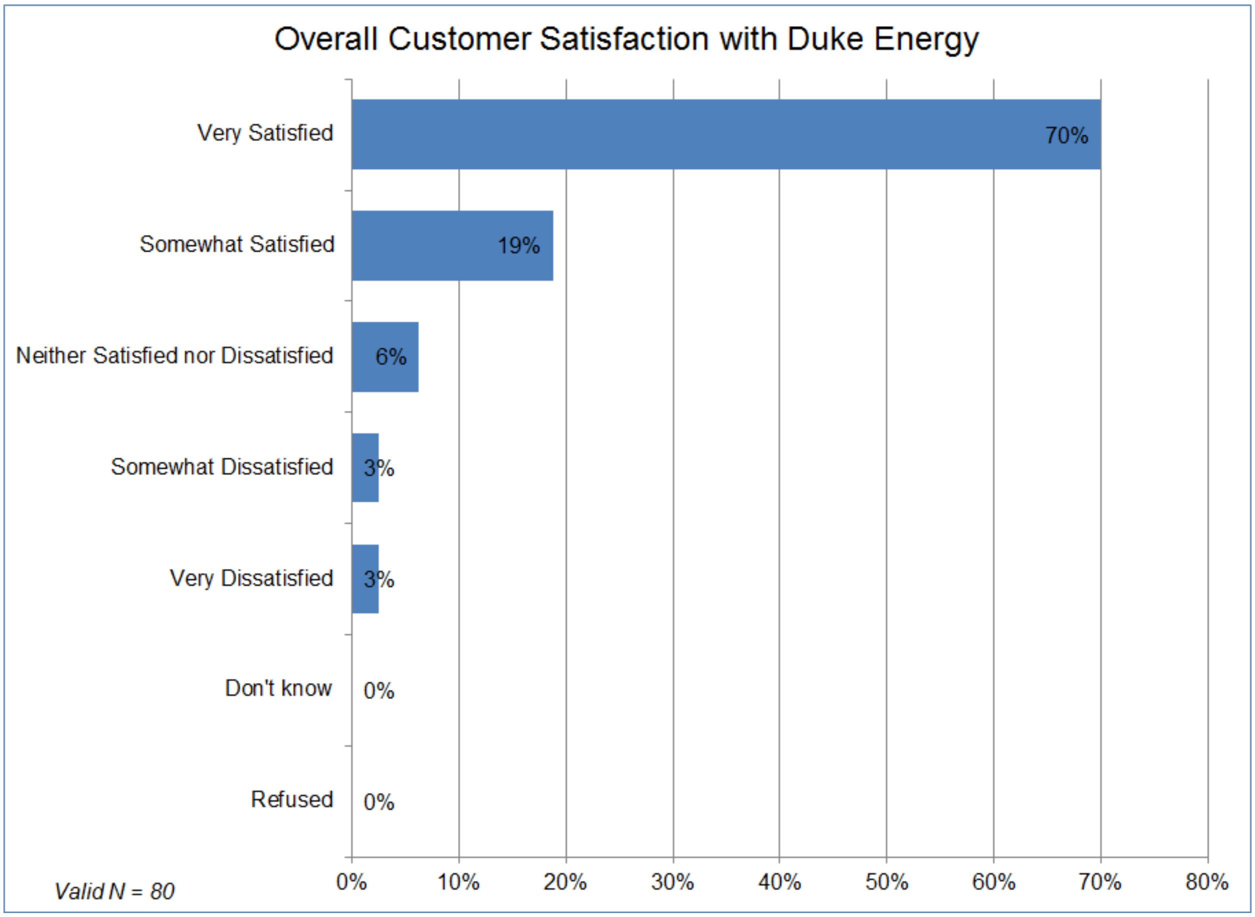

Figure 20. Satisfaction with the Duke Energy

Awareness of Other Duke Energy Programs

TecMarket Works asked participants if they were aware of any other Duke Energy programs besides the Power Manager program. A large majority (80.0%) of participants were able to name at least one other program; the most frequently mentioned programs are free CFLs (70.0%), My Home Energy Report (51.3%), Home Energy House Call (31.3%) and the specialty bulbs

Savings Store (10.0%). Other Duke Energy programs were mentioned by fewer than 10% of participants surveyed, as shown in Table 20.

Table 20. Awareness of Other Duke Energy Programs

What other Duke Energy programs or services have you heard of that help customers save energy?	**Count**	**Percent (N=80)**
Free CFL programs	56	70.0%
My Home Energy Report	41	51.3%
Home Energy House Call	25	31.3%
Savings Store (specialty light bulbs)	8	10.0%
Smart Saver (other than CFL) HVAC or Tune & Seal	3	3.8%
Appliance Recycling	3	3.8%
Personalized Energy Report	2	2.5%
Low Income, Weatherization, or Low Income Weatherization	1	1.3%
K12, NEED, or "Get Energy Smart"	1	1.3%
Other, listed below	4	5.0%
Don't know	16	20.0%

Note: Multiple responses were allowed per participant.

Four participants gave "other" responses to this question, though some do not correspond to Duke Energy program names or offerings. These include: *"People Working Cooperatively," "Retail Fixed Rate Program," "Duke Energy Retail Store," and "the mailer kit."*

Interest in Other Potential Energy Efficiency Programs

TecMarket Works asked participants in the Power Manager program if they would be interested in a similar program for electric water heaters or other devices. As seen in Table 21, a majority of respondents (65.0%) said they would be interested, while 12.5% said they were unsure.

Table 21. Interest in Programs to Cycle Water Heaters or Other Equipment

If Duke Energy were to offer a program that cycles other equipment at your home such as an electric water heater, would you be interested in participating?	**Count**	**Percent (N=80)**
Yes	52	65.0%
No	18	22.5%
Don't know	10	12.5%

Participants who are not interested in a program to cycle water heaters were asked why not. Among the 22.5% who said they would not be interested in such a program, the predominant reason given was that these customers have inappropriate water heaters. Among those who said they were unsure, the most common reason for a tentative reply was that they wanted more information before making a decision. Some examples of these comments are listed below.

<u>No, Not Interested</u>

- *I would not be interested because I have a natural gas-fueled water heater.*
- *I would not be interested because I have a tankless water heater.*

- *All of our appliances are high efficiency.*
- *I do things at different times so I wouldn't want something to be cycling when I needed it.*

Don’t Know/Not Sure

- *I might be interested but it would depend on the program specifics such as time of day, credits, etc.*
- *It would depend on what you would want to cycle and how it would affect us.*
- *Our household's demand for hot water fluctuates and I wouldn't want Duke to be controlling the hot water when we need more than usual.*

Customer Ideas for Other Duke Energy Offerings

Participants were also asked if they had suggestions for other programs or services Duke Energy could offer their customers. Only six participants (7.5% of those surveyed) offered suggestions; their unique suggestions are listed below Table 22.

Table 22. Other Programs or Services Duke Energy Should Provide

Are there any programs or services that you think Duke Energy should provide to its residential customers that are currently not provided?	Count	Percent (N=80)
Yes	6	7.5%
No	63	78.8%
Don’t know	11	13.8%

Customer Suggestions for Other Duke Energy Offerings

- *Duke Energy could provide programmable thermostats.*
- *Duke Energy should provide a comparison of all the competing energy bidders in the area.*
- *Duke Energy should provide home energy audits and more education regarding the proper disposal of CFLs. I have concerns about mercury.*
- *Duke Energy should provide thermostat control services for customers’ homes.*
- *I would like them to offer a solar rebate program and high-efficiency swimming pool heaters. I would also like to pay my utility bill with my credit card to get frequent flier miles.*
- *I'd like to see more solar options. It would be very helpful if Duke sent out more window coverings.*

Appendix A: Participant Survey Instrument

Use four attempts at different times of the day and different days before dropping from contact list. Call times are from 10:00 a.m. to 8:00 p.m. EPT Monday through Saturday. No calls on Sunday.

Note: Only read words in bold type, italics are instructions.

Survey ID ________________

Surveyor Name ________________

Option

( ) 0.5
( ) 1.0
( ) 1.5

For answering machine 1st through penultimate attempts:
Hello, my name is _____ and I am calling with a survey about Duke Energy's Power Manager Program. I am sorry I missed you. I will try again another time.

For answering machine - Final Attempt:
Hello, my name is _____ and I am calling with a survey about Duke Energy's Power Manager Program. This is my last attempt at reaching you, my apologies for any inconvenience.

If person answers:
Hello, my name is _____, and I'm calling on behalf of Duke Energy. According to our information, you presently participate in Duke Energy's Power Manager Program. This program allows Duke Energy to cycle your air conditioner during times of peak energy usage. We are conducting this survey to obtain your opinion about the program. If you qualify, we will send you a check for $20 for completing the survey. This survey will take 25 minutes or less to complete, and the information you provide will be confidential and will help to improve the program.

Do you live at {*address from calling sheet***} ?**

( ) Yes
( ) No
( ) Refuse to answer

If No or Refused, thank them and end the call.

1. **Are you aware of your participation in the Power Manager Program?**

( ) Yes
( ) No
( ) DK/NS

If No or DK/NS,
May I please speak to the person who would be most familiar with your household's participation in the Power Manager Program?
If not available, try to schedule a callback time. If transferred, begin survey from beginning.

We would like to collect some information on why you agreed to participate in the program and how you heard about it.

2. **Were you involved in the decision to participate in Duke Energy's Power Manager Program?**
   ( ) Yes
   ( ) No
   ( ) It was already installed when I moved in.
   ( ) DK/NS

If No, DK/NS or Already Installed, skip to question 8.

3a. **Do you recall how you first heard about the program?**
   ( ) Yes
   ( ) No
   ( ) DK/NS

3b. **What are some of the ways you heard about the Power Manager Program?**
Select all that apply.
   [ ] Something in the mail from Duke Energy
   [ ] Phone call from Duke Energy (telemarketing)
   [ ] Email from Duke Energy
   [ ] Duke Energy website
   [ ] Other website, *specify:* _________________
   [ ] Word-of-mouth (friend/neighbor/landlord)
   [ ] Newspapers
   [ ] Television
   [ ] Radio
   [ ] Social media network, *specify:* _________________
   [ ] Other, *specify:* _________________
   [ ] DK/NS

4. **What was the <u>main</u> reason why you chose to participate in the program?**
   ( ) For the bill credits
   ( ) Helping Duke avoid power shortages/outages
   ( ) Helping Duke avoid building power plants
   ( ) To save energy
   ( ) To save money (through lower utility bills)
   ( ) To help the environment
      Please explain: (to reduce carbon or GHG, etc.) _________________
   ( ) I do not use the air conditioner much

( ) I am usually not home when the events are supposed to occur
( ) Other: ________________
( ) DK/NS

5. **Were there any other reasons why you chose to participate in this program?**
Select all that apply.
[ ] No other reasons
[ ] For the bill credits
[ ] Helping Duke avoid power shortages/outages
[ ] To save energy
[ ] To save money (through lower utility bills)
[ ] To help the environment
Please explain: (to reduce carbon or GHG, etc.) ________________
[ ] I do not use the air conditioner much
[ ] I am usually not home when the events are supposed to occur
[ ] Other, specify: ________________
[ ] DK/NS

6a. **During the time you enrolled, Duke Energy provided you with information that described how the Power Manager program works. Do you recall this information?**
( ) Yes
( ) No
( ) DK/NS

If Yes to q6, ask:
6b. **Using a scale of 1 to 10 where 1 indicates "Very Dissatisfied" and 10 indicates "Very Satisfied", how satisfied were you with this information in helping you to understand how the program works?**
( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) 8 ( ) 9 ( ) 10 ( ) DK/NS

If 7 or below,
6c. **Why were you less than satisfied with this information?**
____

7a. **Using a scale of 1 to 10 where 1 indicates "Very Dissatisfied" and 10 indicates "Very Satisfied", how satisfied were you with the process of enrolling in the program?**
( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) 8 ( ) 9 ( ) 10 ( ) DK/NS

If 7 or below,
7b. **Why were you dissatisfied with this enrollment process?**
____

8a. **Do you recall how often Duke Energy said it would activate the Power Manager device on your air conditioner?**
( ) Yes
( ) No

( ) DK/NS

If 'Yes' in q8, ask:
8b. **How many times per year did Duke Energy tell you it would activate the Power Manager device on your air conditioner? ________________**

9. **Is anything unclear to you about how the program works?**
( ) Yes
( ) No
( ) DK/NS

If Yes, ask:
9a. **What is unclear to you? ________________**

10a. **Did you ever contact Duke Energy to find out more about the Power Manager Program?**
( ) Yes
( ) No
( ) DK/NS

If No or DK/NS, skip to q11

10b. **What method did you use to contact Duke Energy?**
Select all that apply.
[ ] Phone
[ ] Email
[ ] In person
[ ] Other: ________________
[ ] DK/NS

10c. **Using a scale of 1 to 10 where 1 indicates "Very Dissatisfied" and 10 indicates "Very Satisfied", how satisfied were you with the ease of reaching a Duke Energy representative?**
( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) 8 ( ) 9 ( ) 10 ( ) DK/NS

If 7 or below,
10d. **Why were you less than satisfied?**
____

10e. **Using a scale of 1 to 10 where 1 indicates "Very Dissatisfied" and 10 indicates "Very Satisfied", how satisfied were you with how the Duke Energy representative responded to your questions?**
( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) 8 ( ) 9 ( ) 10 ( ) DK/NS

If 7 or below,
10f. **Why were you less than satisfied with this information?**
Select all that apply.

[ ] Did not respond to my questions/ concerns
[ ] Unable to answer/address my questions/concerns
[ ] Not professional/courteous
[ ] Other: ________________
[ ] DK/NS

11. **Are you aware of any times when Duke Energy may have activated your Power Manager device since you joined the program?**
If they ask what this means, respond with:
"Has your air conditioner been controlled so that it cycles off and on when energy demand is high?"
( ) Yes
( ) No
( ) DK/NS

If No or DK/NS in q11, skip to q23.

12. **How do you know when the device has been activated?**
Select all that apply.
[ ] A/C shuts down
[ ] Home temperature rises
[ ] The light on the meter is on
[ ] Light on AC unit flashes
[ ] Fan goes into cycling mode
[ ] Bill credits
[ ] Lower bill
[ ] Contact or notification from Duke Energy (other than bill)
[ ] Customer called the Power Manager 800 number
[ ] Other: ________________
[ ] DK/NS

13. **During the summer of 2014, about how many times do you believe Duke Energy activated your Power Manager device?**
( ) One or more times *13a. record number of times.* ________________
( ) None (not at all)
( ) DK/NS

14. **Were you or any members of your household home when Duke Energy activated your Power Manager device this past summer?**
( ) Yes
( ) No
( ) DK/NS

If No or DK/NS to q14, skip to question 19a.

15. **Using a scale of 1 to 10 where 1 means very uncomfortable and 10 means very comfortable, how would you describe your level of comfort before your device was activated?**
( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) 8 ( ) 9 ( ) 10 ( ) DK/NS

16. **Using the same scale of 1 to 10 where 1 means very uncomfortable and 10 means very comfortable, how would you describe your level of comfort during the period when the device was activated?**
( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) 8 ( ) 9 ( ) 10 ( ) DK/NS

If score from Q16 is lower than score from Q15, ask Q17 and Q18 – otherwise skip ahead to Q19a.

17. **What do you feel caused your decrease in comfort?**
Select all that apply. If customer says "rising temperature" ask whether they are referring to indoor or outdoor temperature, or both.

[ ] Power Manager device activation
[ ] Rising outdoor Temperature
[ ] Rising indoor temperature
[ ] Rising outdoor Humidity
[ ] Rising indoor humidity
[ ] Power Outage
[ ] Other, specify: ________________
[ ] DK/NS

18. **After your comfort level decreased during the Power Manager device activation, how long did it take for the comfort level in your home to return to normal? Would you say…**

( ) **Less than one hour**
( ) **More than 1 but less than 2 hours**
( ) **More than 2 but less than 3 hours**
( ) **More than 3 but less than 4 hours**
( ) **or more than 4 hours**
( ) DK/NS *(do not read)*

19a. **On a day when Duke Energy activates your Power Manager device, for how many hours do you think they are typically controlling your air conditioner?**
Record number of hours ________________

19b. **On a day when Duke Energy activates your Power Manager device, at what time of day do you think that they usually de-activate the control devices and stop controlling your air conditioner?**
Record time of day ________________

20a. **When Duke Energy activated your Power Manager device, did you or any other members of your household adjust the settings on your thermostat?**

( ) Yes

( ) No
( ) DK/NS

If yes, ask:
20b. **At what temperature was it originally set, and what temperature did you set it to during the control event?**
Original temperature setting: degrees F: ________________
Adjusted temperature setting: degrees F: ________________

21. **Did you or other members of your household do anything else to keep cool?**
Select all that apply.
[ ] Continued normal activities/ Did not do anything different
[ ] Turned on room/window air conditioners
[ ] Turned on fan(s)
[ ] Closed blinds/shades
[ ] Moved to a cooler part of the house
[ ] Left the house and went somewhere cool
[ ] Wore less clothing
[ ] Drank more water/cool drinks
[ ] Cooled off with water (shower, bath, sprinkler, hose, pool)
[ ] Opened windows
[ ] Other, specify: ________________
[ ] DK/NS

22. **Thinking about this summer, how many times do you think the activation of the Power Manager program affected your level of comfort?** ________________

23a. **Using a scale of 1 to 10 where 1 indicates "Very Dissatisfied" and 10 indicates "Very Satisfied", how satisfied are you with the Power Manager program in general?**
( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) 8 ( ) 9 ( ) 10 ( ) DK/NS

If q23 is 7 or below, ask 23b:
23b. **Why were you less than satisfied with Power Manager?**
Select all that apply.
[ ] They activated my Power Manager device more often than I would like
[ ] The bill credits/incentives were not large enough
[ ] I am not using less energy / not saving money on utility bill
[ ] I was uncomfortable when my Power Manager device was activated
[ ] Other *specify*: ________________

24a. **If you were rating your overall satisfaction with the Power Manager Program, would you say you were Very Satisfied, Somewhat Satisfied, Neither Satisfied nor Dissatisfied, Somewhat Dissatisfied, or Very Dissatisfied?**
( ) Very Satisfied
( ) Somewhat Satisfied
( ) Neither Satisfied nor Dissatisfied

( ) Somewhat Dissatisfied
( ) Very Dissatisfied
( ) Refused
( ) DK/NS

24b. **Why do you give it that rating?**
____

25a. **Using a scale of 1 to 10, where 1 means "Extremely Unlikely" and 10 means "Extremely Likely", how likely is it that you would recommend this program to a friend, neighbor, or co-worker?**
( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) 8 ( ) 9 ( ) 10 ( ) DK/NS

For all ratings, ask:
25b. **Why do you give it that rating?**
____

26. **What, if any, Duke Energy programs or services have you heard of that help customers save energy? Any others?**
Select all that apply.
[ ] Smart Saver (other than CFL) – HVAC or Tune & Seal
[ ] Savings Store (specialty light bulbs)
[ ] Water Measures (heat pump water heater, water EE products, pool pumps)
[ ] Personalized Energy Report
[ ] Home Energy House Call
[ ] My Home Energy Report
[ ] CFL Program
[ ] Energy Star Homes
[ ] Low Income, Weatherization, or Low Income Weatherization
[ ] K12, NEED, or "Get Energy Smart"
[ ] Appliance Recycling
[ ] Other, specify: ________________
[ ] DK/NS or None

Now I'm going to ask you some questions about your air conditioning use.

27. **How often do you use your central air conditioner? Would you say you use it ...**
Read answers aloud until they reply.
( ) **Not at all**
( ) **Only on the hottest days**
( ) **Frequently during the cooling season**
( ) **Most days during the cooling season**
( ) **Every day during the cooling season**
( ) DK/NS

28. **Have you had your air conditioner tuned-up or serviced since you enrolled in the Power Manager Program?**

( ) Yes
( ) No
( ) DK/NS
( ) Other: _________________

If Yes to q28, ask:
29a. **Was the Power Manager device disconnected while your air conditioner was being serviced?**

( ) Yes
( ) No
( ) DK/NS

If Yes in Q29a ask:
29b. **Was the Power Manager device re-connected after completing service on the air conditioner?**

( ) Yes
( ) No
( ) DK/NS

If No in Q29b ask:
29c. **Why wasn't the Power Manager device re-connected?**

____

30. **Is the air conditioner typically used to keep someone at home comfortable during weekday summer afternoons before 6 P.M.?**
Note: 'someone' includes pets, if applicable

( ) Yes
( ) No
( ) DK/NS

31. **Is the air conditioner typically used to keep someone at home comfortable during summer weekdays after 6 P.M.?**
Note: 'someone' includes pets, if applicable

( ) Yes
( ) No
( ) DK/NS

32. **When you think of a typical hot and humid summer day, at what outside temperature do you tend to feel uncomfortably warm in your home?**

( ) less than 65 degrees
( ) 65-68 degrees
( ) 69-72 degrees
( ) 73-75 degrees
( ) 76-78 degrees

( ) 79-81 degrees
( ) 82-84 degrees
( ) 85-87 degrees
( ) 88-90 degrees
( ) 91-94 degrees
( ) 95-97 degrees
( ) 98-100 degrees
( ) greater than 100 degrees
( ) DK/NS

33a. **At what outside temperature do you tend to turn on the air conditioner?**
( ) It is programmed into the thermostat.
( ) less than 65 degrees
( ) 65-68 degrees
( ) 69-72 degrees
( ) 73-75 degrees
( ) 76-78 degrees
( ) 79-81 degrees
( ) 82-84 degrees
( ) 85-87 degrees
( ) 88-90 degrees
( ) 91-94 degrees
( ) 95-97 degrees
( ) 98-100 degrees
( ) greater than 100 degrees
( ) DK/NS

If "It is programmed into the thermostat", ask:
33b. **Do you set your thermostat seasonally or when the weather gets hot?**
( ) I program the thermostat seasonally
( ) When the weather gets hot
( ) Other: ________________

I am going to read a list of time periods. For each time period, please tell me the temperature that your thermostat is typically set to on a hot summer weekday when you are using the air conditioner, or if it is turned off.

34a. **On a hot weekday morning from 6 am to noon.**
( ) less than 65 degrees
( ) 65-68 degrees
( ) 69-72 degrees
( ) 73-75 degrees
( ) 76-78 degrees
( ) greater than 78 degrees
( ) Off
( ) DK/NS

34b. **On a hot weekday afternoon from noon to 6 pm**
( ) less than 65 degrees
( ) 65-68 degrees
( ) 69-72 degrees
( ) 73-75 degrees
( ) 76-78 degrees
( ) greater than 78 degrees
( ) Off
( ) DK/NS

34c. **On a hot weekday evening from 6 pm to 10pm.**
( ) less than 65 degrees
( ) 65-68 degrees
( ) 69-72 degrees
( ) 73-75 degrees
( ) 76-78 degrees
( ) greater than 78 degrees
( ) Off
( ) DK/NS

34d. **During a hot weekday night from 10pm to 6am.**
( ) less than 65 degrees
( ) 65-68 degrees
( ) 69-72 degrees
( ) 73-75 degrees
( ) 76-78 degrees
( ) greater than 78 degrees
( ) Off
( ) DK/NS

I would now like to know the thermostat temperature setting for those same time periods but on a hot summer weekend.

