COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

THE APPLICATION OF DUKE ENERGY KENTUCKY, INC. TO AMEND ITS DEMAND SIDE MANAGEMENT PROGRAMS	))))	Case No. 2020-00266

APPLICATION OF DUKE ENERGY KENTUCKY, INC. TO AMEND ITS DEMAND SIDE MANAGEMENT PROGRAMS

Comes now Duke Energy Kentucky, Inc. (Duke Energy Kentucky or the Company), pursuant to KRS 278.285, and other applicable law, and does hereby request the Commission to approve an amendment of the Demand Side Management (DSM) programs as Ordered by this Commission.[1] In support of its Application, Duke Energy Kentucky respectfully states as follows:

Introduction

1. Pursuant to 807 KAR 5:001, Section 14(2), Duke Energy Kentucky is a Kentucky corporation that was originally incorporated on March 20, 1901, is in good standing and, as a public utility as that term is defined in KRS 278.010(3), is subject to the Commission's jurisdiction. Duke Energy Kentucky is engaged in the business of furnishing natural gas and electric services to various municipalities and unincorporated areas in Boone, Bracken, Campbell, Gallatin, Grant, Kenton, and Pendleton Counties in

[1] *In the Matter of the Application of Duke Energy Kentucky, Inc. for the Annual Cost Recovery Filing for Demand Side Management*, Case No. 2012-00495, (Order) (April 11, 2013).

the Commonwealth of Kentucky. A copy of its articles of incorporation is on file with the Commission in Case No. 2013-00097.

2. Duke Energy Kentucky's business address is 139 East Fourth Street, Cincinnati, Ohio 45202. The Company's local office in Kentucky is Duke Energy Erlanger Ops Center, 1262 Cox Road, Erlanger, Kentucky 41018. Duke Energy Kentucky's email address is: KYfilings@duke-energy.com.

3. On November 15, 2012, Duke Energy Kentucky filed an application for the cost recovery of demand side management programs. The Company's application was docketed as Case No. 2012-00495. On April 11, 2013, this Commission approved that Application and Ordered Duke Energy Kentucky to file an application requesting program expansion(s) and to include: (1) an Appendix A, setting forth the Cost Effectiveness Test Results of all DSM programs, (2) an Appendix B, setting forth the recovery of program costs, lost revenues, and shared savings that are used in determining the true-up of proposed DSM factors; and (3) a signed and dated proposed Rider DSMR, Demand Side Management rate, for both electric and natural gas customers, Appendix C, by August 15, annually.[2]

Current DSM Programs

4. Duke Energy Kentucky has a long history of successful DSM implementation and has been a leader in the industry with respect to energy efficiency (EE) and peak demand reduction (DR) programs, having offered such programs since the mid-90's. Its existing portfolio of DSM programs was approved by the Commission in

[2] *See* Order, para. 4.

Case No. 2019-00406,[3] by Order dated April 29, 2020. This current portfolio of programs are as follows:

- Program 1: Low Income Services Program
- Program 2: Residential Energy Assessments Program
- Program 3: Residential Smart $aver® Efficient Residences Program
- Program 4: Residential Smart $aver® Energy Efficient Products Program
- Program 5: Smart $aver® Prescriptive Program
- Program 6: Smart $aver® Custom Program
- Program 7: Power Manager® Program
- Program 8: PowerShare®
- Program 9: Low Income Neighborhood
- Program 10: My Home Energy Report
- Program 11: Non-Residential Small Business Energy Saver Program
- Program 12: Non-Residential Pay for Performance[4]
- Program 13: Peak Time Rebate Pilot Program[5]

5. Consistent with the Commission's previous Orders, the Company is proposing programmatic changes in this year's annual amendment filing, and budgetary management proposals to more effectively target funding between programs based upon customer interest mid-stream, which will then be reflected in the financial true-ups and forecasts to be included in the annual cost recovery filing for demand side management:

[3] *In the Matter of the Electronic Application of Annual Cost Recovery Filing for Demand Side Management by Duke Energy Kentucky, Inc.* Case No. 2019-00406.
[4] Marketed as Smart $aver® Performance
[5] Approved in Case No. 2019-00277

- This Application proposes to expand the scope and adjust program budgets to respond to market conditions and enhance the robustness of the following:
    - Home Energy House Call
    - Smart $aver® Prescriptive
    - Peak Time Rebate
- This application describes the Company's on-going efforts to address the Commission's concern regarding the cost effectiveness of the DSM programs.

6. The Residential Collaborative[6] and the Commercial and Industrial Collaborative[7] have received the Company's proposed changes and had the opportunity to provide comments.

Amendments to Existing Programs

7. Duke Energy Kentucky is seeking approval to expand the scope of its Home Energy House Call program as follows:

To increase savings opportunity and value to the customer, the program is requesting to expand customer offerings to include upgradeable measure options at a discounted price during the assessment directly from the advisor. Such measures could include but are not limited to the following:

[6] The Residential Collaborative members receiving the information: John Horne and Heather Napier (Office of the Kentucky Attorney General), Jock Pitts (People Working Cooperatively), Catrena Bowman-Thomas (Northern Kentucky Community Action Commission), Laura Pleiman (Boone County), Peter Nienaber (Northern Kentucky Legal Aid), Kenya Stump (Kentucky Energy and Environment Cabinet), Rob McCracken (Greater Cincinnati Energy Alliance), and Tim Duff and Trisha Haemmerle (Duke Energy).

[7] The Commercial & Industrial Collaborative members receiving the information: John Horne and Heather Napier (Office of the Kentucky Attorney General), Jock Pitts (People Working Cooperatively), Kenya Stump (Kentucky Energy and Environment Cabinet), Chris Baker (Kenton County Schools), and Tim Duff and Trisha Haemmerle (Duke Energy).

- Assessment with blower door
- Handheld low-flow showerheads
- Smart thermostats
- Specialty globes
- Specialty candelabras
- Recessed LED bulbs

While the eligibility of the program does not change, the specific measures will only be offered and installed at a discount where opportunity exists. (Not to include: sockets, faucets, where existing energy efficiency are in place). The updated cost effectiveness scores are included in Appendix A.

8. Duke Energy Kentucky is seeking approval to increase the budget for its Smart $aver® Prescriptive program.[8] Standards continue to change and new, more efficient technologies continue to emerge in the market. In Case No. 2019-00277, the Company requested and received approval to offer new measures that passed the TRC cost effectiveness test. The Company will be truing up the July 2019 – June 2020 program year in November 2020. The non-residential portfolio of programs is underspent for this timeframe by $1,396,010. This is likely a result of impacts associated with the reduction in non-residential customer operations due to COVID-19. The Company

[8] The purpose of the Duke Energy Smart $aver® Prescriptive program is to provide incentives to influence non-residential customers to take action that they would not have absent of the program incentives. Duke Energy Kentucky continues to evaluate changes to existing measures, to take into consideration changes to market conditions and energy efficiency standards, and the addition of measures to offer customers additional options for energy savings.

This program promotes prescriptive incentives for the following technologies – lighting, HVAC, pumps & drives (variable frequency), food services, process equipment, and information technology equipment. Equipment and incentives are predefined based on current market assumptions and Duke Energy's engineering analysis. The eligible measures, and incentives for equipment as well as customer eligibility requirements are listed in the applications posted on Duke Energy's Business and Large Business websites for each technology type.

anticipates increased customer demand and interest in energy efficiency as customer operations return to pre-COVID-19 levels. In anticipation of increased customer demand, the Company is requesting to carry-over the unspent $1,396,010 to the current Smart $aver® Prescriptive budget of $548,785[9] for July 2020 – June 2021 as approved in Case No. 2019-00406. This carry-over for the coming year will provide funding to meet anticipated demand and mitigate volatility in the DSM charge in a future period of reconciliation. Otherwise, the unspent funds would be included in the overall reconciliation of the upcoming November 2020 true-up filing and additional funds would need to be requested to cover the anticipated budgetary spend that the Company believes was delayed as a result of COVID-19.

9. The Peak Time Rebate (PTR) pilot program offers participating customers the opportunity to lower their electric bill by reducing their electric usage during Company-designated peak load periods known as Critical Peak Events ("CPE"). The Company has branded the program to customers under the name of Peak Time Credits and describes CPEs to participants as Peak Day events. Unfortunately, the development of this pilot program did not start in January 2020 as expected. After approval, development started in April 2020 however, due to work resource constraints driven by COVID-19, the program was implemented later than anticipated, having launched on July 27, 2020. Budgeted spending for January 2020 through June 2020 was $207,000. Actual spend for this pilot over that timeframe was $36,811. The Company requests that the difference, $170,189.00 ($207,000 - $36,811 = $170,189), be shifted and added to the budgeted amounts for the July 2020 – June 2021 period. Therefore, in total, budget dollars available to the Peak Time Credit pilot program for July 2020 – June 2021 equal

[9] Program costs only. Does not include lost revenues or shared savings.