35a. **On a hot weekend morning from 6 am to noon.**
( ) less than 65 degrees
( ) 65-68 degrees
( ) 69-72 degrees
( ) 73-75 degrees
( ) 76-78 degrees
( ) greater than 78 degrees
( ) No change from an average summer week day
( ) Off
( ) DK/NS

35b. **On a hot weekend afternoon from noon to 6 pm**

( ) less than 65 degrees
( ) 65-68 degrees
( ) 69-72 degrees
( ) 73-75 degrees
( ) 76-78 degrees
( ) greater than 78 degrees
( ) No change from an average summer week day
( ) Off
( ) DK/NS

35c. **On a hot weekend evening from 6 pm to 10pm.**
( ) less than 65 degrees
( ) 65-68 degrees
( ) 69-72 degrees
( ) 73-75 degrees
( ) 76-78 degrees
( ) greater than 78 degrees
( ) No change from an average summer week day
( ) Off
( ) DK/NS

35d. **During a hot weekend night from 10pm to 6am.**
( ) less than 65 degrees
( ) 65-68 degrees
( ) 69-72 degrees
( ) 73-75 degrees
( ) 76-78 degrees
( ) greater than 78 degrees
( ) No change from an average summer week day
( ) Off
( ) DK/NS

36a. **Duke Energy is always looking for other ways to help their customers. If Duke were to offer a program that cycles other equipment at your home such as an electric water heater, would you be interested in participating?**
( ) Yes
( ) No
( ) DK/NS
comments optional: _________________

If No, ask:
36b. **Why not?** _________________

37. **Are there any programs or services that you think Duke Energy should provide to its residential customers that are currently not provided?**
( ) Yes

( ) No
( ) DK/NS

If Yes,
37b. **What services or types of programs? ___________________________________**

38a. **Using a scale of 1 to 10 where 1 indicates "Very Dissatisfied" and 10 indicates "Very Satisfied", What is your overall satisfaction with Duke Energy?**
( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) 8 ( ) 9 ( ) 10 ( ) DK/NS

If 7 or below,
38b. **Why are you less than satisfied with Duke Energy? ______________________**

(Ohio only)
39a. **If you were rating your overall satisfaction with Duke Energy, would you say you were Very Satisfied, Somewhat Satisfied, Neither Satisfied nor Dissatisfied, Somewhat Dissatisfied, or Very Dissatisfied?**
( ) Very Satisfied
( ) Somewhat Satisfied
( ) Neither Satisfied nor Dissatisfied
( ) Somewhat Dissatisfied
( ) Very Dissatisfied
( ) Refused
( ) DK/NS

(Ohio only)
39b. **Why do you give it that rating? _____________________________________**

40. **What's your best estimate of how many dollars you will receive in yearly bill credits from Duke Energy for participating in the Power Manager program?**
( ) $: ________________
( ) DK/NS

41a. **Have you received any bill credits this year from Duke Energy for participating in this program?**
( ) Yes
( ) No
( ) DK/NS

If Yes to Q41, ask:
41b. **How many times have you noticed the Power Manager credits on your bill this summer?**
( ) Every bill this summer
( ) Once
( ) Twice
( ) Three

( ) Four or more times
( ) Other, *specify*: ________________
( ) DK/NS

Finally, we have some general demographic questions…

d1. **In what type of building do you live?**
( ) Single-family home, detached construction
( ) Single family home, factory manufactured/modular
( ) Single family, mobile home
( ) Row House
( ) Two or Three family attached residence-traditional structure
( ) Apartment (4 + families)---traditional structure
( ) Condominium---traditional structure
( ) Other: ________________
( ) Refused
( ) DK/NS

d2a. **What year was your residence built?**
( ) 1959 or before
( ) 1960-1979
( ) 1980-1989
( ) 1990-1997
( ) 1998-2000
( ) 2001-2007
( ) 2008-present
( ) DK/NS

d2b. **How long have you been living in your current residence?**
( ) less than 1 year
( ) 1 to 3 years
( ) 3 to 5 years
( ) 5 to 10 years
( ) 10 to 15 years
( ) 15 to 20 years
( ) 20 to 25 years
( ) more than 25 years
( ) DK/NS

d3. **How many rooms are in your home (excluding bathrooms, but including finished basements)?**
( ) 1 to 3
( ) 4
( ) 5
( ) 6

( ) 7
( ) 8
( ) 9
( ) 10 or more
( ) DK/NS

d4. **Which of the following best describes your home's heating system?**
Select all that apply.
[ ] None
[ ] Central forced air furnace
[ ] Electric Baseboard
[ ] Heat Pump
[ ] Geothermal Heat Pump
[ ] Other: _________________
[ ] DK/NS

d5. **How old is your heating system?**
( ) 0-4 years
( ) 5-9 years
( ) 10-14 years
( ) 15-19 years
( ) 19 years or older
( ) DK/NS
( ) Do not have

d6. **What is the primary fuel used in your heating system?**
( ) Electricity
( ) Natural Gas
( ) Oil
( ) Propane
( ) Other: _________________
( ) DK/NS

d7. **What is the secondary fuel used in your primary heating system, if applicable?**
( ) Electricity
( ) Natural Gas
( ) Oil
( ) Propane
( ) Other: _________________
( ) None
( ) DK/NS

d8. **Do you use one or more of the following to cool your home?**
Select all that apply.
[ ] None, do not cool the home
[ ] Heat pump for cooling

[ ] Central air conditioning
[ ] Through the wall or window air conditioning unit
[ ] Geothermal Heat pump
[ ] Other *(please specify?)*: ________________
[ ] DK/NS

d9. **How many window-unit or "through the wall" air conditioner(s) do you use?**
( ) None
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8 or more

d10. **What is the fuel used in your cooling system?**
Select all that apply.
[ ] Electricity
[ ] Natural Gas
[ ] Oil
[ ] Propane
[ ] Other: ________________
[ ] None
[ ] DK/NS

d11. **How old is your cooling system?**
( ) 0-4 years
( ) 5-9 years
( ) 10-14 years
( ) 15-19 years
( ) 19 years or older
( ) DK/NS
( ) Do not have

d12. **What is the fuel used by your water heater?**
Select all that apply.
[ ] Electricity
[ ] Natural Gas
[ ] Oil
[ ] Propane
[ ] Other: ________________
[ ] No water heater
[ ] DK/NS

d13. **How old is your water heater?**

( ) 0-4 years
( ) 5-9 years
( ) 10-14 years
( ) 15-19 years
( ) More than 19 years
( ) DK/NS

d14. **What type of fuel do you use for clothes drying?**
Select all that apply.

[ ] Electricity
[ ] Natural Gas
[ ] Oil
[ ] Propane
[ ] Other: ________________
[ ] No clothes dryer
[ ] DK/NS

d15. **About how many square feet of living space are in your home?**
(Do not include garages or other unheated areas)
Note: A 10-foot by 12 foot room is 120 square feet

( ) Less than 500
( ) 500 to 999
( ) 1000 to 1499
( ) 1500 to 1999
( ) 2000 to 2499
( ) 2500 to 2999
( ) 3000 to 3499
( ) 3500 to 3999
( ) 4000 or more
( ) DK/NS

d16. **Do you own or rent your home?**

( ) Own
( ) Rent

d17. **How many levels are in your home (not including your basement)?**

( ) One
( ) Two
( ) Three

d18. **Does your home have a heated or unheated basement?**

( ) Heated
( ) Unheated
( ) No basement
( ) DK/NS

d19. **Does your home have an attic?**
( ) Yes
( ) No
( ) DK/NS

d20. **Are your central air/heat ducts located in the attic?**
( ) Yes
( ) No
( ) N/A
( ) DK/NS

d21. **Does your heating system keep your home comfortable in winter?**
( ) Yes
( ) No
( ) DK/NS

d22. **Does your cooling system keep your home comfortable in summer?**
( ) Yes
( ) No
( ) DK/NS

d23a. **Do you have a programmable thermostat?**
( ) Yes
( ) No
( ) DK/NS

d23b. **How many thermostats are there in your home?**
( ) 0
( ) 1
( ) 2
( ) 3
( ) 4 or more
( ) DK/NS

d24. **What temperature is your thermostat set to on a typical summer weekday afternoon?**
( ) Less than 69 degrees
( ) 69-72 degrees
( ) 73-78 degrees
( ) Higher than 78 degrees
( ) Off
( ) DK/NS

d25. **What temperature is your thermostat set to on a typical winter weekday afternoon?**
( ) Less than 67 degrees
( ) 67-70 degrees

( ) 71-73 degrees
( ) 74-77 degrees
( ) 78 degrees or higher
( ) Off
( ) DK/NS

d26. **Would a two-degree increase in the summer afternoon temperature in your home affect your comfort …**
Read all answers until they reply.
( ) **Not at all**
( ) **Slightly**
( ) **Moderately, or**
( ) **Greatly**
( ) DK/NS

d27a. **How many people live in this home?**
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8 or more
( ) Prefer not to answer

d27b. **How many of them are teenagers?**
(age 13-19)
If they ask why: Explain that teenagers are generally associated with higher energy use.
( ) 0
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8 or more
( ) Prefer not to answer

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.

d28. **What is your age group?**
Read all until they reply.
( ) **18-34**

( ) **35-49**
( ) **50-59**
( ) **60-64**
( ) **65-74**
( ) **Over 74**
( ) Prefer not to answer

d29. **Please indicate your annual household income.**
Read all until they reply.
( ) **Under $15,000**
( ) **$15,000-$29,999**
( ) **$30,000-$49,999**
( ) **$50,000-$74,999**
( ) **$75,000-$100,000**
( ) **Over $100,000**
( ) Prefer Not to Answer
( ) DK/NS

d30. Interviewer: record gender of respondent – do not ask.
( ) Male
( ) Female
( ) DK/NS

We have reached the end of the survey. As I mentioned earlier, we would like to send you $20 for your time and feedback today. Should we send the $20 to *{address on calling sheet}*, **or would a different address be better?**

Confirm Name & complete address from calling sheet. If needed, make any changes to Name or Address on calling sheet, and mark "Changed Info" column.

Shall we use the name and address on the call sheet for their incentive check?
if "No", record any changes on call sheet
( ) Yes
( ) No

You should receive your $20 check in about 4-6 weeks. It will come in an envelope from our company: TecMarket Works.

Thanks again for your time today!
(politely end call)

Appendix B: Participant Survey Customer Descriptive Data

TecMarket Works surveyed 80 participants about their homes and households. Additional descriptive data is provided in this appendix.

In what type of building do you live?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Condominium---traditional structure	2	2.5	2.5	2.5
	Single family home, factory manufactured/modular	5	6.3	6.3	8.8
	Single family, mobile home	1	1.3	1.3	10.0
	Single-family home, detached construction	72	90.0	90.0	100.0
	Total	80	100.0	100.0	

What year was your residence built?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1959 and before	35	43.8	43.8	43.8
	1960-1979	18	22.5	22.5	66.3
	1980-1989	7	8.8	8.8	75.0
	1990-1997	11	13.8	13.8	88.8
	1998-2000	3	3.8	3.8	92.5
	2001-2007	5	6.3	6.3	98.8
	2008-present	1	1.3	1.3	100.0
	Total	80	100.0	100.0	

How long have you been living in your current residence?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 to 3 years	6	7.5	7.5	7.5
	10 to 15 years	13	16.3	16.3	23.8
	15 to 20 years	7	8.8	8.8	32.5
	20 to 25 years	8	10.0	10.0	42.5
	3 to 5 years	5	6.3	6.3	48.8
	5 to 10 years	12	15.0	15.0	63.8
	more than 25 years	29	36.3	36.3	100.0
	Total	80	100.0	100.0	

How many rooms are in your home (excluding bathrooms, but including finished basements)?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	10 or more	10	12.5	12.5	12.5
	4	5	6.3	6.3	18.8
	5	7	8.8	8.8	27.5
	6	14	17.5	17.5	45.0
	7	19	23.8	23.8	68.8
	8	14	17.5	17.5	86.3
	9	11	13.8	13.8	100.0
	Total	80	100.0	100.0	

Which of the following best describes your home's heating system?	**Ohio (N=80)**	
	Count	**Percent**
None	0	0.0%
Central forced air furnace	65	81.3%
Electric Baseboard	0	0.0%
Heat Pump	13	16.3%
Geothermal Heat Pump	0	0.0%
Space heaters	3	3.8%
Wood burning stove or furnace	2	2.5%
Infrared heat / radiant heat	2	2.5%
Don’t know	1	1.3%

May total to more than 100% because respondents could give multiple responses.

How old is your heating system?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-4 years	15	18.8	18.8	18.8
	10-14 years	18	22.5	22.5	41.3
	15-19 years	10	12.5	12.5	53.8
	19 years or older	12	15.0	15.0	68.8
	5-9 years	21	26.3	26.3	95.0
	DK/NS	4	5.0	5.0	100.0
	Total	80	100.0	100.0	

What is the primary fuel used in your heating system?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DK/NS	1	1.3	1.3	1.3
	Electricity	15	18.8	18.8	20.0
	Natural Gas	51	63.8	63.8	83.8
	Oil	9	11.3	11.3	95.0
	Propane	4	5.0	5.0	100.0
	Total	80	100.0	100.0	

What is the secondary fuel used in your primary heating system, if applicable?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DK/NS	2	2.5	2.5	2.5
	Electricity	40	50.0	50.0	52.5
	Natural Gas	1	1.3	1.3	53.8
	None	34	42.5	42.5	96.3
	Oil	1	1.3	1.3	97.5
	Other: "*two ventless gas fireplaces*"	1	1.3	1.3	98.8
	Propane	1	1.3	1.3	100.0
	Total	80	100.0	100.0	

Do you use one or more of the following to cool your home?	**Ohio (N=80)**	
	Count	**Percent**
None, do not cool the home	0	0.0%
Heat pump for cooling	14	17.5%
Central air conditioning	65	81.3%
Through the wall or window air conditioning unit	2	2.5%
Geothermal Heat pump	0	0.0%
Other: "*fans*", "*open windows*"	2	2.5%
Don't know	1	1.3%

May total to more than 100% because respondents could give multiple responses.

How many window-unit or "through the wall" air conditioner(s) do you use?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	1	1.3	1.3	1.3
	3	1	1.3	1.3	2.5
	None	78	97.5	97.5	100.0
	Total	80	100.0	100.0	

What is the fuel used in your cooling system?	**Ohio (N=80)**	
	Count	**Percent**
Electricity	80	100.0%
Natural Gas	1	1.3%
None (no cooling system)	0	0.0%
Don't know	0	0.0%

May total to more than 100% because respondents could give multiple responses.

How old is your cooling system?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-4 years	20	25.0	25.0	25.0
	10-14 years	17	21.3	21.3	46.3
	15-19 years	12	15.0	15.0	61.3
	19 years or older	11	13.8	13.8	75.0
	5-9 years	15	18.8	18.8	93.8
	DK/NS	4	5.0	5.0	98.8
	Do not have	1	1.3	1.3	100.0
	Total	80	100.0	100.0	

	Ohio (N=80)	
What is the fuel used by your water heater?	**Count**	**Percent**
Electricity	34	42.5%
Natural Gas	42	52.5%
Propane	2	2.5%
No water heater	0	0.0%
Don't know	2	2.5%

May total to more than 100% because respondents could give multiple responses.

How old is your water heater?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-4 years	30	37.5	37.5	37.5
	10-14 years	10	12.5	12.5	50.0
	15-19 years	3	3.8	3.8	53.8
	5-9 years	24	30.0	30.0	83.8
	DK/NS	6	7.5	7.5	91.3
	More than 19 years	7	8.8	8.8	100.0
	Total	80	100.0	100.0	

What type of fuel do you use for clothes drying?	Ohio (N=80)	
	Count	Percent
Electricity	67	83.8%
Natural Gas	14	17.5%
Propane	0	0.0%
No water heater	0	0.0%
Don't know	1	1.3%

May total to more than 100% because respondents could give multiple responses.

About how many square feet of living space are in your home? (Do not include garages or other unheated areas)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1000 to 1499	14	17.5	17.5	17.5
	1500 to 1999	19	23.8	23.8	41.3
	2000 to 2499	21	26.3	26.3	67.5
	2500 to 2999	6	7.5	7.5	75.0
	3000 to 3499	2	2.5	2.5	77.5
	3500 to 3999	1	1.3	1.3	78.8
	500 to 999	5	6.3	6.3	85.0
	DK/NS	12	15.0	15.0	100.0
	Total	80	100.0	100.0	

Do you own or rent your home?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Own	79	98.8	98.8	98.8
	Rent	1	1.3	1.3	100.0
	Total	80	100.0	100.0	

How many levels are in your home (not including your basement)?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	One	31	38.8	38.8	38.8
	Two	49	61.3	61.3	100.0
	Total	80	100.0	100.0	

Does your home have a heated or unheated basement?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Heated	59	73.8	73.8	73.8
	No basement	11	13.8	13.8	87.5
	Unheated	10	12.5	12.5	100.0
	Total	80	100.0	100.0	

Does your home have an attic?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DK/NS	1	1.3	1.3	1.3
	No	14	17.5	17.5	18.8
	Yes	65	81.3	81.3	100.0
	Total	80	100.0	100.0	

Are your central air/heat ducts located in the attic?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DK/NS	3	3.8	3.8	3.8
	N/A	10	12.5	12.5	16.3
	No	56	70.0	70.0	86.3
	Yes	11	13.8	13.8	100.0
	Total	80	100.0	100.0	

Does your heating system keep your home comfortable in winter?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	3	3.8	3.8	3.8
	Yes	77	96.3	96.3	100.0
	Total	80	100.0	100.0	

Does your cooling system keep your home comfortable in summer?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	1	1.3	1.3	1.3
	Yes	79	98.8	98.8	100.0
	Total	80	100.0	100.0	

Do you have a programmable thermostat?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	33	41.3	41.3	41.3
	Yes	47	58.8	58.8	100.0
	Total	80	100.0	100.0	

How many thermostats are there in your home?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	1	1.3	1.3	1.3
	1	77	96.3	96.3	97.5
	2	1	1.3	1.3	98.8
	3	1	1.3	1.3	100.0
	Total	80	100.0	100.0	

What temperature is your thermostat set to on a typical summer weekday afternoon?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	69-72 degrees	14	17.5	17.5	17.5
	73-78 degrees	53	66.3	66.3	83.8
	Higher than 78 degrees	9	11.3	11.3	95.0
	Less than 69 degrees	2	2.5	2.5	97.5
	Off	2	2.5	2.5	100.0
	Total	80	100.0	100.0	

What temperature is your thermostat set to on a typical winter weekday afternoon?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	67-70 degrees	36	45.0	45.0	45.0
	71-73 degrees	18	22.5	22.5	67.5
	74-77 degrees	5	6.3	6.3	73.8
	78 degrees or higher	2	2.5	2.5	76.3
	Less than 67 degrees	18	22.5	22.5	98.8
	Off	1	1.3	1.3	100.0
	Total	80	100.0	100.0	

Would a two-degree increase in the summer afternoon temperature in your home affect your comfort…

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DK/NS	1	1.3	1.3	1.3
	Greatly	7	8.8	8.8	10.0
	Moderately	23	28.8	28.8	38.8
	Not at all	23	28.8	28.8	67.5
	Slightly	26	32.5	32.5	100.0
	Total	80	100.0	100.0	

How many people live in this home?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	15	18.8	18.8	18.8
	2	37	46.3	46.3	65.0
	3	12	15.0	15.0	80.0
	4	9	11.3	11.3	91.3
	5	1	1.3	1.3	92.5
	6	3	3.8	3.8	96.3
	7	2	2.5	2.5	98.8
	Prefer not to answer	1	1.3	1.3	100.0
	Total	80	100.0	100.0	

How many of them are teenagers? (age 13-19)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	69	86.3	86.3	86.3
	1	5	6.3	6.3	92.5
	2	4	5.0	5.0	97.5
	3	1	1.3	1.3	98.8
	Prefer not to answer	1	1.3	1.3	100.0
	Total	80	100.0	100.0	

What is your age group?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18-34	7	8.8	8.8	8.8
	35-49	14	17.5	17.5	26.3
	50-59	18	22.5	22.5	48.8
	60-64	10	12.5	12.5	61.3
	65-74	12	15.0	15.0	76.3
	Over 74	19	23.8	23.8	100.0
	Total	80	100.0	100.0	

Please indicate your annual household income.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	$15,000-$29,999	4	5.0	5.0	5.0
	$30,000-$49,999	6	7.5	7.5	12.5
	$50,000-$74,999	15	18.8	18.8	31.3
	$75,000-$100,000	7	8.8	8.8	40.0
	DK/NS	4	5.0	5.0	45.0
	Over $100,000	9	11.3	11.3	56.3
	Prefer Not to Answer	34	42.5	42.5	98.8
	Under $15,000	1	1.3	1.3	100.0
	Total	80	100.0	100.0	

Survey respondent gender (recorded by interviewer)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	28	35.0	35.0	35.0
	Male	52	65.0	65.0	100.0
	Total	80	100.0	100.0	

Appendix C: Participant Explanations of Satisfaction Ratings

Surveyed participants were asked to explain their satisfaction ratings for the Power Manager program and for Duke Energy overall; their verbatim comments are categorized and listed below.

<u>"Very satisfied" with Power Manager program (N=61)</u>

- *I've never had any problems with the program.* (n=2)
- *Duke Energy is a very good company and they have good ideas on how to save energy.*
- *I am very satisfied because the device doesn't bother me a lot. I maintain comfort by keeping a fan running and having shades drawn on sunny days.*
- *I am very satisfied because I haven't experienced any problems; the device is working, and does not interfere with our lives.*
- *I am very satisfied because I haven't felt discomfort due to the device. Enrollment and participation are very easy to do.*
- *I am very satisfied because I haven't noticed a difference in comfort, and I appreciate the bill credits.*
- *I am very satisfied because the program did not affect my level of comfort and it helps conserve energy.*
- *I am very satisfied because the program has not been a hindrance. I have no complaints about Power Manager.*
- *I am very satisfied because the program hasn't negatively impacted us and Duke Energy effectively answered all my questions when I first enrolled in the program.*
- *I am very satisfied because the program saves me a little money and it hasn't caused any discernible amount of discomfort.*
- *I am very satisfied because the program was thoroughly explained, I haven't noticed any discomfort, and I consider it my civic duty to help reduce energy consumption.*
- *I am very satisfied because we haven't noticed any discomfort. The program is essentially invisible to us.*
- *I am very satisfied because we haven't noticed any significant difference in our level of comfort.*
- *I am very satisfied with Power Manager because I don't ever notice it.*
- *I am very satisfied with Power Manager because I haven't experienced any problems with it. I had forgotten that I'd even enrolled in the program.*
- *I am very satisfied with Power Manager because I've never noticed it nor had any problems with it.*
- *I am very satisfied with Power Manager because it hasn't affected my comfort. I haven't noticed it. The device works flawlessly.*
- *I am very satisfied with Power Manager because it hasn't negatively impacted my life.*
- *I am very satisfied with Power Manager because it's essentially invisible to me.*

- *I am very satisfied with the Power Manager program because I have never noticed if or when the device has been activated. It has not affected my comfort.*
- *I believe that I am saving money.*
- *I don't even know it's there.*
- *I don't even know what happened. I really don't know anything about the program but I haven't noticed any changes so I'm assuming that everything is working fine.*
- *I don't notice it because I'm not usually home when they are running the device. I did notice that the house was extremely hot once the summer of 2013 but it was an extremely hot day so I wasn't surprised.*
- *I don't pay any attention to it. I haven't noticed anything.*
- *I have been happy with the program because we never notice when it's being activated.*
- *I don't really know when the device is being activated.*
- *I had forgotten that we were even in the program because we've never noticed when the device was being activated.*
- *I haven't been affected by the device except that one time a few years ago when I was actually home during an event.*
- *I haven't been inconvenienced by the program at all.*
- *I haven't had any problems with being in the program.*
- *I haven't had any problems with the program but there's always room for improvement.*
- *I haven't had any problems with the program. It seemed like a good idea at the time because it is supposed to be saving us money.*
- *I haven't noticed any problems with having the device installed. The house stays pretty comfortable all day.*
- *I haven't noticed any problems with our service and any financial savings is welcome.*
- *I haven't noticed anything and it helps with the enormous amount of energy being used every day.*
- *I haven't noticed anything and it saves a little money on our summer bills.*
- *I haven't noticed anything.*
- *I haven't noticed anything. It doesn't seem to affect our level of comfort at all.*
- *I haven't noticed anything. We've had no problems with the program.*
- *I haven't noticed it but I'm not sure how we benefit from being in the program.*
- *I haven't really noticed anything because the house is well insulated.*
- *I like conserving energy and this program makes it easy to do.*
- *I never had any problems with the program*
- *I trust Duke and I know that they won't turn the AC off too long to make me uncomfortable*

- *I was happy to help conserve energy for places like hospitals and places like that really need it on the hot afternoons.*
- *I wish were saving more money but I feel like it's important for everyone to do their part by conserving energy whenever possible.*
- *I'm very satisfied because I haven't had any negatives issues with the program and I appreciate the bill credits.*
- *I've never noticed when the device has been activated and I had actually forgotten that we were signed up for the program.*
- *I've noticed anything so I have no problems with the program.*
- *It does save a bit of money for us every summer and we haven't noticed when the device is being activated. Also, it helps avoid total power loss in our area. That way people who need power consistently throughout the day will be able to have the power that they need at all times.*
- *It doesn't bother us and we get a little credit on our bills in the summer.*
- *It hasn't caused me any problems.*
- *It offers a good and easy way to save money and energy.*
- *It seems to save money on my bill and I've never noticed if the device is running or not.*
- *It's supposed to save me some money on my bills.*
- *Our house really holds the cold well so we don't notice when the device is being activated.*
- *The program is really hassle-free. I get a credit when I signed up and I didn't have to do anything but make a phone to enroll. I've had no problems with the program*
- *We've never had a problem with the program but I don't think that it's really saving us any money.*
- *We've never noticed when the device is activated. We're gone in the afternoons when they are controlling our AC and by the time we get home in the evenings, the house has cooled off enough.*

“Somewhat satisfied” with Power Manager program (N=12)

- *I am somewhat satisfied because I am unaware of the specifics surrounding the program.*
- *I am somewhat satisfied because the program is not a big inconvenience.*
- *I am somewhat satisfied with Power Manager because I'm not fully aware of all the program details.*
- *I don't know how much energy and money we are saving. I suppose the amounts change every year but I'd like to know how much energy we're actually able to conserve by being enrolled in the program.*
- *I haven't noticed any saving on our bill but I also haven't noticed the house getting hot or humid.*

- *I haven't noticed anything and it's supposed to be saving me some money but I haven't noticed that either.*
- *I haven't seen any savings.*
- *It didn't mess with my life. We don't notice when the device is being activated.*
- *It's a good program and I'm happy to help Duke Energy avoid running out of power during peak usage hours. I noticed the device was running a lot in the summer of 2013 but it wasn't an issue the summer of 2014.*
- *That's just how I want to rate them. I don't really have a reason.*
- *They said that they had to install the Power Manager device even though I didn't want it. The guy from Duke Energy came to the house and installed a little device on the AC. He said that everyone had to have it.*
- *We haven't really noticed anything but it really only benefits Duke Energy.*

“Neither satisfied nor dissatisfied” with Power Manager program (N=5)

- *I don't really understand how the program works but it doesn't seem to be saving me any money.*
- *I wish they would run it all the time. It would be a better program for me if it would save more money all the time.*
- *I'm pretty neutral about the program. I don't really think it's doing anything for me and that it's really just helping Duke not run out of power at peak times.*
- *Since we rarely use the AC it's really hard to evaluate the program. We're not home when the device would be running and we usually have the AC off when we're not home.*
- *The difference in the bill is negligible. I can't tell when the device is running, which is good, but I also can't tell when the device has been activated when I see my bill.*

“Somewhat dissatisfied” with Power Manager program (N=1)

- *I am somewhat dissatisfied because I would have preferred more information about the program. The Duke Energy website could provide an educational video about Power Manager.*

“Very dissatisfied” with Power Manager program (N=0)

- No survey participants gave this response.