$207,000 + $170,189 = $377,189. The Company requests approval for this shift of budget dollars to ensure that adequate funding is available to support the program pilot. The Company requests approval by December 31, 2020. The Company will true-up the costs and include the cost effectiveness scores within the Annual Cost Recovery Filing for Demand Side Management to be filed November 15, 2021 recovering the July 1, 2020 – June 30, 2021 timeframe costs. As approved, this pilot program will not be included in the shared savings mechanism but will receive cost recovery of program costs.

10. In an effort to acknowledge the Commission's concerns about offering cost effective DSM measures, the Company is conducting a thorough review of all the measures within the DSM portfolio and will make recommendations to remove any measure that does not pass the TRC in the annual status update filing that is submitted in November. The portfolio updates associated with any measure removals will be reflected in the forecast of the July 2021 – June 2022 program year.

11. Pursuant to KRS 278.285(1)(b) and the Commission's Order, Appendix A includes the Cost Effectiveness Test Results for Home Energy House Call, Smart $aver® Prescriptive and Peak Time Rebate Pilot programs.

12. Pursuant to KRS 278.285(1)(c) and the Commission's Order, Appendix B includes the calculations to recover program costs, lost revenues, and shared shavings, that are used in determining the true-up of proposed DSM factor(s).

13. A signed and dated proposed Rider DSMR, Sheet No. 78 Demand Side Management Rider, for both electric and natural gas customers, is attached hereto as Appendix C.

14. Pursuant to KRS 278.285(1)(c) and the Commission's Order, the Company is filing program evaluations within this application. The following evaluations are included in appendices D – G: Appendix D: Smart $aver® Custom Evaluation; Appendix E: Smart $aver® Residential – Multifamily Evaluation; Appendix F: Smart $aver® Prescriptive Evaluation; Appendix G: Smart $aver® Save Energy and Water Evaluation.

15. Finally, Duke Energy Kentucky respectfully requests that the Commission's Order in this proceeding approve any tariff modifications to be effective so to align with the Company's first billing cycle in the month following the Commission's Order. The Company is unable to implement tariff changes immediately upon approval and outside of a billing cycle under its current billing system. The Company needs at least five business days from the issuance of an Order to implement rate changes and appropriately test the calculations.

WHEREFORE, Duke Energy Kentucky respectfully requests that the Commission grant the relief requested herein.

Respectfully submitted,

/s/ Rocco D'Ascenzo

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CERTIFICATE OF SERVICE

This is to certify that the foregoing electronic filing is a true and accurate copy of the document being filed in paper medium; that the electronic filing was transmitted to the Commission on August 17, 2020; that there are currently no parties that the Commission has excused from participation by electronic means in this proceeding; and the original filing in paper medium will be delivered to the Commission pending further instruction from Case No. 2020-00085.[10]

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[10] *In the Matter of Electronic Emergency Docket Related to the Novel Coronavirus COVID-19*, Order, Case No. 2020-00085 (Ky. P.S.C. March 16, 2020).

Cost Effectiveness Test Results (A)

	2020-21 Program Modifications			
Program Name	**UCT**	**TRC**	**RIM**	**PCT**
Residential Programs				
Residential Energy Assessments	1.72	1.64	0.69	18.50
Peak Time Rebate Pilot[(B)]	0.19	0.20	0.19	NA
Non-Residential Programs				
Smart $aver® Prescriptive	1.80	3.11	0.80	5.77

(A) Cost effectiveness scores of the modified programs listed, as filed in 2020 amendment filing.
Most recent scores for existing programs can be found In the Company's annual true up filing, Case No. 2019-00406, Appendix A.
(B) Scores are not changed and will be updated in the 2021 status update filing.

Kentucky DSM Rider

Comparison of Revenue Requirement to Rider Recovery

Residential Programs	(1) Projected Program Costs 7/2018 to 6/2019 (A)	(2) Projected Lost Revenues 7/2018 to 6/2019 (A)	(3) Projected Shared Savings 7/2018 to 6/2019 (A)	(4) Program Expenditures 7/2018 to 6/2019 (B)	(5) Program Expenditures (C) Gas	(6) Program Expenditures (C) Electric	(7) Lost Revenues 7/2018 to 6/2019 (B)	(8) Shared Savings 7/2018 to 6/2019 (B)	(9) 2018 Reconciliation Gas (D)	(10) 2018 Reconciliation Electric (E)	(11) Rider Collection (F) Gas	(12) Rider Collection (F) Electric	(13) (Over)/Under Collection Gas (G)	(14) (Over)/Under Collection Electric (H)
Energy Efficiency Education Program for Schools	$ -	$ -	$ -	$ 5,809	$ 5,714	$ 95	$ -	$ (544)						
Low Income Neighborhood	$ 343,237	$ 243	$ (15,216)	$ 234,459	$ -	$ 234,459	$ 459	$ (10,309)						
Low Income Services	$ 911,344	$ 1,157	$ (51,878)	$ 458,781	$ 196,799	$ 261,983	$ 154	$ (19,428)						
My Home Energy Report	$ -	$ -	$ -	$ 30,463	$ -	$ 30,463	$ 1,777	$ (2,736)						
Residential Energy Assessments	$ 300,015	$ 1,532	$ 8,033	$ 185,958	$ -	$ 185,958	$ 1,468	$ 13,048						
Residential Smart $aver®	$ 2,323,461	$ 17,149	$ 106,686	$ 1,103,926	$ -	$ 1,103,926	$ 12,934	$ 222,124						
Power Manager®	$ 760,837	$ -	$ 119,492	$ 568,954	$ -	$ 568,954	$ -	$ 108,088						
Power Manager® for Apartments	$ -	$ -	$ -	$ (7)	$ -	$ (7)	$ -	$ -						
Home Energy Assistance Pilot Program (I)	$ 258,401	$ -	$ -	$ 302,017	$ 126,686	$ 175,331					$ 110,443	$ 152,851		
Revenues collected except for HEA											$ (2,578,966)	$ 4,711,948		
Total	$ 4,897,295	$ 20,081	$ 167,118	$ 2,890,360	$ 329,199	$ 2,561,161	$ 16,792	$ 310,244	$ (1,050,839)	$ (5,236,244)	$ (2,468,523)	$ 4,864,800	$ 1,746,882	$ (7,212,847)

(A) Amounts identified in report filed in Case No. 2017-00427
(B) Actual program expenditures, lost revenues (for this period and from prior period DSM measure installations), and shared savings for the period July 1, 2018 through June 30, 2019.
(C) Allocation of program expenditures to gas and electric in accordance with the Commission's Order in Case No. 2014-00388.
(D) Recovery allowed in accordance with the Commission's Order in Case No. 2012-00085.
(E) Recovery allowed in accordance with the Commission's Order in Case No. 2012-00085.
(F) Revenues collected through the DSM Rider between July 1, 2018 and June 30, 2019.
(G) Column (5) + Column (9) - Column(11).
(H) Column (6) + Column (7) + Column (8) + Column (10) - Column(12).
(I) Revenues and expenses for the Home Energy Assistance Pilot Program.