“Don’t know” satisfaction with Power Manager program (N=1)

- *I don't feel sufficiently informed about the program to give it an accurate satisfaction rating.*

<u>"Very satisfied" with Duke Energy overall (N=56)</u>

- *I've never had any problems with Duke Energy.* (n=7)
- *Anytime we've had a problem with service Duke Energy comes out and fixes it right away. I've never had any problems with them and they have good customer service.*
- *I've always been very satisfied with Duke. I've never had a problem with them and through work I've participated in the Smart $aver [non-residential] program which I liked. We replaced a lot of old inefficient lighting.*
- *Every time I've needed to call they're very responsive.*
- *I am very satisfied because Duke Energy does a good job fixing power outages quickly. A minor gripe would be that they tore up part of my driveway without prior notice this past summer.*
- *I am very satisfied because Duke Energy does their job well. They're a good company. I appreciate the incentive programs.*
- *I am very satisfied because Duke Energy is forgiving when I'm occasionally late paying my bill. I appreciate the free CFLs and Duke's various energy efficiency programs. It's hard to compare energy providers because of the limited information that's available.*
- *I am very satisfied because of Duke Energy's reliability and accurate billing.*
- *I am very satisfied Duke Energy because their service is reliable and they offer fairly good rates.*
- *I am very satisfied with Duke Energy because I haven't experienced any problems with them. They're reliable.*
- *I am very satisfied with Duke Energy because I haven't had any problems with them. On the rare occasions when I've experienced service outages they've made repairs quickly.*
- *I am very satisfied with Duke Energy because I never have any problems with them.*
- *I am very satisfied with Duke Energy because I think they have done a good job. I was initially leery when Duke took over for Cincinnati Gas & Electric but my fears have been quelled.*
- *I am very satisfied with Duke Energy because I've never had any problems with them.*
- *I am very satisfied with Duke Energy because of their seamless service reliability.*
- *I am very satisfied with Duke Energy because their service is diligent.*
- *I am very satisfied with Duke Energy because they demonstrated a willingness to work with me on some billing issues.*
- *I am very satisfied with Duke Energy because they have greatly reduced the number of power outages. I used to need a battery-powered clock because I couldn't trust Duke's electrical service reliability.*
- *I am very satisfied with Duke Energy because they offer comparatively better service than other energy providers.*
- *I am very satisfied with Duke Energy because they restore power quickly during outages and provide responsive customer service.*

- *I am very satisfied with Duke Energy because they've provided prompt service whenever I've had issues.*
- *I am very satisfied with Energy but would have preferred more information about the Power Manager program when I first moved in.*
- *I had one little time I smelled gas and they came right away. They gave me comfort and safety without alarming me. They serviced me just fine.*
- *I haven't had any problems with Duke and my cousin used to work for them.*
- *I haven't had any problems with Duke and we don't have frequent power outages*
- *I haven't had any problems with Duke but they call me at least three times every day and they try to get me to switch companies. They say that they're going to save me money and that they are with Duke Energy but I don't want to switch my power company. They should call so much.*
- *I haven't had any problems with Duke Energy ever and I've been a customer since they took over CG & E.*
- *I haven't had any problems with Duke Energy. I had switched to Jess Electric but they couldn't explain my bill to me so I went back to Duke Energy.*
- *I haven't had any problems with Duke. One time a squirrel chewed through the wire that comes into the house and we had a big issue with that. It electrocuted the Time Warner guy and all my appliances fried but the insurance company paid for most of that. It's not really any fault on Duke's part. It was the squirrel that caused the problem but that's the closest to a problem with Duke we've ever had.*
- *I like Duke because I've never had any problems with them and they always fix stuff quickly when something goes wrong.*
- *I never had any conflict with them.*
- *I'm very happy with them.*
- *I've always been satisfied but very satisfied seems a bit more satisfied than I am but I'm more satisfied than somewhat. We've never had any problems.*
- *I've always used Duke Energy since we came to the United States. They are good at keeping the power running and when there is an outage they are good at getting the power back on quickly.*
- *I've never had any problems with Duke and I trust them.*
- *I've never had any problems with Duke and they have reasonable rates.*
- *I've never had any problems with Duke and we don't lose power much.*
- *I've never had any problems with Duke Energy but the rates keep going up and I'm on a fixed income which is making it hard to keep up with the rising rates.*
- *I've never had any problems with Duke Energy so I'll rate them well.*
- *I've had no problems with Duke but there's always room for improvement.*
- *It's easy to deal with Duke.*
- *The customer service representatives gave me the run around when I needed to change the billing name to mine after my mother's death. I went Cincinnati call center and spoke with a manager there to get the situation taken care of.*

- *The service is consistent and I trust them. Other companies might not be as consistent with the service so I wouldn't want to switch. It's better to stay with a provider that you know is going to be able to provide consistent power instead of going with a provider that you don't know as well even if they promise to save you a few cents here and there.*
- *They are easy to communicate with every time I have problems.*
- *They are pretty good.*
- *They do a good job.*
- *They do a pretty good job. They get the power back on quickly when it goes out.*
- *They give me what I want and don't bother me with anything.*
- *We haven't had any problems with Duke Energy ever and we've been in the same house for 42 years.*

"Somewhat satisfied" with Duke Energy overall (N=15)

- *I am only somewhat satisfied because of Duke Energy's frustrating customer service and line repair policies. I experienced a week-long power outage which resulted in losing all of our refrigerated food. I was disappointed in Duke's slow response to the service outage.*
- *I am somewhat satisfied because Duke Energy provides good customer service and makes repairs quickly. No big complaints, though I wish the rates were cheaper.*
- *I am somewhat satisfied because I think Duke Energy is fair but they tend to increase their rates too often.*
- *I am somewhat satisfied with Duke because the energy-related stuff in my life is confusing. I can't decide what to do when my Duke Energy contract is up and how to deal with all these other energy providers competing for my business.*
- *I don't really have any problems with Duke but I would prefer if they were a bit more environmentally inclined.*
- *I haven't really had any problems with Duke but our house is connected to an older transformer so our house and the neighbor's house lose power quite often. It would be better if that didn't happen.*
- *I still prefer CG & E over Duke Energy because CG & E was more efficient at getting things fixed quickly and addressing my concerns. Duke's customer service just isn't as good. Also the Duke bills are more confusing than CG & E's were.*
- *I've never had any problems with service. I received a letter from Duke about the Duke Energy Retail Fixed Rate Program where I could keep the same rate until 2017 but when I called to sign up I was on hold for hours each time and never got through.*
- *We have a lot of power outage issues.*
- *The rates are too high and they keep going up.*
- *The service is very reliable but it's not like we have a choice. I just wish rates were more stable.*

- *Nothing is bad but it's kind of hard to rate a power company higher than average. It's not like they can "wow" you with more than just reliable power.*
- *They're a pretty good company but I still wish that they were Cincinnati Gas and Electric.*
- *We haven't had any problems with Duke.*
- *I have no idea. That's just how I rate them.*

"Neither satisfied nor dissatisfied" with Duke Energy overall (N=5)

- *I am neither satisfied nor dissatisfied with Duke Energy because of their high energy rates and lack of consumer education.*
- *I am neither satisfied nor dissatisfied with Duke Energy because they're somewhat expensive.*
- *I haven't had any problems but I don't care really. I'm ambivalent about them.*
- *I've never had any problems with Duke Energy but the rates are high and they keep raising the rates.*
- *The rates are very high. We have a very efficient household but our even payment is still $250 per month.*

"Somewhat dissatisfied" with Duke Energy overall (N=2)

- *The rates are high and I don't understand what all those little charges are for. It's really hard to get to someone on the phone to help explain what they are. The power goes on and off for a few seconds almost every day and all the electronics in the house need to reset.*
- *They seem like a pretty heartless corporation because they are so quick to shut off the power to people's homes when they miss a bill. It's happened to me a few times because I travel for work and sometimes I'm not home in time to get the bill paid in time. They even shut it off once right before Thanksgiving.*

"Very dissatisfied" with Duke Energy overall (N=2)

- *Duke Energy has terrible customer relations. When I call I can't ever get someone on the phone and when I do get someone on the phone they usually can't answer my questions. Lately I've been getting letters from Duke about being able to lock down a given rate for 12 months from another supplier. I don't understand how these other suppliers can be giving out lower rates than Duke but still be Duke at the same time. I don't know what they're promising and if I can even believe them. When I call Duke Energy with questions about this, I'm told that they can't help me and that I need to talk with Duke Energy Retail. I don't understand what the difference is. Duke Energy does a horrible job of informing the customer.*
- *My bill is about $300 every month but our usage is less than $30. For some reason there are multiple high-priced riders on our bill that we have to pay every month. I'm a veteran on disability and after I pay my bills every month I'm left with $50 for food*

and other luxuries. I don't understand what these riders are about and no one I call can explain to me why I'm paying them.

APPENDIX N-

Power Manager Impact Evaluation

Impact Evaluation and Review of the 2014 Power Manager Program® Ohio

August 27, 2015

Duke Energy
139 East 4th Street
Cincinnati, Ohio 45202

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CADMUS

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Duke Energy Ohio and Cadmus

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CADMUS

Executive Summary

Power Manager is a voluntary residential load control program available to Duke Energy Ohio homeowners with qualified central air conditioning. Each year, program customers receive a monthly bill credit for participating during the summer months of May through September that we have an event. Participants agree to allow Duke Energy Ohio to cycle their air conditioning units during peak periods of energy demand, when energy costs are high, or for emergency purposes when program-induced load reductions would aid in the reliability of delivering energy to the region. Customers may choose to “opt” out of oneevent each month by contacting the Customer Service center and requesting that they not participate if an event were to occur on a particular date.

Duke Energy Ohio conducted the Program Year 2014 (PY2014) impact evaluation using a variety of commonly accepted, utility industry statistical practices and applications to measure and report results of the program. These included sample selection and validation, air conditioner duty cycle modeling, model simulations, switch device operability analysis, weather normalization, and monthly capability weighting of expected capacity. Due to a lack of events in PY2014, Duke Energy Ohio used impact evaluation models created in 2013. The approaches employed by Duke Energy Ohio were then reviewed by an independent, third-party evaluator (Cadmus) commensurate with standard evaluation, measurement, and verification (EM&V) industry practice. Based on research conducted by Cadmus in other jurisdictions, as well as a critical review of the processes used for Power Manager, the findings for PY2014 are comprehensive and credible.

Program Year 2014 Highlights

- There were 47,960 active switches installed at the end of September 2014.
- For PY2014, the operability study conducted in Ohio revealed that Power Manager switch devices were operational at a 85.4% rate (see Table 1).
- For PY2014, the total summer Ohio Power Manager Program capacity—adjusted for peak normal weather and de-rated for operability and calculated at the point of generation—was 47.8 MW.
- During PY2014, there was one (1) Power Manager event in Ohio. This event was part of the required PJM annual test for demand response capacity resources.
- Duke Energy Ohio was faced with operational and market challenges due to a lack of significant hot weather and low energy prices. The program team decided not to call events for days when the program impact would have been marginal and of little economic impact.

Table 1. PY2014 Program Summary

Program Year	Active Switches	Summer Capacity	Operability Rate	Average Realization Rate (1.0 kW)	Average Realization Rate (1.5 kW)
PY2014	47,960	47.8 MW	85.4%	105.0%	98.7%

Introduction

Power Manager is a voluntary residential load control program available to Duke Energy Ohio homeowners with qualified central air conditioning. Each year, program customers receive a monthly bill credit for participating during the summer months of May through September that we have an event. Participants agree to allow Duke Energy Ohio to cycle their air conditioning units during peak periods of demand, when energy costs are high, or for emergency purposes when program-induced load reductions would aid in the reliability of delivering energy to the region. Customers may choose to “opt” out of oneevent each month by contacting the Customer Service center and requesting that they not participate if an event were to occur on a particular date.

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Program Participation

When a customer enrolls in the Power Manager Program, Duke Energy Ohio professionally installs a switch device at the customer premise that allows the air conditioning unit to be cycled for a temporary basis. Participating customers receive a one-time sign-up incentive that is based ontheir preference of level of load shed time they prefer (1.0 kW or 1.5 kW). For PY2014, the initial signup incentive was $25 for 1.0 kW or $35 for 1.5 kW load shed option. Participants are also eligible to receive a per-event energy credit on their electric bill during event months (May-September).

The switch devices are installed outside the residence in close proximity to the air conditioning unit and they cycle the air conditioner unit in response to event signals sent over an internal paging network. Customers with multiple air conditioning units can receive multiple credits.

Duke Energy Ohio may call Power Manager cycling events on non-holiday weekdays during the summer months of May through September. There were 47,960 active switches enrolled at the end of September 2014 (see Table 2).

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Table 2. Power Manager Program Participation Summary (as of end of September)[1]

Program Year	Active Switches	Annual Change	Summer Capacity (MW)
PY2014	47,960	3.52%	47.8
PY2013	46,329	8.76%	46.1
PY2012	42,597	N/A	44.9

[1] Capacity reported at the point of generation.

Analytical Methodology

Duke Energy Ohio conducted the impact evaluation of the Power Manager Program in a three step approach:

1. Tested the operability of the active switch devices installed at the customer premises
2. Calculated the impact or demand reduction per switch during events as determined by a duty cycle analysis
3. Provided documentation to Cadmus for review and approval as the independent EM&V contractor

Operability Study

For PY2014, Duke Energy Ohio determined the operability of the active switch devices installed at the customer premises using a representative sample group of customers. There are two components of device operability: the setup factor and the shed factor.

- ***Setup Factor*** - Quantifies the proper installation and configuration of switch devices in the sample group (including the physical installation, wiring, and programming)
- ***Shed Factor*** - Quantifies performance during actual load control events for switches with the correct setup, and measures the switch effectiveness at achieving the programmed load shed

Combined, the setup and shed factors provide an overall operability rate, which is used to de-rate the program impacts and capacity.

Setup Factor

The setup factor used in this evaluation was established in the 2013 Operability Study, which occurs every four years. In March 2013, Duke Energy Ohio selected a random sample of 150 households with 158 switch devices[2] from the population of Power Manager participants in Ohio and Kentucky.[3] The sample size was designed to target ±5% precision at the 90% confidence level. The combination of households selected from Ohio and Kentucky met the ±5% precision at the 90% confidence level.

[2] Multiple switch devices may be installed at a single household with more than one air conditioning unit enrolled in the program.

[3] Due to timing and sample selection, future Operability Studies (i.e. PY2016 and beyond) will only include participant data from Ohio customers.

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In July 2013, Duke Energy Ohio collected switch data from the sample group, downloading it directly from the switch devices. A total of 5 households were dropped from the operability study (reflecting 5 participating switches) due to the following reasons:

- 3 households due to access problems (gates on households, large dogs)
- 2 households with no data due to the switches not being on

Table 3. PY2013 Operability Group Removals

	Households	Switches
Beginning Sample Group	150	158
Removals from Sample Group	(5)	(5)
Final Sample Group	145	153

The final operability sample group size was 145 households with 153 load control devices. Table 4 summarizes the Operability group observations pertaining to the setup factor.

Table 4. Operability Group Observations of Setup Factor

Reason for Removal from Operability Study	Switch Device Count	Qualifying Multiplier	Weighted Factor
Switch disconnected from air conditioner	14	0.00	0
No switch present at customer premise	3	0.00	0
1.5 kW switch configured as 1.0 kW switch	6	0.67 (2/3)	4
Switch set up correctly	130	1.00	130
Total	**153**		**134**
Set-Up Factor	**0.876**		

Duke Energy Ohio calculated the setup factor to be 87.6%.

Setup Factor = Total Weighted Factor / Total Switch Device Count

Shed Factor

As defined in Appendix A, Duke Energy Ohio used the 97.5% shed factor from the last operability study findings in the PY2013 report.

Shed Factor = Total Weighted Factor / Total Switch Device Count

Operability Study Findings

The operability study performerd in 2013 revealed that Power Manager switch devices were operational at a 85.4% rate. Duke Energy Ohio applied this de-rate factor to all program switch devices to more accurately represent the available program capacity and kW reduction during events.

The following calculation determined switch operability:

*87.6% [2013 sample group setup factor] * 97.5% [2013 sample group shed factor] = 85.4%*

The historical operability study results are shown in Table 5.

Table 5. Historical Operability Study Performance

Program Year	Setup Factor	Shed Factor	De-Rating Factor
PY2013	87.6%	97.5%	85.4%
PY2010	N/A	N/A	93.1%[4]

Impact Study

The program event Impact results were calculated using a duty cycle analysis model. An hourly historical duty cycle, or percentage of runtime, is recorded and later collected in the field for the customers selected to be in the EM&V group. The historical profile is created by instructing the switch devices to record key run time data on specified days. The dates saved are non-event program days with high temperatures, typically above 90°. Each "saved day" goes into the switch device historical profile as a weighted proportion. This process creates a unique historical air conditioning usage profile which serves as a representative sample for the larger general population of switch devices in the program. The historical profile is compared to the actual air conditioning run time during an event day. Event impacts are calculated on an hourly basis. During PY2014, there was a 1-hr required PJM test event. Due to a lack of events, Duke Energy Ohio used impact evaluation models (potential impact kW) from the PY2013 impact report to estimate MW impacts shown in Table 6.[5]

Table 6. Impact Results on 8/26/2014

Date	Hour (EDT)	De-Rated Impact (MW)	Switch Count (1.5 kW)	Switch Count (1.0 kW)	Temperature (°F)
8/26/2014	17	48.38	6,865	41,232	88°

Impact Per Switch Realization Rate

Table 7 details the realization rate between the actual impact per switch and expected impact per switch on an event day. These numbers are not de-rated or accounted for line losses. The actual impact per switch is based on the average impact for each cycling strategy: Target Cycle and True Cycle. Those averages are then weighted according to the switch percentages in the population. The actual impact per switch will vary during each event day based off temperatures and programming in the switch. The calculation for the realization rate is:

Realization Rate (%) = Actual Impact / Expected Impact

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3 De-Rating factors prior to 2010 were not split out between Setup and Shed Factors.

4 The PY2013 load impact methodology is provided in Appendix B.

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Table 7. Impact Realization Rate

Date	Hour (EDT)	Expected Impact/Switch	Actual Impact/Switch	Realization Rate
8/26/2014	17	1.5 kW	1.48 kW	98.7%
		1.0 kW	1.05 kW	105.0%

PY2013 Load Impact Results

Table 8 details the calculated demand reduction per switch device under peak normal weather and using the de-rated impact from the operability study.

Table 8. Demand Reduction per Switch Device

Switch Type	Control Strategy	Potential Impact (kW)	De-rating Factor	De-rated Impact (kW)
Cannon	Target Cycle 1.5	1.53	0.854	1.31
	Target Cycle 1.0	1.02	0.854	0.87

PY2014 Program Capacity

Table 9 details the PY2014 Ohio Power Manager Program capacity, adjusted for peak normal weather, de-rated, and calculated at the point of generation. The loss factor used for Ohio in PY2014 was 6.3%.

Table 9. PY2014 Program Capacity, Ohio (MWs)

State	Control Strategy	May	June	July	August	September	Average Summer Capability
Ohio	Cycling	47.88	47.91	47.84	47.72	47.52	47.77

Independent Third-Party Review of Impacts

Duke Energy Ohio conducted the impact analysis of the Power Manager Program. Cadmus reviewed the results presented in this report to ensure proper methodology. With limited events called during PY2014, Duke Energy Ohio's approach of using historical data was both cost-effective and justified.

Cadmus reviewed the current operability rate for PY2014 of 85.4% and determined Duke Energy Ohio is in reasonable standing.

Cadmus determined that Duke Energy Ohio's impact evaluation provides an accurate estimate of PY2014 program impacts.

Appendix A

The following data is from the PY2013 Power Manager EM&V Report

2013 Operability Study for Ohio Cannon Load Control Devices

Cannon devices were instructed to execute a Target Cycle. With Target Cycle, each device calculates a unique shed time for each hour of load control based on the Amps parameter for the attached AC unit (entered into the device at installation) and the expected hourly run-time of the attached AC unit stored in the historical profile registers. Expected run-time is accumulated in the historical profile by saving run-time of the attached AC unit on days with weather conditions similar to load control days.

Table 10 shows the list of events occurred during the summer of 2013 for Cannon switches. The data collection included both device scan data and device data logs. Device data logs contain hourly shed minutes and hourly run-time for the attached AC unit. We obtained shed minutes during each hour of load control from device data logs and this information was used to assess shed performance of devices.

Table 10. OH PM events for Cannon devices

Event Date	Event Duration (EDT)
7/15/2013	2:30 – 5:00 pm
7/16/2013	2:30 – 6:00 pm
7/17/2013	2:30 – 5:00 pm
7/18/2013	2:30 – 5:00 pm

The shed factor measures correct response by properly configured devices to paging signals sent immediately prior to and during a load control event. In the PY2013 study, 136 devices were properly configured to shed. The shed factor was calculated by dividing the total non-zero shed event hours by total event hours for each device. Table 11summarizes the results pertaining to the shed factor. From this data, the shed factor estimate is 97.5%.

Table 11. Shed Factor

Factor	Count	Weighted Factor
0	1	0
0.17	1	0.17
0.26	1	0.26
0.63	1	0.63
0.83	1	0.83
0.9	2	1.8
0.93	1	0.93
1	128	128
Sum	**136**	**132.62**
Shed Factor	**0.975**	

Shed Factor = Sum of Weighted Factor / Total count

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Appendix B

The following data is from the PY2013 Power Manager EM&V Report

Load Impact Results – 2013 Impact Report

Load impacts described in this section are computed with population estimates of load reduction per switch, rather than load reduction per household. Simulation results are converted to load reduction per switch using the factor of 1.048 switches per household. Population estimates of load reduction per household are divided by this factor to get corresponding population estimates of load reduction per switch. The estimate of switches per household is determined from the M&V sample.

Table 12 shows de-rating factors used for the 2013 impact evaluation. Cannon factors in Ohio were determined by operability studies conducted in 2013.

Table 12. De-Rating Factors for Impact Evaluation

Switch Type	Ohio
Cannon	0.854

PM load control was activated in Ohio on 7 days during the summer of 2013. Table 13 gives hourly impact results adjusted with line losses for each control day.

Table 13. 2013 PM Impact Results

Event Date	Hour	PM Impact (MW)
7/15/2013	16	47.9
	17	48.8
7/16/2013	16	47.0
	17	48.4
	18	47.9
7/17/2013	16	56.3
	17	56.2
7/18/2013	16	49.1
	17	50.4
8/28/2013	16	56.6
9/10/2013	16	47.2
	17	47.0
9/11/2013	15	37.0
	16	38.3
	17	42.0

Table 14 gives estimated load reduction per switch not adjusted for line losses under peak normal weather conditions for different PM program options and load control technologies. Table 15 shows the summer monthly load reduction adjusted for line losses under peak normal weather conditions. Table 16 shows the peak normal weather conditions used to calculate the results. The system peak is assumed

to occur in the hour 4:00-5:00 pm EDT in Ohio (impacts for hour 18 reported due to requirement by PJM).