Commercial Programs	(1) Projected Program Costs 7/2018 to 6/2019 (A)	(2) Projected Lost Revenues 7/2018 to 6/2019 (A)	(3) Projected Shared Savings 7/2018 to 6/2019 (A)	(4) Program Expenditures 7/2018 to 6/2019 (B)	(5) Lost Revenues 7/2018 to 6/2019 (B)	(6) Shared Savings 7/2018 to 6/2019 (B)	(7) 2018 Reconciliation (C)	(8) Rider Collection (D)	(9) (Over)/Under Collection (E)
Small Business Energy Saver	$ 909,657	$ 3,776	$ 117,551	$ 436,936	$ 3,999	$ 57,362			
Smart $aver® Custom	$ 1,527,598	$ 207,789	$ 402,802	$ 1,275,217	$ 11,889	$ 575,639			
Smart $aver® Non-Residential Performance Incentive Program	$ 205,022	$ 2,543	$ 47,181	$ 42	$ -	$ (4)			
Smart $aver® Prescriptive - Energy Star Food Service Products	$ 40,698	$ 241	$ 8,192	$ 18,313	$ 149	$ 2,899			
Smart $aver® Prescriptive - HVAC	$ 130,263	$ 513	$ 25,382	$ 70,326	$ 172	$ 10,887			
Smart $aver® Prescriptive - IT	$ 7,997	$ 0	$ (800)	$ 3,830	$ -	$ (383)			
Smart $aver® Prescriptive - Lighting	$ 1,349,145	$ 7,708	$ 290,570	$ 717,012	$ 5,117	$ 273,302			
Smart $aver® Prescriptive - Motors/Pumps/VFD	$ 13,754	$ 0	$ (1,287)	$ 13,720	$ -	$ 2,562			
Smart $aver® Prescriptive - Process Equipment	$ 7,116	$ 0	$ (712)	$ 2,507	$ -	$ (251)			
Power Manager® for Business	$ 180,181	$ 244	$ (7,458)	$ 2,723	$ -	$ 536			
Total	$ 4,371,431	$ 222,814	$ 881,422	$ 2,540,625	$ 21,326	$ 922,548	$ 6,022,795	$ 9,166,516	$ 340,779
PowerShare®	$ 923,717	$ -	$ 93,854	$ 593,292	$ -	$ 157,387	$ 565,255	$ 1,011,564	$ 304,370

(A) Amounts identified in report filed in Case No. 2017-00427
(B) Actual program expenditures, lost revenues (for this period and from prior period DSM measure installations), and shared savings for the period July 1, 2018 through June 30, 2019.
(C) Recovery allowed in accordance with the Commission's Order in Case No. 2012-00085.
(D) Revenues collected through the DSM Rider between July 1, 2018 and June 30, 2019.
(E) Column (4) + Column (5) + Column (6) + Column (7) - Column (8)

Kentucky DSM Rider

2020-2021 Projected Program Costs, Lost Revenues, and Shared Savings

Residential Program Summary (A)

	Costs	Lost Revenues	Shared Savings	Total	Allocation of Costs (B) Electric	Allocation of Costs (B) Gas	Electric Costs	Budget (Costs, Lost Revenues, & Shared Savings) Electric	Budget (Costs, Lost Revenues, & Shared Savings) Gas Costs
Low Income Neighborhood	$ 306,300	$ 3,758	$ (10,254)	$ 299,805	100.0%	0.0%	$ 306,300	$ 299,805	$ -
Low Income Services	$ 450,263	$ 1,662	$ (18,999)	$ 432,926	73.2%	26.8%	$ 329,629	$ 312,292	$ 120,634
My Home Energy Report	$ 171,457	$ 91	$ 6,071	$ 177,619	100.0%	0.0%	$ 171,457	$ 177,619	$ -
Residential Energy Assessments(D)	$ 272,353	$ 8,060	$ 19,308	$ 299,720	100.0%	0.0%	$ 272,353	$ 299,720	$ -
Residential Smart $aver®	$ 905,354	$ 10,949	$ 62,074	$ 978,377	100.0%	0.0%	$ 905,354	$ 978,377	$ -
Power Manager®	$ 585,261	$ -	$ 131,900	$ 717,161	100.0%	0.0%	$ 585,261	$ 717,161	$ -
Peak Time Rebate Pilot Program(D)	$ 377,189	$ -	$ -	$ 377,189	100.0%	0.0%	$ 377,189	$ 377,189	$ -
Total Costs, Net Lost Revenues, Shared Savings	$ 3,068,178	$ 24,520	$ 190,100	$ 3,282,798			$ 2,947,544	$ 3,162,164	$ 120,634

NonResidential Program Summary (A)