Table 14. Shed kW/switch with Peak Normal Weather

Switch Type	Control Strategy	Potential Impact	De-rated Impact
Cannon	TC 1.5	1.53	1.31
	TC 1.0	1.02	0.87

Table 15. Monthly Peak Normal Weather Load Reduction De-rated Impacts, Adjusted for Line Losses for Cycling

State	Control Strategy	May	June	July	August	September	Summer Capability
Ohio	Cycling	45.6	45.7	46.1	46.1	46.1	46.1

Table 16. Peak Normal Weather

Hour	Ohio	
	Temp	Dewpt
11	85.3	71.8
12	87.6	71.9
13	89.9	71.9
14	92.0	71.5
15	93.1	70.7
16	93.9	70.5
17	92.5	70.0
18	92.4	69.5

The last column of Table 15 shows the weighted average capability of the Power Manager program across the summer months in 2013. This weighted average value is calculated using the summer monthly values and weighting them based on the probability of experiencing an annual peak load in that month.

APPENDIX O-

Smart $aver Custom Evaluation

Evaluation of the Smart $aver Nonresidential Custom Incentive Program in Ohio

November 15, 2015

Evaluation, Measurement, & Verification for Duke Energy Ohio

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Prepared by:

Cadmus
NORESCO
BuildingMetrics

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Executive Summary

Duke Energy Ohio (DEO) engaged Cadmus, along with NORESCO and BuildingMetrics as subcontractors, (evaluation team) to perform an impact evaluation of the Smart $aver® Custom Incentive Program.

The evaluation team performed an impact analysis using measurement and verification (M&V) on a sample of 33 project participants. The evaluation team estimated a savings realization rate (RR) for each project and projected this RR onto the program participant population in the evaluation period.

TecMarket Works (along with NORESCO and BuildingMetrics as subcontractors) completed site visits and prepared M&V reports for 33 sites visited as part of the evaluation. In March 2015, the evaluation contract was transferred to Cadmus, with NORESCO and BuildingMetrics as subcontractors. Cadmus completed this report describing the results of the evaluation.

The evaluation period includes 164 projects completed by July 2015, with application received dates between January 2010 and March 2014. TecMarket Works performed verification site visits in two phases during fall of 2013 and winter of 2014.

Key Findings and Recommendations

In conducting this evaluation, the evaluation team identified the following key findings and recommendations.

Engineering Impact Estimates: Key Findings and Recommendations

- The program achieved an overall kWh realization rate (RR) across all projects of 95%, indicating it produced very close to expected savings on average. However, the individual RR ranged from 10% to 963%.
- Lighting and HVAC projects performed very close to program estimates (kWh RR of 97% and 101% respectively), while process projects underperformed relative to program estimates (kWh RR of 78%).
- Fourteen percent (14%) of the evaluated program savings are associated with freeriders, based on participants' responses to the program participation application survey. Therefore, the program net of freeridership ratio is 86%.
- HVAC projects with low RRs generally resulted from suboptimal or not fully implemented control strategies. Post-installation inspections or project commissioning can be used effectively to obtain the full energy savings available from HVAC control measures.
- Process projects with low RRs were generally characterized as variable frequency drive (VFD) projects with more operating hours at higher loads than assumed by program calculations. The VFD loads were less variable than assumed by program calculations. The evaluation team recommends reviewing VFD project load history assumptions during project screening.
- The large variations in RRs were caused by incorrect applications of the ASHRAE 90.1 Energy Standard to the project baseline in building performance models developed to estimate

expected savings. The evaluation team recommends more careful screening of new construction or renovation projects using ASHRAE 90.1 as the baseline.

- Lighting produced 32% of total program evaluated savings. Based on the review, some lighting projects could go through the Prescriptive Programs, reducing the burden on customers when filling out applications and the burden on Duke Energy staff when reviewing applications.
- Program calculations for lighting projects generally excluded consideration of HVAC interactive effects. The evaluation team suggests all lighting projects include interactive effects using multipliers available in the Ohio Technical Reference Manual (TRM).

Table 1 shows the program's *expected* (claimed, prior to the application of the RR from the previous Evaluation, Measurement, and Verification study), evaluated gross, and net energy savings by measure type.

Table 1. Program *Expected,* Evaluated Gross, and Net Energy Savings by Measure Type

Measure Type	Population Size	*Expected* Population kWh Impact	Realization Rate	Gross Evaluated Population kWh Impact	Net of Freeridership Ratio	Net Evaluated Population kWh Impact
Lighting	86	18,616,348	97%	18,064,815	86%	15,535,741
HVAC	49	30,108,389	101%	30,330,099		26,083,885
Process	29	11,418,348	78%	8,849,344		7,610,435
Total	**164**	**60,143,084**	**95%**	**57,244,257**	**86%**	**49,230,061**

Table 2 and Table 3 show the *expected*, evaluated gross, net summer coincident peak (CP), and non-coincident peak (NCP) demand savings for the program.

Table 2. Program *Expected,* Evaluated Gross, and Net CP Demand Savings by Measure Type

Measure Type	Population Size	*Expected* Population CP kW Impact	Realization Rate	Gross Evaluated Population CP kW Impact	Net of Freeridership Ratio	Net Evaluated Population CP kW Impact
Lighting	86	2,318	124%	2,868	86%	2,467
HVAC	49	2,775	175%	4,857		4,177
Process	29	1,195	94%	1,125		967
Total	**164**	**6,288**	**141%**	**8,850**	**86%**	**7,611**

Table 3. Program *Expected,* Evaluated Gross, and Net NCP Demand Savings by Measure Type

Measure Type	Population Size	*Expected* Population NCP kW Impact	Realization Rate	Gross Evaluated Population NCP kW Impact	Net of Freeridership Ratio	Net Evaluated Population NCP kW Impact
Lighting	86	2,742	168%	4,612	86%	3,966
HVAC	49	6,329	119%	7,512		6,461
Process	29	1,436	74%	1,065		916
Total	**164**	**10,507**	**126%**	**13,189**	**86%**	**11,342**

Table 4 shows the net energy and demand savings per unit and total for the M&V sampled projects.

Table 4. Net Energy and Demand Savings per Unit and Total for Sampled Projects

Measure Type	Number of Sampled Units	Evaluated Net Per Unit kWh	Evaluated Net Per Unit NCP kW	Evaluated Net Per unit CP kW	Evaluated Net Sample Total kWh	Evaluated Net Sample Total NCP kW	Evaluated Net Sample Total CP kW
Lighting	10	54,457	11	7	544,567	111	67
HVAC	16	982,816	202	170	15,725,056	3,228	2,718
Process	7	215,982	17	15	1,511,875	119	107

Evaluation Parameters

Table 5 lists the parameters reviewed in this evaluation, which consisted of gross savings realization rate for energy, CP, and NCP demand.

Table 5. Evaluated Parameters with Value, Units, and Precision and Confidence

Gross Savings	Value	Units	Confidence/ Precision
Energy RR	95%	N/A	90%/±9%
NCP demand RR	126%	N/A	90%/±10%
CP demand RR	141%	N/A	90%/±10%

Table 6 lists the start and end dates for sampling and review activities conducted for the impact evaluation.

Table 6. Sample Period Start and End Dates and Dates Evaluation Activities Conducted

Evaluation Component	Sample Period*	Dates Conducted	Total Conducted
Site visits	January 2010 – March 2014	Fall 2013 and Winter 2014	33
*Sample period is identified based on the application received dates.			

Introduction and Purpose of Study

Summary of the Evaluation

This report presents the results of an impact evaluation of the Ohio Smart $aver Nonresidential Custom Incentive Program (Custom Program).

Evaluation Objectives

The evaluation team performed an impact analysis using a measurement and verification (M&V) plan developed by NORESCO. The M&V plan followed the International Performance Measurement and Verification Protocol (IPMVP),[1] separating projects into lighting, HVAC, and process categories and drawing size-stratified samples from each category. The impact analysis sought to estimate a savings realization rate (RR) for each category that could be projected into the full program participant population in the evaluation period.

The sample was pulled from the list of customers that submitted an application for participation in the program. The program received the first application in January of 2010 and paid the first incentive in January of 2012. Two series of samples were pulled in May 2013 (20 projects) and June 2014 (15 projects) from the program opportunity tracking database.[2] The sites were visited during fall of 2013 and winter 2014.

The evaluation team based total impact savings on savings identified from 33 sites visited. The team then extrapolated the savings to all completed projects with application receipt dates ranging from January 2010 through March 2014. March 2014 was the last application received date in the tracking database when the last sampled was pulled. The evaluation period includes all projects completed by June 2015, with application received dates from January 2010 through March 2014.

Researchable Issues

In completing this study, the evaluation team performed the following activities:

- Estimated kWh, non-coincident peak (NCP) kW, and coincident peak (CP) kW savings for each project in the sample;
- Calculated kW and kWh RRs for each project;
- Calculated average kW and kWh RRs by lighting, HVAC, and process projects;
- Calculated confidence intervals around the RRs; and
- Identified causes for differences between evaluated savings and *ex ante* savings estimates.

1 International Performance Measurement and Verification Protocol. Concepts and Options for Determining Energy and Water Savings. Volume 1. Prepared by Efficiency Valuation Organization. www.evo-world.org. September, 2010. EVO 10000 – 1:2010.

2 Two sites later dropped out of the verification site visits.

Description of Program

The Duke Energy Custom Program intends to supplement the Smart $aver Nonresidential Prescriptive Incentive Program, which provides prescriptive rebates for preselected measures. Customers wishing to install measures not included in the Smart $aver Nonresidential Prescriptive Incentive Program list may apply for a rebate through the Custom Program. Table 7 lists the number of completed projects within the sample frame.

Table 7. Program Participation Count[3]

Program	Completed Projects
Smart $aver Nonresidential Custom Incentive Program	164

[3] The evaluation team is basing the program participation count on the number of applications received during the evaluation period that resulted in complete projects by June 2015.

Methodology

Overview of the Evaluation Approach

The evaluation team conducted an impact evaluation, performing an engineering analysis on a sample of 33 out of 164 projected program participants during the evaluation period. This impact analysis sought to estimate a savings RR for each category (lighting, HVAC, and process) that could be prospectively projected onto the full program participant population.

Study Methodology

The impact methodology consisted of an engineering analysis following the IPMVP.[4] For the final sample group, the evaluation team separated the total number of projects into lighting, HVAC, and process categories and drew samples from each category. Field staff conducted site surveys and installed metering equipment to gather data according to the M&V plan, taking pre- and post-installation measurements whenever possible. The team developed energy and demand savings estimates for each sampled project.

Data Collection Methods, Sample Sizes, and Sampling Methodology

During the sampling phase of the evaluation, the evaluation team projected a total population of 175 program participants for the evaluation period. The evaluation team chose a sample of 32 projects to meet a sampling error of ±10% at 90% confidence. The team stratified the participant population by project type and size to achieve an efficient sample. In particular, the evaluation included three very large HVAC projects in a "certainty" stratum to improve overall sample precision.

Number of Completes and Sample Disposition for Each Data Collection Effort

Table 8 lists the sample disposition for the impact study.

Table 8. Status of Sample with Application Received Dates January 2010 – March 2014

Group	Stratum	Sample Size	Completed	Notes
Lighting	1	7	10	Oversampled lighting in year 1
HVAC	1	3	3	Sample completed
	2	7	7	Sample completed
	3	7	6	One site dropped from the study
Process	1	8	7	One site dropped from the study
Total		**32**	**33**	

4 International Performance Measurement and Verification Protocol. *Concepts and Options for Determining Energy and Water Savings. Volume 1*. Prepared by Efficiency Valuation Organization. www.evo-world.org. September, 2010. EVO 10000–1:2010.

Expected and Achieved Precision

The evaluation team expected the sample design to return a sampling error of ±10% at 90% confidence. Based on the final sample disposition and observed sample variability, the evaluation achieved a precision of ±9% and ±10%, for energy and demand savings respectively, at 90% confidence.

Description of Baseline Assumptions, Methods, and Data Sources

For most projects included in the M&V sample, the evaluation team used existing equipment as the baseline assumption. Renovation and new construction projects used ASHRAE 90.1 as the baseline.

Description of Measures and Selection of Methods by Measures or Markets

The custom program encompasses a wide selection of measures. Current applications include a variety of lighting, HVAC, and industrial process projects. The evaluation team evaluated all projects in compliance with the IPMVP.[5]

Use of TRM Values and Explanations if TRM Values not Used

The evaluation team used primary data collection, engineering algorithms, building energy simulation modeling, and statistical regression modeling to conduct this study. As this is a custom program, Technical Reference Manual (TRM) algorithms and values generally do not apply. TRM algorithms for lighting measures and HVAC interactive effects were used, as applicable.

Validity Threats, Bias Sources of Bias, and Methods for Addressed These

When feasible, the study utilized a pre- and post-M&V protocol. Due to the project's timing, the evaluation team took post-only measurements for most projects. Use of post-only measurements for these projects was not expected to bias the results significantly. The team assigned projects to a measure category (e.g., lighting, HVAC, process) and then stratified the projects by kWh savings. The team selected sites at random within each stratum. Two projects in the sample did not complete before the end of the study, and one site experienced a data logger failure that required the team to perform a desk review on the project, an action not expected to bias the results. The team employed state-of-the-art engineering modeling techniques to reduce engineering bias.

Snapback and Persistence

For two key reasons, the team did not view snapback as a factor for the Custom Program:

- First, customers participating in custom programs typically do not base energy-intensive investment decisions on the degree of savings achieved from previously installed energy efficiency measures. Instead, these customers tend to base energy efficiency investment decisions on benefits and costs associated with a single project requiring an investment decision.
- Second, snapback is a theoretical concept. To date, an evaluation has not been conducted of an energy efficiency program that reliably has documented a snapback effect. Snapback studies,

[5] *IPMVP Option A–Partially Measured Retrofit Isolation*. See Impact section for more information.

> based on the last 20-plus years of California's well-funded and aggressive energy efficiency portfolio, indicate snapback does not exist. California's per-person energy consumption has remained flat for 20 years, despite energy efficiency programs; other states not offering aggressive portfolios of energy efficiency programs over the same period have increased their per-person energy consumption. Based on these data, if snapback existed to any degree, per-person energy consumption in California would have increased at the same rate as states not offering a long history of energy efficiency programs. The evaluation team does not believe snapback serves a factor for the Duke Energy Custom Program and, as such, did not incorporate this approach into this study.

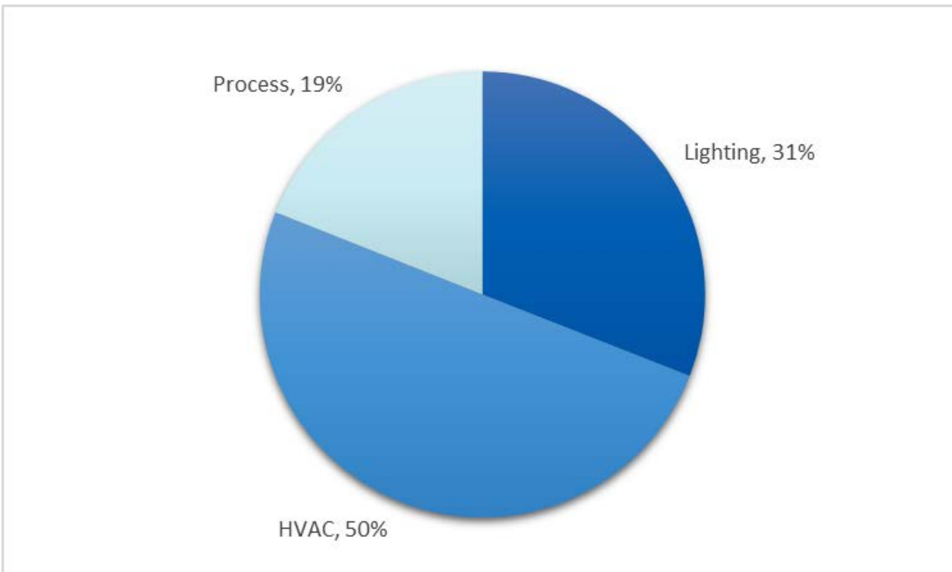
The evaluation team did not address how long these savings would likely persist as the available data's time span proved insufficient to address this issue. Rather, the team compared project-life estimates claimed by the program to measure-life estimates contained in the Indiana Evaluation Framework.

Impact Evaluation Findings

Engineering-Based Impact Analysis

The impact evaluation included the following elements: a tracking system review, sample design and selection, an engineering review of the custom program applications, field M&V of selected projects, data analysis, and reporting. For the sample plans for on-site logging, the evaluation team obtained tracking data from Duke Energy for pre-approved projects with applications that were in various stages of completion, received from January 2010 through March 2014. Figure 1 shows the breakdown of *expected* (claimed, prior to the application of the RR from the previous Evaluation, Measurement, and Verification study) energy savings by measure for these projects.

Figure 1. *Expected* Energy Savings by Project Type



Sample Design

The evaluation team assigned projects into three categories: lighting, HVAC, and process. The team then grouped projects into similar technology categories to minimize variations in RRs across projects and to provide better precision in overall program results. RRs across the technology categories also provided an indication of project types performing closer to original expectations.

The program tracking system is based on the Sales Force customer relationship management tool. Program staff enter project leads into the Sales Force system and track them as they progress in the system. In general, the process takes the following form:

1. ***Initial Application***. A customer submits an application for the project, including a project description and energy savings calculations.

2. ***Application Review***. A Duke Energy contractor reviews the application for program eligibility and reasonableness. Modifications are made to savings estimates as necessary. Project cost-effectiveness is calculated and determines the incentive offer.
3. ***Proposal to Customer***. A rebate proposal, based on the reviewed and adjusted (as necessary) savings estimate and incentive offer, is presented to the customer.
4. ***Contract Approval***. The customer accepts the incentive and plans to move forward with the project.
5. ***Project Completion***. The customer completes the project and receives the incentive.

Projects that are at the Proposal to Customer stage are put in a list of potential candidates. Once the project proceeds to Contract Approval, it is eligible for sampling. The intention is to capture as many projects in the contract approval phase, before construction begins, to obtain pre-installation data. Note, once a project is closed out and paid, the final record is entered into Duke's data warehouse, which is a database that houses participation records, the list of custom measures, and the impacts associated with each measure. The impacts claimed by the program team for each custom project are modeled in DSMore software to determine the avoided costs associated with the custom project. During the DSMore modeling, minor updates to the impacts can occur, and thus it is the impacts after DSMore modeling that are captured in the data warehouse and considered "claimed."

The sampling plan incorporates a stratified random sample approach, where projects are stratified according to size and technology type (i.e., lighting, HVAC, or process) and are sampled randomly within each stratum. The evaluation team separated Lighting and Process projects into three, size-based strata.

The team calculated the total sample size using the following equation: [6]

$$n = \frac{\left(\sum_k \left(kWh_k \times cv_k\right)\right)^2}{\left(\frac{P \times kWh}{Z}\right)^2 + \sum_k \frac{\left(kWh_k \times cv_k\right)^2}{N_k}}$$

Where:

n	=	total sample size required
kWh_k	=	estimated savings from group k
cv_k	=	assumed coefficient of variation for group k
P	=	desired precision

[6] Bonneville Power Administration (BPA). *Sampling Reference Guide*. Research Supporting an Update of BPA's Measurement and Verification Protocols. August 2010.

KWh = total kWh savings

Z = z statistic (1.645 at 90% confidence)

N_k = population size of group k

The team allocated samples to each group using the following equation:

$$n_k = n \times \frac{kWh_k \times cv_k}{\sum_k (kWh_k \times cv_k)}$$

Table 9 summarizes total program savings by sample stratum, expected variations in the project RRs, the number of projects in each stratum, and sample sizes required to meet the design's relative precision at the program level. This table represents a projection of the final program population at the time of sample selection. This projection assumed all customers in the Contract Approval stage would complete construction on their projects and would receive incentives in this evaluation cycle.

Table 9. Sample Selection for Custom Component of Ohio Custom Program

Group	kWh	CV	Total Projects	Sample Size
Lighting 1	13,883,797	0.42	88	7
HVAC 1	8,429,798	0.54	3	3
HVAC 2	9,751,467	0.54	10	7
HVAC 3	10,594,666	0.54	43	7
Process 1	13,526,905	0.5	31	8
Total			**175**	**32**

The team used coefficients of variation by project type from the 2011 DEO Custom program impact evaluation to design the sample.

Sample Status

The evaluation team could not complete the sample as designed, given oversampled lighting projects early in the evaluation, and two HVAC projects dropped from the study. Table 10 summarizes the sample achieved.

Table 10. Sample Status

Group	Stratum	Sample Size	Completed	Notes
Lighting	1	7	10	Oversampled during the first year of evaluation
HVAC	1	3	3	Sample completed
	2	7	7	Sample completed
	3	7	6	One site dropped
Process	1	8	7	One site dropped
Total		**32**	**33**	

Table 11 lists the key characteristics of sampled projects.

Table 11. Summary of *Expected* Savings for Sampled Projects

	Customer	Group	Project Type	*Expected* kWh	*Expected* NCP kW	*Expected* CP kW
1	[Redacted]	Lighting	High bay fixture retrofit	29,052	6	6
2	[Redacted]	HVAC	Whole building retrofit	887,484	146	122
3	[Redacted]	HVAC	VAV conversion	789,375	73	44
4	[Redacted]	HVAC	Window replacement	1,032	26	25
5	[Redacted]	HVAC	Lighting and HVAC upgrades	2,420,314	307	247
6	[Redacted]	HVAC	DDC upgrade	2,192,110	291	38
7	[Redacted]	HVAC	Chiller replacement	220,000	4	4
8	[Redacted]	Lighting	Lighting upgrade	47,429	10	4
9	[Redacted]	Process	Dry cooler	649,824	0	0
10	[Redacted]	Process	Air compressor upgrade	612,650	70	70
11	[Redacted]	HVAC	Controls upgrade	889,566	408	142
12	[Redacted]	Lighting	Exterior lighting retrofits at three schools	193,412	7	0
13	[Redacted]	Lighting	Interior lighting retrofit	27,078	7	7
14	[Redacted]	Process	Refrigeration compressor upgrade	437,515	50	(7)
15	[Redacted]	Process	VFD retrofit	15,879	4	6
16	[Redacted]	HVAC	Chiller upgrade	346,708	18	18
17	[Redacted]	Lighting	LED retrofit at three stores	12,611	2	2
18	[Redacted]	Lighting	Refrigerated case lighting at 17 stores	130,021	12	10
19	[Redacted]	Process	Heat sealer	360,060	41	41
20	[Redacted]	Lighting	Interior lighting retrofit	138,545	17	16
21	[Redacted]	Process	VFD air compressor	98,972	11	11
22	[Redacted]	Lighting	LED retrofit at two stores	35,615	7	8

	Customer	Group	Project Type	*Expected* kWh	*Expected* NCP kW	*Expected* CP kW
23	[Redacted]	HVAC	Add VFD to existing chiller	532,027	79	39
24	[Redacted]	Lighting	LED retrofit at one store	3,766	1	1
25	[Redacted]	HVAC	New chilled water plant	730,151	142	(49)
26	[Redacted]	HVAC	Upgrades to 6 schools	3,448,380	633	217
27	[Redacted]	HVAC	New construction	806,200	310	79
28	[Redacted]	HVAC	Lab fume hood VAV conversion	1,957,873	415	349
29	[Redacted]	Process	Vending machine controllers	93,447	11	11
30	[Redacted]	HVAC	Chiller replacement	580,966	225	193
31	[Redacted]	HVAC	Energy management system	694,307	0	0
32	[Redacted]	Lighting	Metal halide fixture replacement	35,021	8	8
33	[Redacted]	HVAC	Energy management system	244,110	26	19

Application Review

Duke Energy provided the evaluation team with a customer application for each site, along with any supporting documentation. The team reviewed each application to better understand the measures included and expected savings. The Duke Energy Business Relations Manager associated with each sampled site contacted customers to secure participation in the evaluation. Once contact was established with the customer, the team followed up with the customer via phone calls and e-mails to gain additional information about the facility, measures, and construction schedule.

M&V Plan Development

For each sampled site, NORESCO developed an M&V plan that covered the following topic areas:

- ***Introduction:*** a description of the project and the measures installed, including the following: sufficient detail to understand the M&V project scope and methodology; savings by measure and a list of M&V priorities for measures within the project; and baseline assumptions.
- ***Goals and Objectives:*** a list of overall goals and objectives of M&V activity.
- ***Building Characteristics:*** an overview of the building, with a summary table of relevant building characteristics, such as building size (square footage), number of stories, building envelope, lighting system, and HVAC system.
- ***Data Products and Project Output:*** specific end products, such as kWh savings, coincident and noncoincident kW savings, therm savings, and a list of raw and processed data to be supplied at the study's conclusion.

- ***M&V Option:*** a description of the M&V Option, according to the IPMVP. A summary follows of these options:
  - ***Option A—Partially Measured Retrofit Isolation***. Savings under Option A are determined by partial field measurements of energy use of systems to which an energy conservation measure (ECM) was applied, separate from the rest of the facility's energy use. Measurements may be short-term or continuous. Partial measurement means some parameters affecting a building's energy use may be stipulated if the total impact of possible stipulation errors does note prove significant to resultant savings. Savings are estimated from engineering calculations, based on stipulated values and spot, short-term, and/or continuous post-retrofit measurements.
  - ***Option B—Retrofit Isolation.*** Savings under Option B are determined by field measurements of the energy use of systems to which an ECM was applied, separate from energy use by the rest of the facility. Savings are estimated directly from measurements. Stipulated values are not allowed.
  - ***Option C—Whole Facility.*** Savings under Option C are determined by measuring energy use at the whole-facility level. Short-term or continuous measurements are taken throughout the post-retrofit period and are compared to 12 to 24 months of pre-retrofit data. Savings are estimated from analysis of whole-facility utility meter or submeter data, using techniques ranging from simple comparisons of utility bills to regression analysis.
  - ***Option D—Calibrated Simulation.*** Savings under Option D are determined through building energy simulation[7] of energy use by components or by whole facility, calibrated with hourly or monthly utility billing data and/or end-use metering.
- ***Data Analysis:*** a list of engineering methods and/or equations used to generate the data products identified above and a list of data sources, either measurements or stipulated values from secondary data sources.
- ***Field Data Points:*** a list of specific field data points collected through the M&V plan. Field data were composed of survey data, one-time measurements, and time series data, collected from data loggers installed for the project, or trend data, collected from a site's energy management system (EMS).
- ***Data Accuracy:*** a list of meter and sensor accuracy for each field measurement point.
- ***Verification and Quality Control:*** a list of steps taken to validate the accuracy and completeness of raw field data.
- ***Recording and Data Exchange Format:*** a list of formats of raw and processed data files used in the analysis and supplied as data products.

[7] DOE-2 is a commonly used building energy simulation program.

Appendix B contains the M&V plans, along with the processed data summary and project results. Table 12 summarizes M&V plans for each sampled site.

Table 12. M&V Plan Summary

Customer Number	Customer	Project Type	IPMVP Option	Baseline Assumption	M&V Plan Summary
1	[Redacted]	Lighting	A	Existing equipment	Post-installation current logging of a sample of lighting circuits
2	[Redacted]	HVAC	D	ASHRAE 90.1	Post-renovation logging of apartments and common areas to establish occupancy patterns and plug loads
3	[Redacted]	HVAC	A	Existing equipment	Post-installation monitoring of installed measures
4	[Redacted]	HVAC	D	ASHRAE 90.1	On-site survey to verify installation of measures and develop data for simulation model inputs
5	[Redacted]	HVAC	D	Existing equipment	On-site survey and short-term trend logging of affected systems to update eQuest model
6	[Redacted]	HVAC	D	Existing equipment	Post-installation, on-site survey and monitoring of installed measures to update eQuest model
7	[Redacted]	HVAC	A	Existing equipment	On-site survey and monitoring of installed measures
8	[Redacted]	Lighting	A	Existing equipment	On-site survey and monitoring of installed measures
9	[Redacted]	Process	A	Existing equipment	On-site survey and monitoring of installed measures
10	[Redacted]	Process	B	Existing equipment	Pre/post-monitoring of installed measures
11	[Redacted]	HVAC	A	Existing equipment	On-site survey and monitoring of installed measures
12	[Redacted]	Lighting	A	Existing equipment	On-site survey and monitoring of installed measures
13	[Redacted]	Lighting	A	Existing equipment	On-site survey and monitoring of installed measures
14	[Redacted]	Process	A	Existing equipment	On-site survey and monitoring of installed measures
15	[Redacted]	Process	A	Existing equipment	On-site survey and monitoring of installed measures
16	[Redacted]	HVAC	A	Existing equipment	On-site survey and monitoring of installed measures
17	[Redacted]	Lighting	A	Existing equipment	On-site survey and monitoring of installed measures

Customer Number	Customer	Project Type	IPMVP Option	Baseline Assumption	M&V Plan Summary
18	[Redacted]	Lighting	A	Existing equipment	On-site survey and monitoring of installed measures
19	[Redacted]	Process	A	Existing equipment	On-site survey and monitoring of installed measures
20	[Redacted]	Lighting	A	Existing equipment	On-site survey and monitoring of installed measures
21	[Redacted]	Process	A	Existing equipment	On-site survey and desk review of engineering calculations
22	[Redacted]	Lighting	A	Existing equipment	On-site survey and monitoring of installed measures
23	[Redacted]	HVAC	A	Existing equipment	On-site survey and monitoring of installed measures
24	[Redacted]	Lighting	A	Existing equipment	On-site survey and monitoring of installed measures
25	[Redacted]	HVAC	A	ASHRAE 90.1	On-site survey and monitoring of installed measures
26	[Redacted]	HVAC	C	Existing equipment	Pre/post billing analysis at two schools, comprising 90% of project savings
27	[Redacted]	HVAC	D	ASHRAE 90.1	Short-term monitoring of lighting circuits to establish eQuest model lighting schedules
28	[Redacted]	HVAC	A	Existing equipment	On-site survey and monitoring of installed measures
29	[Redacted]	Process	A	Existing equipment	On-site survey and monitoring of installed measures
30	[Redacted]	HVAC	A	Existing equipment	On-site survey and monitoring of installed measures
31	[Redacted]	HVAC	D	Existing equipment	Short-term monitoring of affected systems to update eQuest model
32	[Redacted]	Lighting	A	Existing equipment	On-site survey and monitoring of installed measures
33	[Redacted]	HVAC	D	Existing equipment	On-site survey and short-term monitoring of affected systems to update eQuest model

Measurement and Verification

TecMarket Works subcontractors collected field data according to the M&V plan, with personnel from NORESCO training the contractors. Metering equipment included a combination of the following: portable data acquisition equipment (capable of measuring temperature, relative humidity, and electric current); true electric power meters; and trend logs from facility control systems. Appendix B describes specific instrumentation used at each site (also summarized in Table 13). The evaluation team also obtained survey data and spot measurements during meter installation. The team configured metering equipment and/or trend logs to collect data for a period of three to four weeks. One process site had instrumentation installed over two separate, four-week periods to capture winter and summer operations.

Table 13. M&V Approach Summary

Site Number	Customer	Project Type	Measurements Taken	Monitoring Duration
1	[Redacted]	Lighting	Spot true electric power and time-series lighting circuit current measurements	3 weeks
2	[Redacted]	HVAC	Residential unit feeder circuit current, common area circuit current	3 weeks
3	[Redacted]	HVAC	Trend logging of AC unit flow, VFD speed, and static pressure setpoint. Logging of VFD input power and outdoor temperature and humidity	3 weeks
4	[Redacted]	HVAC	On-site survey to develop simulation model inputs. No monitoring done	N/A
5	[Redacted]	HVAC	Trend logging of fan speed, static pressure, and supply air, return air, mixed air and outdoor air temperatures at a sample of air handlers; outdoor temperature and humidity	4 weeks
6	[Redacted]	HVAC	Trend logging of chilled and hot water temperatures at central plant, supply temperatures, static pressure and VFD speeds at a sample of air handlers, outdoor temperatures and humidity	2 weeks
7	[Redacted]	HVAC	Power logging of lead and lag chillers, current logging of chilled water pumps, outdoor temperature and humidity	3 weeks
8	[Redacted]	Lighting	Spot true electric power and time series current measurements of a sample of lighting circuits	3 weeks
9	[Redacted]	Process	Power logging of chillers and dry cooler; current logging of chilled water and dry cooler pumps; and sump heater, outdoor temperatures, and humidity	3 weeks during summer and 3 weeks during winter
10	[Redacted]	Process	Power logging of new and replaced air compressor	5 days pre; 3 weeks post

Site Number	Customer	Project Type	Measurements Taken	Monitoring Duration
11	[Redacted]	HVAC	Trend logging of: supply, return, and mixed air temperatures; fan powers and speeds; static pressure and outdoor air at a sample of air handlers; outdoor temperatures and humidity	3 weeks
12	[Redacted]	Lighting	Spot power and post-installation current monitoring of a sample of lighting circuits	3 weeks
13	[Redacted]	Lighting	Spot power and post-installation current monitoring of a sample of lighting circuits	3 weeks
14	[Redacted]	Process	Spot power and post-installation kW monitoring of a new refrigeration compressor	5 weeks
15	[Redacted]	Process	Spot power and post-installation kW monitoring of a new VFD	3 weeks
16	[Redacted]	HVAC	Spot power and post-installation kW monitoring of all chillers in chilled water plant; trend logs of chilled and condenser water supply and return temperatures and flow rates; logging outdoor temperatures and humidity	3 weeks
17	[Redacted]	Lighting	Spot power and post-installation current monitoring of a sample of lighting circuits	3 weeks
18	[Redacted]	Lighting	Spot power and post-installation current monitoring of a sample of refrigerated case lighting circuits	3 weeks
19	[Redacted]	Process	Post-installation power monitoring of a sample of heat sealers across 7 stores; spot measurement of baseline heat sealer power	3 weeks per sealer
20	[Redacted]	Lighting	Post-installation light logging of a sample of fixtures	3 weeks
21	[Redacted]	Process	Spot measurement of compressor power	1 week pre; logger failed, no post time series data available
22	[Redacted]	Lighting	Spot power and post-installation current monitoring of a sample of lighting circuits	4 weeks
23	[Redacted]	HVAC	Power logging of chiller kW; trend logging of chilled and condenser water supplies and return temperatures; outdoor temperatures and humidity	3 weeks

Site Number	Customer	Project Type	Measurements Taken	Monitoring Duration
24	[Redacted]	Lighting	Spot power and post-installation current monitoring of a sample of lighting circuits	3 weeks
25	[Redacted]	HVAC	Power logging of chiller and tower kW; trend logging of chilled and condenser water supply and return temperatures; chilled water flow rate	3 weeks
26	[Redacted]	HVAC	On-site survey to confirm installation and to identify non-routine baseline adjustments; cooling and heating degree days corresponding to billing data	12 months pre and 12 months post
27	[Redacted]	HVAC	Spot power and current monitoring of a sample of lighting circuits representing major usage areas	3 weeks
28	[Redacted]	HVAC	Trend logging of air-handlers' air flow, fan speeds, supply air temperature and static pressures, and outdoor temperatures and humidity; power and current logging of AHU fan power	3 weeks
29	[Redacted]	Process	Post-installation power monitoring of a sample of vending machines	3 weeks
30	[Redacted]	HVAC	Post-installation kW logging of new chiller, chilled water, and condenser water pumps; trend logging of chilled and condenser water supply and return temperatures, flow rates, and VFD speeds; cooling tower fan VFD speeds and outdoor temperatures	5 weeks
31	[Redacted]	HVAC	Fan kW measurements at a sample of AHUs; outdoor temperatures and humidity	3 weeks
32	[Redacted]	Lighting	Spot kW and post-installation current monitoring of affected lighting circuits	3 weeks
33	[Redacted]	HVAC	Trend logging of AHU supply, return and mixed air temperatures, static pressure and OA damper position; space temperatures and terminal discharge temperatures at a sample of VAV boxes	3 weeks

Calculations and Reporting

TecMarket Works subcontractors collected pre- and post-installation data and forwarded them to NORESCO for analysis. The evaluation team analyzed the data according to the M&V plan developed for each project. Data analysis consisted of pre- and post-comparisons of monitored data, extrapolated to annual consumption and demand using simple engineering models or linear regression techniques described in the M&V plan. The team then developed a site report for each completed project (included in Appendix B). Table 14 summarizes calculations and analysis techniques used.

Table 14. Calculation Approach Summary

Site Number	Customer	Project Type	Calculations
1	[Redacted]	Lighting	Engineering equations with parameters from metered data
2	[Redacted]	HVAC	eQuest model, revised based on on-site survey and monitored data
3	[Redacted]	HVAC	Developed average daily pre/post load profiles from monitored data and engineering calculations
4	[Redacted]	HVAC	Developed eQuest model from drawings and on-site survey
5	[Redacted]	HVAC	eQuest model revised based on on-site survey and monitored data
6	[Redacted]	HVAC	eQuest model revised based on on-site survey and monitored data
7	[Redacted]	HVAC	Post-installation regression model of new chiller plant, engineering equations to establish existing equipment baseline
8	[Redacted]	Lighting	Engineering equations with parameters from metered data
9	[Redacted]	Process	Post-installation regression model of chiller plant and drycooler; engineering equations to establish an existing equipment baseline
10	[Redacted]	Process	Developed average daily pre/post-load profiles from monitored data
11	[Redacted]	HVAC	Engineering equations with parameters from metered data
12	[Redacted]	Lighting	Engineering equations with parameters from metered data
13	[Redacted]	Lighting	Engineering equations with parameters from metered data
14	[Redacted]	Process	Developed average daily pre/post-load profiles from monitored data

Site Number	Customer	Project Type	Calculations
15	[Redacted]	Process	Developed average daily pre/post-load profiles from monitored data and engineering calculations
16	[Redacted]	HVAC	Post-installation regression model of new chiller plant; engineering equations to establish an existing equipment baseline
17	[Redacted]	Lighting	Engineering equations using parameters from metered data
18	[Redacted]	Lighting	Engineering equations using parameters from metered data
19	[Redacted]	Process	Developed average daily pre/post-consumption from monitored data and engineering calculations
20	[Redacted]	Lighting	Engineering equations with parameters from on-site survey and logger data
21	[Redacted]	Process	Engineering desk review based on pre-installation data
22	[Redacted]	Lighting	Engineering equations with parameters from on-site survey and logger data
23	[Redacted]	HVAC	Post-installation regression model of chiller with VFD; engineering equations to establish a baseline
24	[Redacted]	Lighting	Engineering equations with parameters from on-site survey and logger data
25	[Redacted]	HVAC	Post-installation regression model of chiller plant; engineering equations to establish a baseline
26	[Redacted]	HVAC	Weather-adjusted, pre/post-billing analysis
27	[Redacted]	HVAC	eQuest model, revised based on on-site survey and monitored data
28	[Redacted]	HVAC	Developed average daily AHU pre/post-load profiles from monitored data and engineering calculations; bin analysis conducted to estimate chiller savings
29	[Redacted]	Process	Developed average daily pre/post-load profiles from monitored data and engineering calculations
30	[Redacted]	HVAC	Post-installation regression model of new chiller plant, engineering equations to establish an existing equipment baseline
31	[Redacted]	HVAC	eQuest model updated with results of AHU monitoring

Site Number	Customer	Project Type	Calculations
32	[Redacted]	Lighting	Engineering equations with parameters from on-site survey and logger data
33	[Redacted]	HVAC	eQuest model updated with trend data and calibrated to billing data

Freeridership Calculations[8]

The evaluation team based the freeridership score on applicant responses to a battery of questions, placed into the program application form.

The freeridership question battery consisted of four questions, focusing on reasons leading to applicants' decisions to implement their energy efficiency projects. The scoring approach is linear, which allocates from 0% to 100% (full freeridership), based on responses provided by applicants to cause-and-effect questions.

During the evaluation period, the program team used the freeridership battery of questions to calculate the incentive levels for individual projects based on net expected savings. The program team may reject applicants with freeridership scores too high to make custom projects cost-effective at any incentive level. This approach allowed pre-screening of projects; so almost all projects proved cost-effective, with incentive levels paid based on net savings achieved.

This approach helps ensure program funds are spent obtaining net new energy savings. Other approaches typically used by other program implementers approve and incent projects before net savings are known, increasing the probability that program funds will be spent on projects that would have been implemented without the program's financial or informational assistance.

The freeridership battery of questions includes the following questions. The scoring approach *(in italics)*, used by Duke Energy to calculate freeridership scores for each applicant, does not appear on the application forms:

1. **Please indicate if the Duke Energy incentive is/was a factor in your choice to install the more energy efficient equipment instead of other equipment that may not have saved as much energy.**
    1. Incentive had an influence on the decision (*move to next question*)
    2. Incentive had no influence on the decision (*100% freerider*)
2. **If the Duke Energy incentive/program was a factor in your choice, please indicate how much of an influence the program incentive had on your energy efficient equipment choice. Please circle the number that best represents the influence the program has on your equipment choice. (***allowed responses = 0 to 10***)**

    0 = The Duke Energy program had no effect on our equipment choice (*100% freerider*).

[8] The freeridership calculations section will be redacted in the public version of the report.

1 or 2 = The Duke Energy program may have a minor influence on our energy efficient equipment choice (*1=80% freerider; 2=70% freerider*)

3 or 4 = The Duke Energy program had a positive influence in our selection of energy efficiency equipment (*3=50% freerider; 4=40% freerider*)

5 or 6 = The Duke Energy program was one of the key reasons for the energy efficient equipment choice, but not the most important reason (*5=30% freerider 6=25% freerider*)

7 or 8 = The Duke Energy program was one of the most important reasons for the energy efficient equipment choice (*7=15% freerider 8= 10% freerider*)

9 or 10 = The Duke Energy program was the primary reasons for the energy efficient equipment choice (*9=5% freerider 10=0% freerider*)

3. **Do you think that you would have selected the same level of energy efficiency if the program information and technical assistance would not have been available to you?**
   - A. No. We would make a somewhat different equipment selection or not do the same project (*decrease freerider score by 10% but not lower than 0%)*
   - B. Not sure what we would do (*no change in score*)
   - C. Yes. We would make exactly the same equipment choice (*increase freeridership score by 10% but no higher than 100%)*
4. **Do you think that you would have selected the same level of energy efficiency if the program's financial incentive would not have been available to you?**
   - A. No. We would make a somewhat different equipment selection or not do the same project (*decrease freerider score by 25% but no lower than 0%)*
   - B. Not sure what we would do (*no change in score*)
   - C. Yes. We would make exactly the same equipment choice (*increase freerider score by 25% but no lower than 100%*)

To calculate the freeridership ratio, the evaluation team examined the freeridership calculation workbooks prepared by Duke Energy for the projects that were part of the evaluation period. The workbook includes responses provided to the freeridership battery of questions provided by the program participant on the participation application form. In a few cases, the freeridership scores that were calculated from the scoring algorithm were manually changed (in a separate file) to allow projects with high freeridership to participate in the program. For this analysis, the evaluation team used the unaltered scores corresponding to the participants responses to the freeridership battery of questions. Of the 164 projects in the evaluation period, six did not have original records of the unaltered scores, and are omitted from the overall savings weighting. Table 15 shows the evaluated savings weighted results of the 158 projects with the original scoring. The projects exhibited 14% freeridership, and therefore the program receives a net of freeridership ratio of 0.86.

Table 15. Net of Freeriderhsip Ratio Development

States	Number of Applicants in Freerider Assessment	Evaluated Energy Savings Weighted Freeridership Score	Evaluated Net of Freeridership Ratio
Ohio	158	14.0%	0.86

Results

This section reports evaluation results, including annual savings for kWh and kW as well as RRs for each project. The report summarizes these data by project type. The section also includes independent assessments of project life.

Annual Savings

Table 16, Table 17, and Table 18 list the estimated sampling precision in RRs by kWh, NCP kW, and CP kW.

Table 16. kWh Realization Rate and Achieved Sampling Precision

Stratum	Population Size	Sample Size	Actual Sample Error Ratio	Relative Precision
Lighting	86	10	0.07	4%
HVAC 1	3	3	0.00	0%
HVAC 2	13	7	0.49	31%
HVAC 3	33	6	0.53	36%
Process	29	7	0.31	19%
Total	**164**	**33**		**9%**

Table 17. NCP kW Realization Rate and Achieved Sampling Precision

Stratum	Population Size	Sample Size	Actual Sample Error Ratio	Relative Precision
Lighting	86	10	0.21	11%
HVAC 1	3	3	0.00	0%
HVAC 2	13	7	0.76	47%
HVAC 3	33	6	0.25	17%
Process	29	7	0.72	45%
Total	**164**	**33**		**10%**

Table 18. CP kW Realization Rate and Achieved Sampling Precision

Stratum	Population Size	Sample Size	Actual Sample Error Ratio	Relative Precision
Lighting	86	10	0.07	3%
HVAC 1	3	3	0.00	0%
HVAC 2	13	7	0.81	50%
HVAC 3	33	6	0.53	36%
Process	29	7	0.41	26%
Total	**164**	**33**		**10%**

Table 19 summarizes annual savings from each project, and Table 20 lists average annual RRs by project types.

Table 19. Annual Gross Realization Rate Results by Project

Site	Customer	Project Type	kWh Savings			NCP kW Savings			CP kW Savings		
			Evaluated	Expected [9]	RR	Evaluated	Expected	RR	Evaluated	Expected	RR
1	[Redacted]	Lighting	33,163	29,052	1.14	6.5	5.7	1.15	6.8	5.7	1.18
2	[Redacted]	HVAC	472,937	887,484	0.53	5.4	146.5	0.04	3.4	122.1	0.03
3	[Redacted]	HVAC	289,424	789,375	0.37	13.7	73.2	0.19	24.8	44.3	0.56
4	[Redacted]	HVAC	9,941	1,032	9.63	0.6	26.0	0.02	4.6	25.2	0.18
5	[Redacted]	HVAC	2,168,811	2,420,314	0.90	225.8	307.2	0.74	185.0	247.5	0.75
6	[Redacted]	HVAC	1,564,549	2,192,110	0.71	95.8	290.9	0.33	212.9	37.9	5.62
7	[Redacted]	HVAC	109,283	220,000	0.50	25.3	3.9	6.57	25.3	3.9	6.57
8	[Redacted]	Lighting	71,718	47,429	1.51	15.1	9.8	1.53	9.8	4.2	2.31
9	[Redacted]	Process	556,075	649,824	0.86	-	-		-	-	
10	[Redacted]	Process	301,013	612,650	0.49	6.2	69.9	0.09	29.1	69.9	0.42
11	[Redacted]	HVAC	390,832	889,566	0.44	36.5	408.3	0.09	36.2	141.6	0.26
12	[Redacted]	Lighting	192,361	193,412	0.99	44.4	6.7	6.64	-	-	
13	[Redacted]	Lighting	28,140	27,078	1.04	9.0	7.1	1.27	9.0	7.3	1.23
14	[Redacted]	Process	265,983	437,515	0.61	-2.9	50.3	-0.06	6.4	-6.9	-0.92
15	[Redacted]	Process	29,818	15,879	1.88	22.6	4.0	5.71	6.0	5.8	1.04
16	[Redacted]	HVAC	219,938	346,708	0.63	37.8	17.9	2.11	-15.2	17.9	-0.85
17	[Redacted]	Lighting	14,365	12,611	1.14	3.2	2.5	1.30	3.2	2.5	1.30
18	[Redacted]	Lighting	99,312	130,021	0.76	12.7	11.6	1.09	12.4	10.5	1.18
19	[Redacted]	Process	223,750	360,060	0.62	51.0	41.1	1.24	32.2	41.1	0.78
20	[Redacted]	Lighting	113,142	138,545	0.82	16.9	17.1	0.99	16.0	16.3	0.98
21	[Redacted]	Process	216,227	98,972	2.18	27.2	11.3	2.41	21.6	11.3	1.91
22	[Redacted]	Lighting	47,252	35,615	1.33	12.4	7.4	1.68	11.9	7.6	1.57
23	[Redacted]	HVAC	366,940	532,027	0.69	83.0	79.0	1.05	81.1	38.8	2.09

[9] Expected values are equal to the claimed value prior to the application of the realization rate from the previous EM&V study.

Site	Customer	Project Type	kWh Savings			NCP kW Savings			CP kW Savings		
			Evaluated	Expected [9]	RR	Evaluated	Expected	RR	Evaluated	Expected	RR
24	[Redacted]	Lighting	3,534	3,766	0.94	0.9	0.8	1.23	0.9	0.8	1.21
25	[Redacted]	HVAC	2,088,267	730,151	2.86	127.4	142.0	0.90	141.5	-48.9	-2.89
26	[Redacted]	HVAC	6,466,479	3,448,380	1.88	1,784.0	633.1	2.82	1,616.0	216.8	7.45
27	[Redacted]	HVAC	1,242,006	806,200	1.54	502.9	310.0	1.62	122.6	78.9	1.55
28	[Redacted]	HVAC	1,899,212	1,957,873	0.97	445.0	415.4	1.07	396.0	349.1	1.13
29	[Redacted]	Process	165,128	93,447	1.77	34.7	10.7	3.25	28.8	10.7	2.70
30	[Redacted]	HVAC	461,629	580,966	0.79	353.4	224.5	1.57	311.0	193.4	1.61
31	[Redacted]	HVAC	72,558	694,307	0.10	-16.0	-		-14.0	-	
32	[Redacted]	Lighting	30,230	35,021	0.86	8.4	8.4	0.99	8.4	8.4	0.99
33	[Redacted]	HVAC	462,143	244,110	1.89	32.5	25.9	1.25	29.1	18.6	1.56

Table 20. Average Annual Gross Realization Rate by Project Type

Project Type	kWh Savings			NCP kW Savings			CP kW Savings		
	Evaluated	Expected[10]	RR	Evaluated	Expected	RR	Evaluated	Expected	RR
Lighting	18,064,815	18,616,348	97%	4,612	2,742	168%	2,868	2,318	124%
HVAC	30,330,099	30,108,389	101%	7,512	6,329	119%	4,857	2,775	175%
Process	8,849,344	11,418,348	78%	1,065	1,436	74%	1,125	1,195	94%
Overall	**57,244,257**	**60,143,084**	**95%**	**13,189**	**10,507**	**126%**	**8,850**	6,288	**141%**

[10] Expected values are equal to the claimed value prior to the application of the realization rate from the previous EM&V study.

Table 21 summarizes specific findings for each project. Appendix B contains more information on each project sampled.

Table 21. Findings Summary

Site Number	Customer	Project Type	kWh RR	NCP kW RR	Findings Summary
1	[Redacted]	Lighting	1.14	1.15	RR close to 1; small difference in the assumed operating hours and fixture watts
2	[Redacted]	HVAC	0.53	0.04	ASHRAE 90.1 baseline incorrectly implemented; lighting power density and baseline HVAC system type revised
3	[Redacted]	HVAC	0.37	0.19	Flow modulation assumed in application was not realized
4	[Redacted]	HVAC	9.63	0.02	Glazing specifications used in ex-ante model do not match the manufacturer specifications. Normal replacement rather than early replacement baseline used.
5	[Redacted]	HVAC	0.90	0.74	Verified lighting power density higher than program assumption, small boiler not installed, boiler room upgrades only partially completed, condenser water reset not implemented, static pressure reset not fully implemented, revised thermostat setpoints and economizer settings, some VAV conversions were not done, optimum start not implemented.
6	[Redacted]	HVAC	0.71	0.33	Controls not implemented as planned; air handler shut down; chilled water reset and supply air reset strategies not implemented
7	[Redacted]	HVAC	0.50	6.57	New chiller cycled on a biweekly basis with existing chiller; runs for half of the available hours
8	[Redacted]	Lighting	1.51	1.53	Verified installed fixture watts less than assumed in application; monitored operating hours exceeded assumed values for several lighting systems
9	[Redacted]	Process	0.86		Increased dry cooler fan and pump operations at low temperatures; more chiller operations at low temperatures than assumed in the application

Site Number	Customer	Project Type	kWh RR	NCP kW RR	Findings Summary
10	[Redacted]	Process	0.49	0.09	Existing compressor used less energy, and new compressor used more energy than assumed in the application
11	[Redacted]	HVAC	0.44	0.09	Excessive minimum outdoor air; lack of economizer operations relative to program assumptions
12	[Redacted]	Lighting	0.99	6.64	Monitoring showed slight variations in operating hours; apparent error in program NCP kW calculations
13	[Redacted]	Lighting	1.04	1.27	Program calculations did not include HVAC interactive effects
14	[Redacted]	Process	0.61	-0.06	Program assumption of part-load operation of baseline compressor was incorrect; monitoring indicated more hours at higher loads, reducing savings
15	[Redacted]	Process	1.88	5.71	Actual motor speeds were less than program assumptions; baseline drive losses were not included in program calculations
16	[Redacted]	HVAC	0.63	2.11	Verified chiller plant sequencing differed from program assumptions; program calculations did not include process chilled water loads
17	[Redacted]	Lighting	1.14	1.30	Fixture watt savings slightly higher than program assumptions; program calculations did not include HVAC interactions
18	[Redacted]	Lighting	0.76	1.09	Operating hours longer than assumed in program calculations; interactive effects with refrigeration plant not included in program calculations
19	[Redacted]	Process	0.62	1.24	Program calculations overestimated baseline heat sealer watts and operating hours
20	[Redacted]	Lighting	0.82	0.99	Fixture watt savings slightly lower than program assumptions; program calculations did not include HVAC interactions
21	[Redacted]	Process	2.18	2.41	More hours at part load; higher savings from new compressor.

Site Number	Customer	Project Type	kWh RR	NCP kW RR	Findings Summary
22	[Redacted]	Lighting	1.33	1.68	Fixture-watt savings exceeded program assumptions; HVAC interactions not included in program calculations
23	[Redacted]	HVAC	0.69	1.05	Chiller full-load hours were less than program assumptions
24	[Redacted]	Lighting	0.94	1.23	Lighting operating hours were less than program assumptions; HVAC interactions were not included in program calculations
25	[Redacted]	HVAC	2.86	0.90	Monitoring indicates more hours at low loads than in program assumptions
26	[Redacted]	HVAC	1.88	2.82	Project exceeds program expectations, based on billing analysis
27	[Redacted]	HVAC	1.54	1.62	Verified a lighting power density lower than program assumptions; window overhangs and side fins removed from baseline model, per ASHRAE 90.1
28	[Redacted]	HVAC	0.97	1.07	Lower air flow observed in monitored data increased AHU savings and decreased chiller savings relative to program calculations
29	[Redacted]	Process	1.77	3.25	Energy and demand savings exceeded program expectations; HVAC interactive effects not included in program calculations
30	[Redacted]	HVAC	0.79	1.57	Verified chiller plant full load hours were lower than program assumptions
31	[Redacted]	HVAC	0.10		AHU scheduling was not implemented
32	[Redacted]	Lighting	0.86	0.99	Monitoring indicated lower operating hours than assumed in program applications
33	[Redacted]	HVAC	1.89	1.25	Calibrated model predicted greater savings than program expectations

Project Life

The evaluation team conducted an independent assessment of the project life, comparing project life estimates to those claimed by the program. Program project life estimates were used to set incentive levels and to calculate lifecycle savings and benefits of each project. Table 22 lists project life estimates for each project.

Table 22. Program Claimed Project Life Estimates

Site Number	Customer	Project Type	Program Project Life (years)
1	[Redacted]	Lighting	10.0
2	[Redacted]	HVAC	18.0
3	[Redacted]	HVAC	15.0
4	[Redacted]	HVAC	20.0
5	[Redacted]	HVAC	14.0
6	[Redacted]	HVAC	10.0
7	[Redacted]	HVAC	20.0
8	[Redacted]	Lighting	10.9
9	[Redacted]	Process	20.0
10	[Redacted]	Process	15.0
11	[Redacted]	HVAC	8.0
12	[Redacted]	Lighting	10.0
13	[Redacted]	Lighting	10.0
14	[Redacted]	Process	15.0
15	[Redacted]	Process	15.0
16	[Redacted]	HVAC	20.0
17	[Redacted]	Lighting	8.0
18	[Redacted]	Lighting	12
19	[Redacted]	Process	7.0
20	[Redacted]	Lighting	8.0
21	[Redacted]	Process	15.0
22	[Redacted]	Lighting	12.0
23	[Redacted]	HVAC	15.0
24	[Redacted]	Lighting	8.0
25	[Redacted]	HVAC	20.0
26	[Redacted]	HVAC	13.9
27	[Redacted]	HVAC	15.0
28	[Redacted]	HVAC	10.0
29	[Redacted]	Process	10.0
30	[Redacted]	HVAC	20.0
31	[Redacted]	HVAC	10.0
32	[Redacted]	Lighting	8.0
33	[Redacted]	HVAC	7.0

The evaluation team conducted an independent assessment of project life, examining measures making up each project and assigning an effective useful life (EUL) to each measure. EUL estimates were obtained from the Ohio TRM, the California Database for Energy Efficiency Resources (DEER) EUL table, or program claims for measures not yet addressed by these data sources. Table 23 shows the assessment results.

Table 23. Evaluated Project Life Estimates

Site Number	Customer	Project Type	Measures	EUL	Source	Source Measure
1	[Redacted]	Lighting	High bay fixture retrofit	15	OH TRM	High Bay lighting
2	[Redacted]	HVAC	Whole building retrofit	15	OH TRM, DEER	Interior lighting, heat pump, cooling tower, VFD, EMS
3	[Redacted]	HVAC	VAV conversion	15	DEER	VAV box and VFD fan
4	[Redacted]	HVAC	Window Replacement	20	DEER	Low Solar Heat Gain Coefficient Windows
5	[Redacted]	HVAC	Lighting and HVAC upgrades	15	OH TRM	Interior Lighting, HVAC
6	[Redacted]	HVAC	DDC Upgrade	15	DEER	Energy Management System (EMS)
7	[Redacted]	HVAC	Chiller Replacement	20	OH TRM	Chiller replacement
8	[Redacted]	Lighting	Lighting upgrade	15	OH TRM	High efficiency linear fluorescent
9	[Redacted]	Process	Dry cooler	20	Application	Not applicable
10	[Redacted]	Process	Air compressor upgrade	15	OH TRM	High efficiency air compressor
11	[Redacted]	HVAC	Controls upgrade	15	DEER	Energy Management System (EMS)
12	[Redacted]	Lighting	Exterior lighting retrofits at three schools	15	OH TRM	High Bay lighting
13	[Redacted]	Lighting	Interior lighting retrofit	15	OH TRM	High efficiency linear fluorescent
14	[Redacted]	Process	Refrigeration compressor upgrade	15	DEER	Refrigeration Plant Upgrade
15	[Redacted]	Process	VFD Retrofit	15	OH TRM	Variable Frequency Drives
16	[Redacted]	HVAC	Chiller upgrade	20	OH TRM	Chiller replacement
17	[Redacted]	Lighting	LED retrofit at three stores	20	IN Framework	LED lighting

Site Number	Customer	Project Type	Measures	EUL	Source	Source Measure
18	[Redacted]	Lighting	Refrigerated case lighting at 17 stores	8.1	OH TRM	Refrigerated Case Lighting
19	[Redacted]	Process	Heat Sealer	7	Application	Not applicable
20	[Redacted]	Lighting	Interior lighting retrofit	15	OH TRM	High efficiency linear fluorescent
21	[Redacted]	Process	VFD Air Compressor	15	OH TRM	High efficiency air compressor
22	[Redacted]	Lighting	LED retrofit at two stores	20	IN Framework	LED lighting
23	[Redacted]	HVAC	Add VFD to existing chiller	15	OH TRM	Variable Frequency Drives
24	[Redacted]	Lighting	LED retrofit at one store	20	IN Framework	LED lighting
25	[Redacted]	HVAC	New chilled water plant	20	OH TRM	Chiller replacement
26	[Redacted]	HVAC	Upgrades to 6 schools	15	OH TRM, DEER	VFD, VAV box, RTU, EMS
27	[Redacted]	HVAC	New construction	16.3	OH TRM	Lighting - new construction, lighting controls, high performance glazing
28	[Redacted]	HVAC	Lab fume hood VAV conversion	15	DEER	VAV box and VFD fan
29	[Redacted]	Process	Vending machine controllers	5	OH TRM	Vending Machine Occupancy Sensors
30	[Redacted]	HVAC	Chiller Replacement	20	OH TRM	Chiller replacement
31	[Redacted]	HVAC	Energy Management System	15	DEER	Energy Management System (EMS)
32	[Redacted]	Lighting	Metal halide fixture replacement	7.5	OH TRM	PS Metal Halide
33	[Redacted]	HVAC	EMS	15	DEER	Energy Management System (EMS)

The program estimated the project life, and independent project life estimates were weighted by expected kWh savings and evaluated kWh savings, respectively, with a weighted average project life calculated for each project type. The RR on each project life was calculated as the ratio of the evaluated EUL to the program project life estimates. Table 24 shows the results.

Table 24. Summary of Project Life Estimates by Project Type

Project Type	Program Project Life	Evaluated EUL	RR
Lighting	10	14.1	1.41
HVAC	13.4	15.9	1.18
Process	15.0	14.6	0.98

Appendix A. Required Savings Tables

Measure Name	State	Gross kWh RR	NCP kW RR	CP kW RR	EUL	Net of Freeridership Ratio
Custom	OH	0.95	1.26	1.41	Custom	86%

Appendix B. Site M&V Reports—Full Customer Detail

[Redacted]

- Lighting Retrofit -

M&V Report

PREPARED FOR:
Duke Energy
Ohio

PREPARED BY:
Architectural Energy Corporation
2540 Frontier Avenue, Suite 100
Boulder, Colorado 80301

PREPARED IN:
December 2012

NOTE: This project has been randomly selected from the list of applications for which incentive agreements have been authorized under Duke Energy's Smart $aver® Custom Incentive Program.

The M&V activities described here are undertaken by an independent third-party evaluator of the Smart $aver® Custom Incentive Program.

Findings and conclusions of these activities shall have absolutely no impact on the agreed upon incentive between Duke Energy and [Redacted].

INTRODUCTION

This report addresses M&V activities for the [Redacted] custom program application. The application covered a lighting retrofit at two locations in Cincinnati, Ohio. This M&V report was for post-retrofit monitoring only. The measures included:

ECM-1 – Compact fluorescent fixtures replaced with LED fixtures – [Redacted]

- This phase of the project involved the removal of 245 existing 27W compact fluorescent fixtures, replaced with 245 new 12W LED fixtures.

ECM-2 – Compact fluorescent fixtures replaced with LED fixtures – [Redacted]

- This phase of the project involved the removal of 311 existing 37W compact fluorescent fixtures, replaced with 161 new 12W LED fixtures and 150 new 17W LED fixtures.

GOALS AND OBJECTIVES

A post-retrofit survey of the lighting usage was conducted to determine the power reduction from the lighting upgrade.

The projected savings goals identified in the application were:

Facility	Proposed Annual kWh savings	Proposed Summer Peak kW savings	Duke Annual kWh savings	Duke Summer Peak kW savings
[Redacted]	17,199	4	[not itemized]	[not itemized]
[Redacted]	32,877	7	[not itemized]	[not itemized]
Total	**50,076**	**11**	**35,615**	**7.4**

The objective of this M&V project was to verify the actual:

- Annual gross kWh savings
- Summer peak kW savings
- kWh & kW Realization Rates

PROJECT CONTACTS

Duke Energy M&V Coordinator	Frankie Diersing	513-287-4096
Duke Energy BRM	Terry Holt	
Customer Contact	[Redacted]	[Redacted]
Architectural Energy Corporation Contact	Katie Gustafson	p: 303-459-7430 kgustafson@archenergy.com

SITE LOCATIONS/ECM'S

Site	Address	Sq. Footage	ECM's Implemented

[Redacted]	[Redacted]	159,743	#1
[Redacted]	[Redacted]	84,203	#2

Data Products and Project Output

- Average pre/post load shapes by daytype for controlled equipment
- Verify fixture counts (post-retrofit) and that all fixtures have been upgraded
- Summer peak demand savings
- Annual Energy Savings

M&V Option

IPMVP Option A

M&V Implementation Schedule

For each store:

- The post-retrofit survey was conducted after the customer had performed the lighting retrofit.
  - Spot measurements were taken of the lighting load connected to the circuit by measuring the kW load and current draw of the circuit.
  - Post-retrofit loggers were deployed.
- Logger and spot data was collected continuously in 5 minute intervals between June 13th and July 11th, 2012.

Data Accuracy

Measurement	Sensor	Accuracy	Notes
Current	Magnelab CT	±1%	> 10% of rating

Field Data Points

Post-Installation, for each store:

Survey data

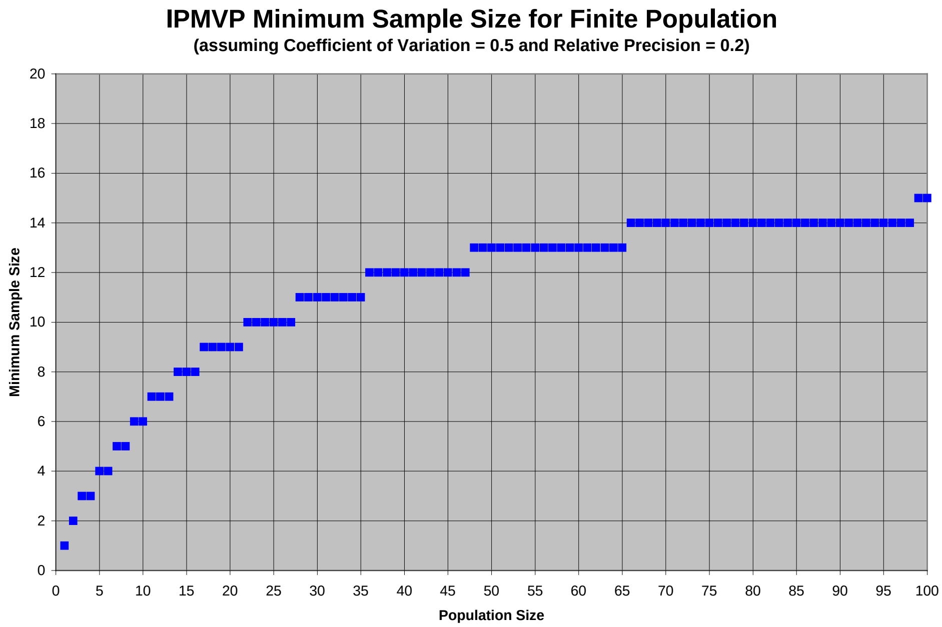
- All fixture specifications, wattages and quantities were consistent with the original application.
- All pre (existing) fixtures were verified to have been removed.
- The building was determined to observe only two holidays over the course of the year (Thanksgiving and Christmas).
- Lighting zones were determined to be completely disabled during the holidays.

One-time measurements (to establish ratio of kW/amp and simultaneous logger amp readings)

- Lighting circuit power was recorded with lights on, and compared to the simultaneous logger data.

Time series data on controlled equipment

- Typical lighting load shape
    - Current measurement CT loggers were deployed to measure current at the panelboard.
    - Based on the following sample size table, 6 circuits were randomly chosen to be monitored based upon the total number of circuits.



    - Loggers were setup for 5 minute instantaneous readings and allowed to operate from June 13th to July 11th, 2012.
- Spot measurements of the lighting load connected to the circuit were recorded by measuring the kW load and current draw of the circuit during post-retrofit survey.

Logger Table

The following table summarizes all logging equipment needed to accurately measure the above noted ECMs:

ECM	Hobo U-12	20A CT
1	6	6
2	6	6
Total	**12**	**12**

Data Analysis

1. Converted time series data on logged equipment into pre/post average load shapes by day type (ex. weekday, weekend, holiday).
2. Load shapes were used to determine the daily Equivalent Full Load Hours (ELFH) for each day type.
3. The Pre annual kWh was calculated using the following equations:

$$\frac{kWh}{year}_{pre} = \left[\sum_{i=1}^{N_{daytypes}} EFLH_i * N_{days/yr_i}\right] * ConnectedLoad_{pre}$$

4. The Post annual kWh was calculated using the following equations:

$$\frac{kWh}{year}_{post} = \left[\sum_{i=1}^{N_{daytypes}} EFLH_i * N_{days/yr_i}\right] * ConnectedLoad_{post}$$

5. The annual kWh ***saved*** was calculated using the previous data in the following equation:

$$\frac{kWh}{year}_{Savings} = \frac{kWh}{year}_{Pre} - \frac{kWh}{year}_{Post}$$

6. Estimated peak demand savings by subtracting pre/post time series data.
7. Calculated coincident peak savings by subtracting pre/post kW values at the grid peak.

Verification and Quality Control

1. Logger data was visually inspected for consistent operation. Some data from [Redacted] was removed due to suspected mixing of post-retrofit lamp wattages on a single monitored circuit.
2. Post retrofit lighting fixture specifications and quantities were verified to be consistent with the application.
3. Pre-retrofit lighting fixtures were verified to be removed from the project.

Recording and Data Exchange Format

1. Post-installation Lighting Survey Form and Notes.
2. Hobo logger binary files
3. Excel spreadsheets

Field Staff

☐ Verifiable Results
☐ AEC
■ **Other**

Contracting type

■**T&M**
☐ Per logger

Results Summary

The following results account for benefits of the lighting replacement at [Redacted].

The following tables summarize the energy and demand savings from Store 564:

	Lighting	HVAC	Total
Pre kW	6.6		
Post kW	2.9		
Demand Savings	3.6	0.7	4.3
Coincident Pk Demand Svgs (kW):	3.5	0.6	4.1

	Duke Savings	Realized Savings		Realization Rate	
		Lighting Only	Lighting and HVAC	Lighting Only	Lighting and HVAC
Energy (kWh)	not itemized	14,329	16,469	N/A	N/A
Demand (kW)	not itemized	4	4	N/A	N/A

The following tables summarize the energy and demand savings from [Redacted]:

	Lighting	HVAC	Total
Pre kW	11.3		
Post kW	4.5		
Demand Savings	6.9	1.2	8.1
Coincident Pk Demand Svgs (kW):	6.6	1.2	7.8

	Duke Savings	Realized Savings		Realization Rate	
		Lighting Only	Lighting and HVAC	Lighting Only	Lighting and HVAC
Energy (kWh)	not itemized	26,782	30,783	N/A	N/A

Demand (kW)	not itemized	7	8	N/A	N/A

The following tables show the total savings for both stores and the kWh and kW realization rates:

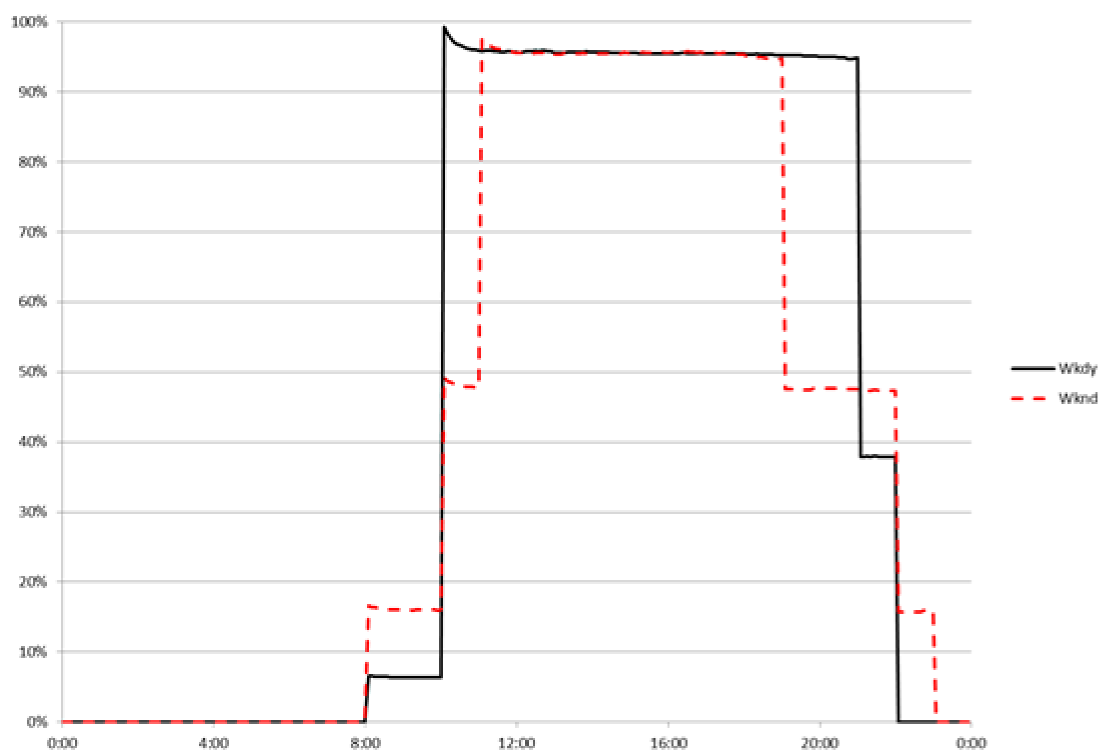
	Lighting	HVAC	Total
Pre kW	18		
Post kW	7		
Demand Savings	10.5	1.9	12.4
Coincident Pk Demand Svgs (kW):	10.1	1.8	11.9

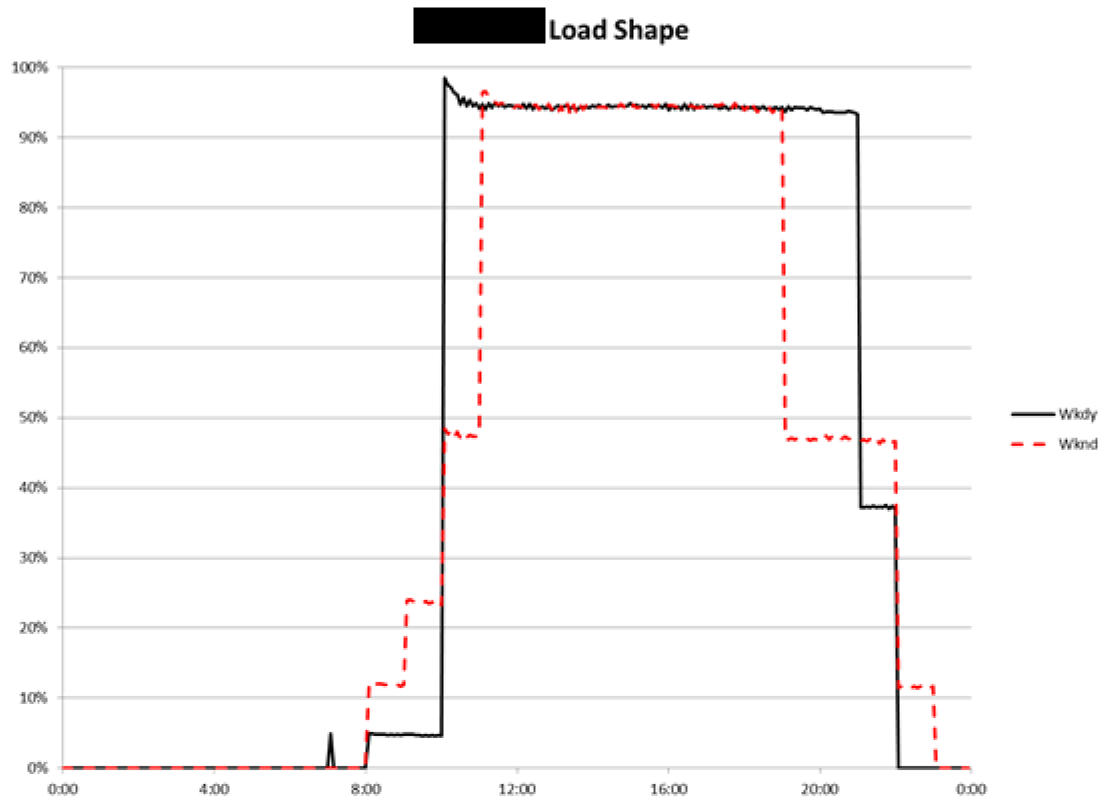
	Duke Savings	Realized Savings		Realization Rate	
		Lighting Only	Lighting and HVAC	Lighting Only	Lighting and HVAC
Energy (kWh)	35,615	41,111	47,252	115%	133%
NCP Demand (kW)	7.4	10.5	12.4	142%	168%
CP Demand (kW)	7.6	10	11.9	132%	157%

- Used the pre wattages from the application as supported by Appendix B: Table of Standard Fixture Wattages, 2008.
- Used post wattages from application as supported by product spec sheets.

The figures below show the lighting load shapes for each store.

[redacted] Load Shape




[redacted] Load Shape
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0:00
4:00
8:00
12:00
16:00
20:00
0:00
Wkdy
Wknd

[Redacted] (12-112)

- Lighting Retrofit -

M&V Report

PREPARED FOR:
Duke Energy
Ohio

PREPARED BY:
Architectural Energy Corporation
2540 Frontier Avenue, Suite 100
Boulder, Colorado 80301

PREPARED IN:
August 2012
V1.2

NOTE: This project has been randomly selected from the list of applications for which incentive agreements have been authorized under Duke Energy's Smart $aver® Custom Incentive Program.

The M&V activities described here are undertaken by an independent third-party evaluator of the Smart $aver® Custom Incentive Program.

Findings and conclusions of these activities shall have absolutely no impact on the agreed upon incentive between Duke Energy and [Redacted]

Introduction

This report addresses M&V activities for the [redacted] custom program application. The application covers a lighting retrofit at one location in Cincinnati, Ohio. This M&V report is for post-retrofit monitoring only. The measures include:

ECM-1 – High bay fixture retrofit with motion sensors

- This project involves the removal of 36 existing T-12 high output strip fixtures, to be replaced by 11 new 6-lamp T-5 fluorescent high bay fixtures with motion sensors. This will result in an overall power reduction of 5,742W.

Goals and Objectives

A post-retrofit survey of the lighting usage was conducted to determine the power reduction from the lighting upgrade.

The projected savings goals identified in the application are:

Facility	Application Proposed Annual kWh savings	Application Proposed Summer Peak kW savings	Duke Proposed Annual kWh savings	Duke Proposed Summer Peak kW savings
[Redacted]	29,560	6	29,052	6
Total	**29,560**	**6**	**29,052**	**6**

The objective of this M&V project will be to verify the actual:

- Annual gross kWh savings
- Summer peak kW savings
- kWh & kW Realization Rates

Project Contacts

Duke Energy M&V Coordinator	Frankie Diersing	513-287-4096
Duke Energy BRM		
Customer Contact	[Redacted]	[Redacted]
Architectural Energy Corporation Contact	Todd Hintz	p: 303-459-7476 thintz@archenergy.com

Site Locations/ECM's

Site	Address	Sq. Footage	ECM's Implemented

[Redacted]	[Redacted]	8,000	# 1

Data Products and Project Output

- Average pre/post load shapes by daytype for controlled equipment
- Verify fixture counts (post-retrofit), and that all fixtures have been upgraded
- Summer peak demand savings
- Annual Energy Savings

M&V Option

IPMVP Option A

M&V Implementation Schedule

- Conducted the post-retrofit survey after the customer performed the lighting retrofit.
  - Deployed post-retrofit loggers.
  - Spot measured the lighting load connected to the circuit by measuring the kW load and current draw of the circuit.
- Since the customer has already performed the lighting retrofit, pre-retrofit operating hours were used and pre- fixture information was taken from the application. Pre-retrofit fixture specifications and quantities removed from the project were verified in the field to match the application.
- Collected data during normal operating hours (avoided holidays or atypical operating hours).

Data Accuracy

Measurement	Sensor	Accuracy	Notes
Current	Magnelab CT	$\pm1\%$	> 10% of rating

Field Data Points

Post-Installation

Survey data

- Determined fixture count and Wattage
- Verified that all new fixture specifications and quantities were consistent with the application
- Determined how lighting is controlled post-retrofit and recorded controller settings
- Determined how lighting was controlled pre-retrofit
- Verified that all pre (existing) fixtures were removed

- Determined what holidays the building observes over the year
- Determined if the lighting zones are disabled during the holidays

One-time measurements taken (to establish ratio of kW/amp and simultaneous logger amp readings)

- Lighting circuit power when lights are on

The following procedure was used to gather time series data on controlled equipment:

- Typical lighting load shape
    - o Deployed two current measurement CT loggers to measure current at the panelboard.
    - o Loggers were configured for 5 minute instantaneous readings and operated for three weeks.
- Spot measure the lighting load connected to each circuit by measuring the kW load and current draw of the circuit during the post-retrofit survey. The lighting load circuits had only one fixture type on the circuit.

Logger Table

The following table summarizes all logging equipment that was used to accurately measure the above noted ECM's (PER STORE):

ECM	Hobo U-12	20A CT
1	2	2
Total	**2**	**2**

Data Analysis

- **ECM-1**

1. Converted time series data on logged equipment into pre/post average load shapes by day type (ex. weekday, weekend, holiday).
2. Load shapes were used to determine the daily Equivalent Full Load Hours (ELFH) for each day type.
3. The Pre annual kWh was calculated using the following equations:

$$\frac{kWh}{year}_{pre} = \left[\sum_{i=1}^{N_{daytypes}} EFLH_i * N_{days/yr_i} \right] * ConnectedLoad_{pre}$$

4. The Post annual kWh was calculated using the following equations:

$$\frac{kWh}{year}_{post} = \left[\sum_{i=1}^{N_{daytypes}} EFLH_i * N_{days/yr_i} \right] * ConnectedLoad_{post}$$

5. The annual kWh ***saved*** was calculated using the previous data in the following equation:

$$\frac{kWh}{year}_{Savings} = \frac{kWh}{year}_{Pre} - \frac{kWh}{year}_{Post}$$

6. Estimated peak demand savings by subtracting pre/post time series data.
7. Calculated coincident peak savings by subtracting pre/post kW values at the grid peak.

Verification and Quality Control

1. Visually inspected lighting logger data for consistent operation. Sorted by day type and removed invalid data.
2. Verified that pre-retrofit and post retrofit lighting fixture specifications and quantities are consistent with the application.
3. Verified that pre-retrofit lighting fixtures were removed from the project. Inspected storeroom for replacement lamps or fixtures.
4. Verified electrical voltage of pre and post lighting circuits.

Recording and Data Exchange Format

1. Pre-installation Lighting Survey Form and Notes.
2. Post-installation Lighting Survey Form and Notes.
3. Hobo/Elite Pro logger binary files
4. Excel spreadsheets

Field Staff

☐ Verifiable Results
☐ AEC
■ **Other**

Contracting type

■**T&M**
☐ Per logger

RESULTS SUMMARY

The following results account for benefits of the lighting replacement and occupancy sensor installation at [Redacted].

A summary of the estimated annual savings is shown in Table 1.

TABLE 1. ESTIMATED ANNUAL ENERGY SAVINGS

[Redacted] Results	
Actual Post Total (kWh/year)	14250
Estimated Pre Total (kWh/year)	47413
Lighting Savings (kWh/year)	33163
Application Savings (kWh/year)	29052
Realization Rate (kWh/Year)	**114%**
Actual Post Total (Non-Coincident Peak kW)	3.5
Actual Post Total (Coincident Peak kW)	3.2
Estimated Pre Total (Peak kW)	9.7
Lighting Savings (Non-Coincident Peak kW)	6.2
Lighting Savings (Coincident Peak kW)	6.5
Application Savings (Peak kW)	5.7
Realization Rate (Coincident Peak kW)	**118%**
Realization Rate (Non-Coincident Peak kW)	**115%**

The lighting was initially estimated to run 5148 hours/year with motion control on all of the fixtures. The estimated pre-retrofit run hours were determined to be 4898 hours/year. The pre-retrofit run hours were estimated by assuming that the lighting was on at 100% in the pre-retrofit case whenever the lights were on at any level greater than 5% in the post retrofit case. The increased kWh/year realization rate could possibly be explained by the decrease in actual run hours from the original estimation.

Graphs of actual logger data are shown in Figures 1-2. Evidence of the installed motion detectors can be seen in both figures.

FIGURE 1.

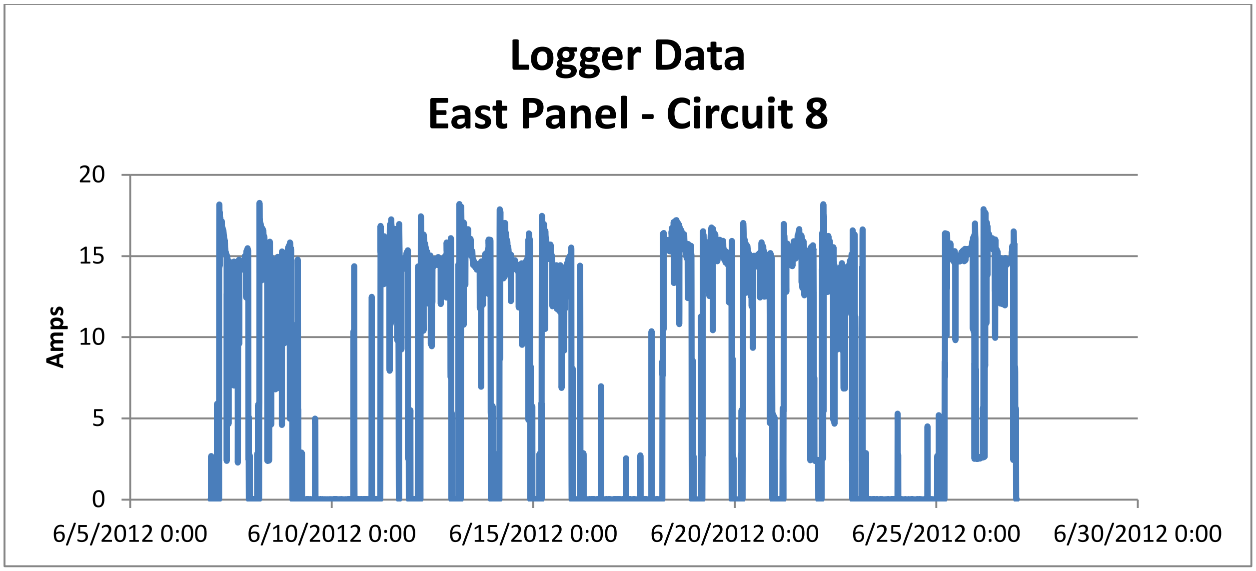
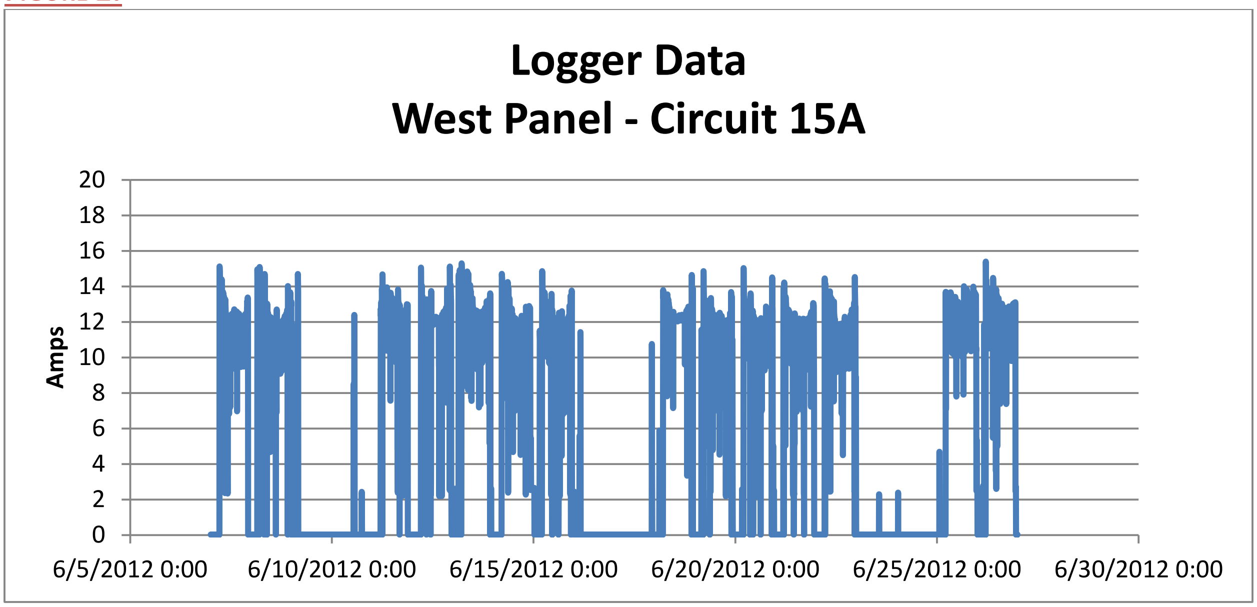

Logger Data
East Panel - Circuit 8
Amps
20
15
10
5
0
6/5/2012 0:00
6/10/2012 0:00
6/15/2012 0:00
6/20/2012 0:00
6/25/2012 0:00
6/30/2012 0:00

FIGURE 2.


Logger Data
West Panel - Circuit 15A
Amps
20
18
16
14
12
10
8
6
4
2
0
6/5/2012 0:00
6/10/2012 0:00
6/15/2012 0:00
6/20/2012 0:00
6/25/2012 0:00
6/30/2012 0:00

[Redacted]
Whole Building Renovation
M&V Report

Prepared for
Duke Energy Ohio

March 2015, Version 1.0

Note: This project has been randomly selected from the list of applications for which incentive agreements have been authorized under Duke Energy's Smart $aver® Custom Incentive Program.

The M&V activities described here are undertaken by an independent third-party evaluator of the Smart $aver® Custom Incentive Program.

Findings and conclusions of these activities shall have absolutely no impact on the agreed upon incentive between Duke Energy and [Redacted]

Submitted by:

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Introduction

This report addresses M&V activities for the [Redacted] custom program application. The application covers a whole-building energy retrofit at one location in Cincinnati, Ohio. The measure includes:

ECM-1 – Whole Building Retrofit
The [redacted] in downtown Cincinnati was purchased by [Redacted] and was renovated to include retail and apartment space. The 15 story building was mixed use retail and office space at the time of purchase. After retrofits, the basement and first 3 floors of the building remain retail/office space, while floors 4 through 15 have been converted into 87 apartment units.

All energy components (HVAC, lighting, appliances) were removed in the retrofit and replaced with new, high-efficiency components. Many existing components were original to the building (1920's era). The original building was mainly lit by T12 lamps, with an overall building lighting power density of approximately 1.1 W/ft^2. In the new design, water source heat pumps are utilized throughout the building, and the lighting power density has been reduced to 0.83 W/ft^2. Other components include high-efficiency boilers, cooling towers, pump VFDs, individually programmable thermostats throughout the building, and a DDC control system.

Goals and Objectives

The projected savings goals identified in the application are:

Facility	Proposed Annual kWh savings	Proposed kW Savings	Duke Projected Annual kWh savings	Duke Projected NCP kW savings	Duke Projected CP kW savings
[Redacted]	541,200	0	**887,484**	**146.5**	**122.1**
Total	**541,200**	**0**	**887,484**	**146.5**	**122.1**

It should be noted that NORESCO was provided eQuest energy model files dated February 2013 that showed an annual electric savings of 850,353 kWh. Per the customer, proposed savings from the application was based on much earlier modeling performed in 2010 using a different energy simulation software program. Between then and final design, numerous design changes were made which the customer thought resulted in greater savings over the ASHRAE Baseline.

The objective of this M&V project was to verify the actual:

- Average pre/post load shapes by daytype for controlled equipment
- Facility peak demand (kW) savings
- Summer utility coincident peak demand (kW) savings
- Annual energy (kWh) savings

Project Contacts

Duke Energy M&V Coordinator	Frankie Diersing	p: 513-287-4096
NORESCO Engineer	Mike Johnston	c: 303-459-7433 mjohnston@noresco.com
Customer Contact	[Redacted]	[Redacted]

Site Locations/ECMs

Address
[Redacted]

Data Products and Project Output

- Average pre/post load shapes by daytype for the whole facility
- Facility peak demand (kW) savings
- Summer utility coincident peak demand (kW) savings
- Annual energy (kWh) savings
- kWh & kW Realization Rates

M&V Option

IPMVP Option D

M&V Implementation Schedule

- Conducted the post-retrofit survey after the customer performed the energy retrofits.
  - Collected data during normal operating hours (avoid holidays or atypical operating hours).
  - Obtained and verified the post-retrofit HVAC system configuration, parameters, and selected equipment..
  - Performed spot-measurements on selected controlled equipment.

- Deployed post-retrofit loggers to record temperature and power measurements on selected circuits.
- Confirmed and updated the provided eQUEST energy model to reflect as-built conditions (NORESCO's responsibility).
- Evaluated the energy and demand savings of the retrofit measure.

Field Survey Points

Pre – installation

- No pre-installation field survey was performed, as this was a complete renovation, and the Baseline was based on ASHRAE 90.1-2007, rather than existing conditions.

Post – installation

- Visual verification of information listed in attached "Energy Model Input Summary".

Spot measurements

- V/A/kW/PF for residential circuits.

Time series data on controlled equipment

- Current on feeders for a group of residential apartments
- SAT and RAT for a heat pump in a common area
- OAT and RH
- Lighting circuit current for sampled circuits for common residential areas

Set up loggers for 5-minute instantaneous readings. Deploy for 3 weeks.

Data Accuracy

Measurement	Sensor	Accuracy	Notes
Current	Magnelab CT	±1%	Recorded load must be < 130% and >10% of CT rating
Power	ElitePro	±1%	
Temperature	Onset Temp/RH	±0.36°F	

Field Data Logging

- Installed data loggers to collect data on a sample of residential apartments (feeders serving 14th floor. Sample a heat pump in the commercial area for SAT and RAT Logged outdoor air temperature and relative humidity. Logged for 3 weeks with a 5-minute interval.

- For lighting circuits, monitored circuit current for three different residential common areas in order to determine lighting schedules. Logged for 3 weeks with a 5-minute interval.

Logger Table

The following table summarizes the logging equipment that was used for the above noted items:

Item	Hobo Loggers	CT-V Current Transducers	Hobo Temperature Probes	Weather Station
Residential Feeders	1	4 (CTV-C, 100A)		
OA, SA, RA	1		2	1
Lighting	1	3 (CTV-A, 20A)		
Total	**3**	**7**	**2**	**1**

Data Analysis

- Used the data collected in the operator interview to verify equipment specifications, schedules, setpoints and sequence of operation data for the eQUEST energy model.

- Confirmed that ASHRAE 90.1-2007 Baseline building is properly represented in the model.

- Compared trend data on schedules and setpoints to the post-retrofit eQUEST model and update with as-built conditions. Confirmed that the post-retrofit building envelope, lighting, and HVAC systems are properly represented in the model.

- Confirmed all other data in the “Energy Model Input Summary” (attached).

Verification and Quality Control

1. Visually inspected logger data for consistent operation. Sorted by day type and removed invalid data. Looked for data out of range and data combinations that are physically impossible.
2. Verified post-retrofit equipment specifications and quantities are consistent with the application. If they were not consistent, recorded discrepancies.

Recording and Data Exchange Format

1. Energy Model Input Summary and Notes.
2. Building Automation System data files OR data logger files
3. Excel spreadsheets
4. eQUEST files
5. DOE-2 energy model data files

Results

BASELINE ENERGY MODEL PARAMETERS

The following items were observed based on evaluation of the Baseline energy modeling inputs:

- A weather file was not included in the model submittal, therefore, a TMY3 weather file for Cincinnati, OH was used from the DOE2.2/eQuest website to perform the simulation.
- The Baseline model had the same concrete envelope as the proposed model. This correctly follows protocol of Table G3.1 of ASHRAE 90.1-2007 for existing building envelopes, where the Baseline building design reflects existing conditions prior to any revisions that are part of the scope of work being evaluated. The information provided in the Energy Model Input Summary for the Baseline envelope is incorrect in that it indicated R-13 + R-7.5 Continuous Insulation was modeled (metal frame construction). Additionally, for the Proposed model, exterior walls were modeled as 12 inch concrete, with an R-10 layer. Per conversations with the customer, no insulation was added to the existing, uninsulated walls in the renovation. Therefore, this R-10 layer was removed in both models.
- The Baseline model had glazing specified based on ASHRAE 90.1 requirements for climate zone 4A, with the Proposed model having glazing specifications for the existing glass. Because the windows were not replaced in the renovation, the Baseline model glazing should represent the existing glazing, such that no differences in glazing performance is modeled. Glazing specifications in the Proposed model (SC = 0.63 and a conductance of 0.69) was transferred to the Baseline model.
- The Baseline model incorrectly specified the system for residential floors as Packaged Multizone. This should have been modeled as packaged terminal air conditioners (PTAC)

with hot water fossil fuel boiler heating type per ASHRAE 90.1-2007 Appendix G Tables G3.1.1A and G3.1.1B.

- The Baseline model specified residential floor lighting power densities of 1.1 W/ft^2. It appears this was arrived at using the space-by-space method of calculating interior lighting power allowance (9.6.1 of ASHRAE 90.1-2007). This method is to be used when spaces are separated by space type in the model, depicting other power allowances of other spaces, such as corridors, electrical/mechanical, stairs, storage, restrooms, lobby, etc. Because these spaces are not represented in the model, the Building Area Method of Calculating Interior Lighting Power Allowance (9.5.1 of ASHRAE 90.1-2007) should be used. This results in a 0.7 W/ft^2 LPD allowance for the Multifamily floors and a 1.0 W/ft2 for the Office area, 1.5 W/ft^2 for the financial/bank area, using Retail as a proxy, per 9.5.1a: “For building area types not listed, selection of a reasonably equivalent type shall be permitted.”

PROPOSED DESIGN ENERGY MODEL PARAMETERS

Where possible, the inputs to the Proposed Design model were verified with project design and bid documents that were submitted with the application. These included:

- Glazing in the Proposed Design was modeled with a Solar Heat Gain Coefficient (SHGC) of 0.59 (SC = 0.63) and a conductance of 0.69 (excluding exterior film coefficient). No documentation was provided on existing glazing performance.
- Exterior walls were modeled as 12 inch concrete, with an R-10 layer. Per conversations with the customer, no insulation was added to the existing, uninsulated walls in the renovation. Therefore, this R-10 layer was removed.
- Lighting plans and fixture schedules were used to verify installed lighting power densities. No information was provided for commercial floors, presumably because no savings were claimed for these floors. Residential floors appeared nearly identical in fixture count for each floor based on lighting plans submitted. A representative lighting power take-off for a residential floor was performed to determine installed LPD as follows.

Table 1: Residential Floor Lighting Power Density Calculation.

Fixture Code	Fixture Wattage	Fixture Count	Total Wattage
A1	19	104	1976
Ceiling Fan (lighting only)	28	13	364
P1 (assumed Wattage)	15	13	195
B1	34	13	442
C2	32	15	480
S3 (Existing fixture- assumed Wattage)	64	9	576
		Total Watts:	**4033**
		Gross Floor Area (ft^2):	**7047**

Installed LPD (W/ft²):	**0.57**

This compares to a 0.83 W/ft^2 in the proposed model. It may have been that net floor area was used by the customer for calculation, rather than gross area. ASHRAE 90.1 guidelines dictate that gross floor area be used for calculation of lighting power density.

- Mechanical schedules and equipment specifications to verify water source heat pump heating and cooling efficiencies. Based on design documents, average nominal cooling efficiency for the heat pumps is 13.5 EER and average nominal heating efficiency is 4.6 COP. This agreed with inputs to the model, though it did not agree with the modeling input summary provided (14 EER, 4.1 COP).
- Mechanical schedules and equipment specifications to verify boiler efficiencies. Based on design documents, boilers are condensing, with 93.5% full fire efficiency. This agreed with inputs to the model, though it did not agree with the modeling input summary provided (98% efficiency).
- Mechanical schedules and equipment specifications to verify pumping power. Modeling inputs for pumping gpm, head, and pump and motor efficiencies were verified, and modeling inputs were confirmed to be in agreement with design documents.

DATA REVIEW

Current transducers were installed on feeders to nine apartments totaling 10,239 square feet, as shown in Table 2. Note the 14th floor has larger apartments than other floors because additional lofts exist, extended into the 15th level. Data was logged at 5 minute intervals for a period of three weeks, from September 6th – Sept 30th, 2014.

Table 2: Apartments on Monitored Circuit.

Apartment #	Area (sf)
[redacted]	710
[redacted]	653
[redacted]	1,517
[redacted]	1,111
[redacted]	1,138
[redacted]	1,140
[redacted]	1,046
[redacted]	814
[redacted]	2,110
Total:	**10,239**

A power calculation was made from the current measured in amps by assuming 120 V supply voltage phase-to neutral and a 0.85 power factor, summing the current for each of two conductors of one phase. Power was then normalized by square footage and typical weekday and weekend hourly profiles were developed by averaging hourly data. This is shown in Figure 1.

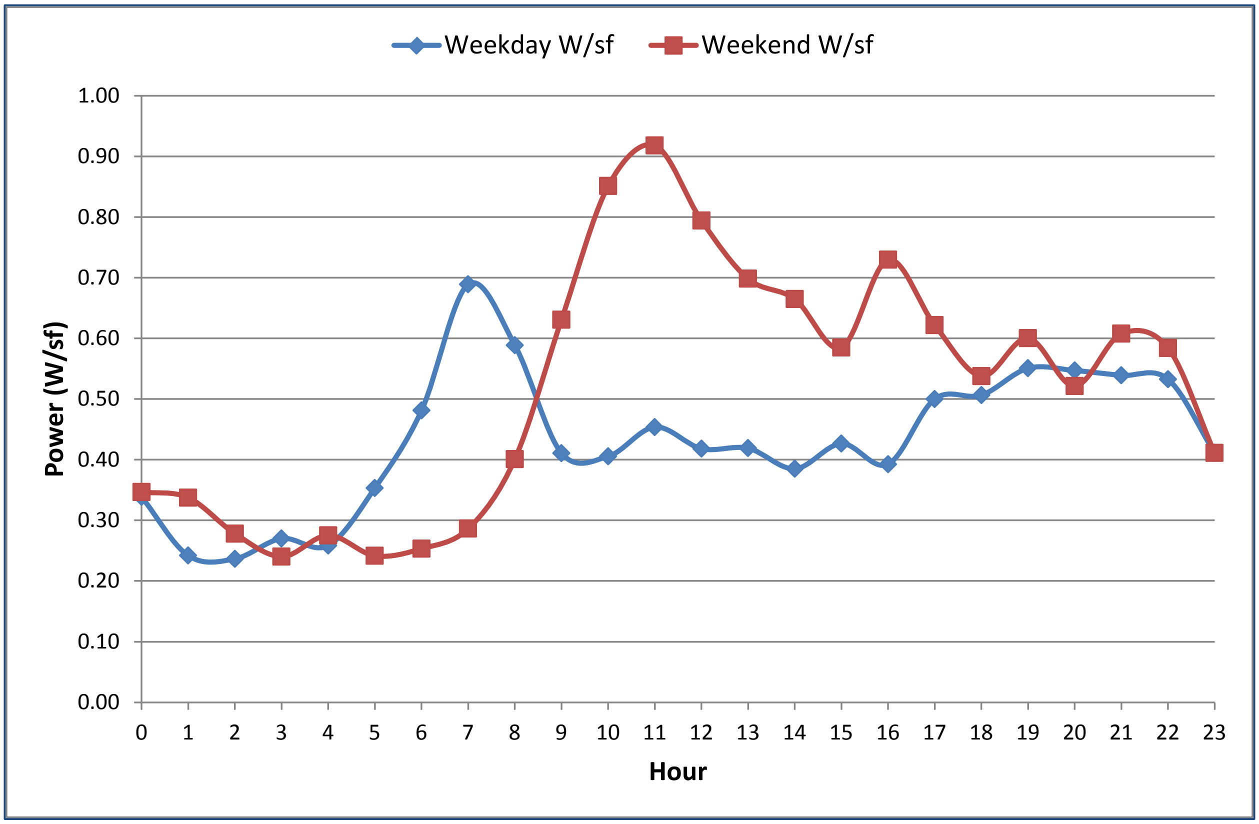

Figure 1: Average Apartment Load Profile.

It was noted that no OAT correlation could be discerned between normalized apartment power and outdoor air temperature. This is because there are too many end-uses mixed into the total measurement. This lack of correlation is shown in Figure 2.

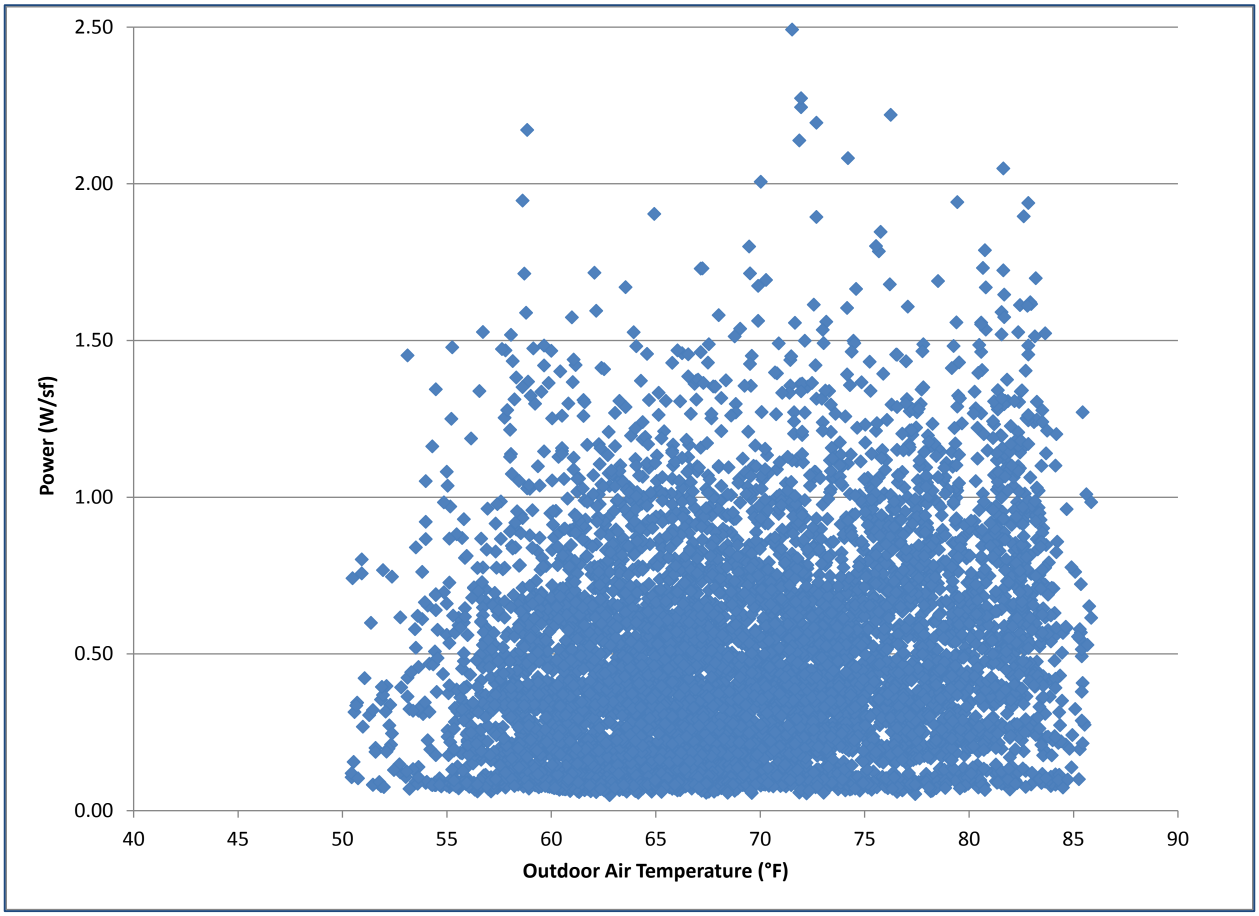

Figure 2: Apartment Load Correlation to OAT.

Also collected were several common area loads via current transducers, including the fitness room, corridor, and entertainment room, with results shown in Figure 3. Unfortunately, none of these spaces were explicitly built in the model (which involved highly simplified 5-zone core/perimeter modeling), nor did any of the spaces represent primary scheduling for the commercial space. For this reason, schedules in the commercial space were not adjusted from scheduling assumed in the original model.

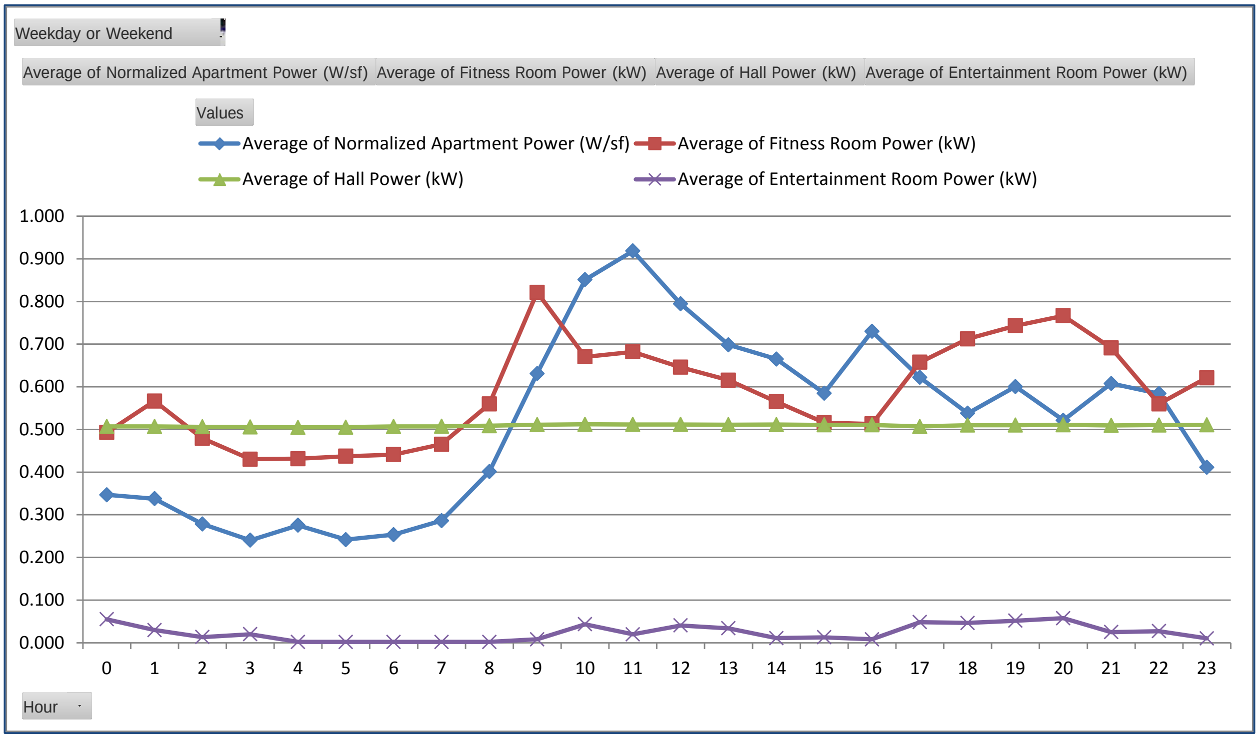

Figure 3: Monitored Residential Common Space Power.

MODEL ADJUSTMENTS

First, the Baseline and Proposed models inputs were adjusted based on parameters evaluated in the previous sections.

Because there are more than 80 apartments that are individually metered in the renovated building, not all of which are occupied, it was not practical to collect utility data for model calibration. However, logger data were used for adjustment of schedules to reflect observed operating conditions with the following methodology.

Because end-uses in apartments were not individually measured or logged, and in order to develop operating schedules for use in the energy model as multipliers on installed lighting power density and equipment power, it was assumed that 90% of the installed lighting power was operating at the peak hour (11 am on weekends). From there, a percent usage profile schedule was developed from the normalized power profiles. This is illustrated in Figure 4. It was assumed that plug loads also tracked this profile, so the schedule was also applied to equipment power densities in the residences. Since schedules are to be identical between the Baseline and the Proposed per ASHRAE 90.1 modeling, the same adjusted schedules for residential lighting and plug loads were input into the Baseline model.

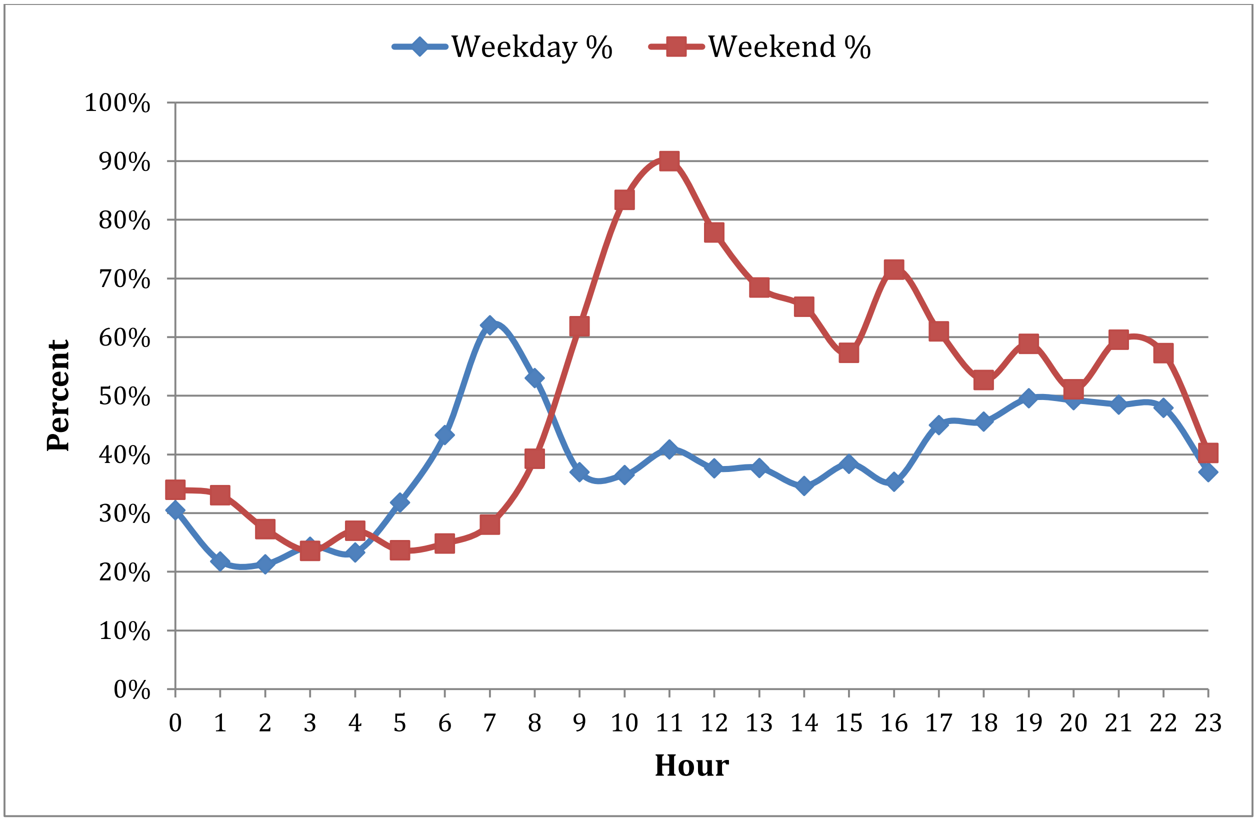

Figure 4: Apartment Lighting and Equipment Schedules.

ENERGY SAVINGS

The revised models were then run to calculate the annual post-retrofit demand and energy consumption of the Adjusted Proposed model compared to an average of four 90 degree rotations of the Adjusted Baseline model per ASHRAE 90.1 modeling protocol. Table 3 presents Adjusted modeling results.

Table 3: Adjusted Model Results.

Rotation	kWh	Coincident Peak Demand	Peak Demand	Therms
0° Baseline	2,620,320	565.1	675.1	41,846
90° Baseline	2,628,350	555.2	684.6	41,052
180° Baseline	2,635,541	568.5	685.3	39,782
270° Baseline	2,637,110	580.9	689.6	40,971
Average Baseline	**2,630,330**	**567.4**	**683.7**	**40,913**
Proposed Design	**2,157,393**	**564.0**	**678.3**	**14,427**
Savings	**472,937**	**3.4**	**5.4**	**26,486**

Table 4 presents the final energy and demand savings and realization rates for the [Redacted] Custom Incentive Program project. For Ohio in 2013, the coincident peak demand is evaluated on July 17 (Monday), for the hour between 4-5 PM.

Table 4: Comparison of Results to Projected Savings.

Facility	[Redacted]		
	Annual Energy Usage (kWh)	Summer Coincident Peak Demand (kW)	Summer Peak Demand (kW)
Duke Projected Savings	887,484	122.1	146.5
Model Savings	472,937	3.4	5.4
Realization Rate	53%	3%	4%

There are two primary reasons for the lower realization rates on this project:

1. The lighting power density for the Multifamily floors of the ASHRAE 90.1-2007 Baseline was incorrectly modeled as 1.1 W/ft^2 using the 90.1 Building Area Method. This should have been modeled as 0.7 W/ft^2.

2. The Baseline model incorrectly specified the system for residential floors as Packaged Multizone. This should have been modeled as packaged terminal air conditioners (PTAC) with hot water fossil fuel boiler heating type per ASHRAE 90.1-2007 Appendix G Tables G3.1.1A and G3.1.1B.

Attachments

1. Energy Model Input Summary

ENERGY MODEL INPUT SUMMARY (as received and as modified) (page 1 of 2)

Baseline Energy Analysis Input Summary According to ASHRAE 90.1-2007

1. Building Envelope
   1.1. Roof: R-20 Insulation
   1.2. Exterior walls: R-13 + R-7.5 Continuous Insulation Adjusted to be same as existing building per 90.1 modeling guidelines. 12 inch on most levels. Model submitted showed an R-10 layer, which was removed for the model adjustment.
   1.3. Slab: 6" Slab
   1.4. Floors: Metal frame with R-30 Insulation
2. Vertical Fenestrations
   2.1. Windows: U-Value of 0.55 and Shading Coefficient of 0.40 Adjusted to be same as existing building per 90.1 modeling guidelines.
   2.2. Doors: Metal door no insulation
3. Daylighting control
   3.1. Not Modeled
4. Operational Schedule
   4.1. Subbasement – 3rd Floor: office/financial occupancy 8AM-5PM no weekend or holidays
   4.2. 4-15 Floors: Residential Occupancy, mainly 5PM-7AM
5. Lighting Power Density
   5.1. 1.1 W/sq.ft. all floors Adjusted to 1.0 W/sf for office, 1.5 W/sf for financial, and 0.7 W/sf for residential floors.
6. Domestic Water Heating
   6.1. 50 gallons electric storage tanks in each apartment.
7. HVAC System
   7.1. DX Cooling units with 9.8 EER. Submitted model showed Packaged Multizone. Changed to packaged terminal air conditioners (PTAC) with hot water fossil fuel boiler heating type per ASHRAE 90.1-2007 Appendix G Tables G3.1.1A and G3.1.1B.
   7.2. Hot water fossil fuel boiler, 80% efficiency.

ENERGY MODEL INPUT SUMMARY (page 2 of 2)

Proposed Energy Analysis Input Summary

1. Building Envelope
    1.1. Roof: R-20 Insulation
    1.2. Exterior walls: 24” Concrete Walls no insulation 12 inch on most levels. Model submitted showed an R-10 layer, which was removed for the model adjustment.
    1.3. Slab: Concrete slab
    1.4. Floors: concrete floors
2. Vertical Fenestrations
    2.1. Windows: Perimeter windows are double pane ½” air gap and tinted
    2.2. Light-well and first floor are single pane 1/8” clear
    2.3. Doors: as in baseline
3. Daylighting control
    3.1. Not Modeled
4. Operational Schedule
    4.1. Sub basement-3 Floor: office occupancy 8AM-5PM no weekend or holidays
    4.2. 4-15 Floor Apartments: residential occupancy 5PM-7AM Lighting and equipment schedules adjusted based on analysis of monitored data.
5. Lighting Power Density
    5.1. Sub-3 Floor Office: estimated at 1.1 W/sqft Adjusted to 1.0 W/sf for office and 1.5 for financial to be same as ASHRAE Baseline.
    5.2. 4-15 Floor Apartments: 0.83 W/sqft Adjusted to 0.57 W/sf based on takeoffs.
6. Domestic Water Heating
    6.1. 50 gallons electric storage tanks in each apartment.
7. HVAC System
    7.1. Cooling: WSHP with efficiency of EER 14. Model submitted and equipment installed averaged 13.5.
    7.2. Heating: WSHP with efficiency of COP 4.1. Model submitted and equipment installed averaged 4.6.
    7.3. Cooling plant: high efficiency cooling tower with VFD
    7.4. Heating plant: High efficiency boiler with 98% efficiency. Model submitted and equipment installed was 93.5%

[Redacted]
AC2 West Upgrade
M&V Report

Prepared for
Duke Energy Ohio

February 2015, Version 1.1

Note: This project has been randomly selected from the list of applications for which incentive agreements have been authorized under Duke Energy's Smart $aver® Custom Incentive Program.

The M&V activities described here are undertaken by an independent third-party evaluator of the Smart $aver® Custom Incentive Program.

Findings and conclusions of these activities shall have absolutely no impact on the agreed upon incentive between Duke Energy and [Redacted].

Submitted by:

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Introduction

This report addresses measurement and verification (M&V) activities for [redacted] custom program application. The application covers upgrading the HVAC unit AC 2 West. The measure includes:

ECM-1 – Air Valve Modifications to Reduce Building Air Flow

- Replacing the existing supply fan in a constant volume, dual duct air handler with a new Huntair FANWALL 12-fan array system. Two new VFD's allow full modulation and also provide redundancy.
- Two new VFDs were also installed on the two existing return fans to allow variable speed operation.
- Old DDC controls were entirely replaced. This effort including adding static pressure sensors in the three duct mains served by this unit. The unit previously maintained 6.5 inches of static pressure at the discharge. The new maximum pressure setpoint was to be 4.0 in-WG at the fan discharge, and the new fans would modulate downward from that pressure as VAV boxes in the space close off. (Approximately 40% of the existing terminal boxes had already been converted to single duct, variable volume, although the main system still operated at constant volume.)
- A power (kW) meter was to be installed on the return fan to verify savings.
- The application considered fan energy savings only, although additional energy savings in cooling are expected.

The installation was completed in September, 2013, so the M&V activities were for post-retrofit only.

Goals and Objectives

Pre-and post-retrofit energy calculations for the building HVAC systems were previously created by the applicant's engineering firm. These calculations are included in the application.

The projected savings goals identified for this project are:

	APPLICATION		DUKE PROJECTIONS		
Facility	**Proposed Annual kWh Savings**	**Proposed Peak kW Savings**	**Proposed Annual kWh Savings**	**Proposed Non-Coincident Peak kW Savings**	**Proposed Coincident Summer Peak kW Savings**
[Redacted] HVAC Unit AC 2 West	792,201	-5	789,375	73.2	44.3

The objective of this M&V project is to verify the actual:

- Annual electric energy (kWh) savings
- Building peak demand (kW) savings
- Utility coincident peak demand (kW) savings
- Energy, demand and coincident demand Realization Rates.

Project Contacts

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Duke Energy M&V Coordinator	Frankie Diersing	Frankie.Diersing@duke-energy.com	O: 513-287-4096 C: 513-673-0573
Customer Contact	[Redacted]	[Redacted]	[Redacted]

Site Locations/ECM's

Site	Address	Sq. Footage	ECMs Implemented
[Redacted]	[Redacted]	1,400,000	1

Data Products and Project Output

- Energy consumption pre- and post-retrofit for the controlled equipment
- Annual energy savings
- Peak demand savings
- Coincident peak demand savings