	Costs	Lost Revenues	Shared Savings	Total	Allocation of Costs (B) Electric	Allocation of Costs (B) Gas	Electric Costs	Budget (Costs, Lost Revenues, & Shared Savings) Electric	Budget (Costs, Lost Revenues, & Shared Savings) Gas
Small Business Energy Saver	$ 763,524	$ 4,825	$ 123,224	$ 891,572	100.0%	0.0%	$ 763,524	$ 891,572	NA
Smart $aver® Custom	$ 707,158	$ 8,176	$ 241,184	$ 956,518	100.0%	0.0%	$ 707,158	$ 956,518	NA
Smart $aver® Prescriptive (C), (D)	$ 1,944,795	$ 10,904	$ 154,642	$ 2,110,341	100.0%	0.0%	$ 1,944,795	$ 2,110,341	NA
PowerShare®	$ 904,512	$ -	$ 147,510	$ 1,052,022	100.0%	0.0%	$ 904,512	$ 1,052,022	NA
Total Costs, Net Lost Revenues, Shared Savings	$ 4,319,989	$ 23,904	$ 666,560	$ 5,010,454			$ 4,319,989	$ 5,010,454	NA
Total Program	$ 7,388,166	$ 48,424	$ 856,661	$ 8,293,251					

(A) Costs, Lost Revenues (for this period and from prior period DSM measure installations), and Shared Savings for Year 8 of portfolio.
(B) Allocation of program expenditures to gas and electric in accordance with the Commission's Order in Case No. 2014-00388.
(C) Smart $aver® Prescriptive consists of the following technologies: Energy Efficient Food Service Projects, HVAC, Lighting, IT, Pumps and Motors, and Process Equipment.
(D) Yellow highlighted rows include modifications to programs as described in application.

Kentucky DSM Rider

Duke Energy Kentucky
Demand Side Management Cost Recovery Rider (DSMR)
Summary of Calculations for Programs

July 2019 to June 2020

	Program Costs (A)
Electric Rider DSM	
Residential Rate RS	$ 3,162,164
Distribution Level Rates Part A DS, DP, DT, GS-FL, EH & SP	$ 3,958,431
Transmission Level Rates & Distribution Level Rates Part B	$ 1,052,022
Gas Rider DSM	
Residential Rate RS	$ 120,634

(A) See Appendix B, page 2 of 7

Kentucky DSM Rider

Duke Energy Kentucky
Demand Side Management Cost Recovery Rider (DSMR)
Summary of Billing Determinants

Year	2020
Projected Annual Electric Sales kWH	
Rate RS	1,475,582,438
Rates DS, DP, DT, GS-FL, EH, & SP	2,305,428,301
Rates DS, DP, DT, GS-FL, EH, SP, & TT	2,541,311,301
Projected Annual Gas Sales CCF	
Rate RS	62,137,848

Kentucky DSM Rider

Duke Energy Kentucky
Demand Side Management Cost Recovery Rider (DSMR)
Summary of Calculations

July 2018 to June 2019

Rate Schedule Riders	True-Up Amount (A)	Expected Program Costs (B)	Total DSM Revenue Requirements	Estimated Billing Determinants (C)		DSM Cost Recovery Rider (DSMR)	
Electric Rider DSM							
Residential Rate RS	$ (7,387,398)	$ 3,162,164	$ (4,225,234)	1,475,582,438	kWh	$ (0.002863)	$/kWh
Distribution Level Rates Part A							
DS, DP, DT, GS-FL, EH & SP	$ 349,026	$ 3,958,431	$ 4,307,457	2,305,428,301	kWh	$ 0.001868	$/kWh
Transmission Level Rates & Distribution Level Rates Part B							
TT	$ 311,735	$ 1,052,022	$ 1,363,758	2,541,311,301	kWh	$ 0.000537	$/kWh
Distribution Level Rates Total							
DS, DP, DT, GS-FL, EH & SP						$ 0.002405	$/kWh
Gas Rider DSM							
Residential Rate RS	$ 1,789,157	$ 120,634	$ 1,909,790	62,137,848	CCF	$ 0.030735	$/CCF
Total Rider Recovery			$ 3,355,771				

(A) (Over)/Under of Appendix B page 1 multiplied by the average three-month commercial paper rate for 2018 to include interest on over or under-recovery in accordance with the Commission's order in Case No. 95-312. Value is: 1.024200
(B) Appendix B, page 2.
(C) Appendix B, page 4.

Allocation Factors based on July 2018-June 2019

Summary of Load Impacts July 2018 Through June 2019 (1)

Residential Programs	kWh	% of Total Res Sales	ccf	% of Total Res Sales	Elec % of Total % of Sales	Gas % of Total % of Sales
Energy Efficiency Education Program for Schools	1,670	0.0001%	4,214	0.0066%	2%	98%
Low Income Neighborhood	227,395	0.0149%	-	0.0000%	100%	0%
Low Income Services	207,830	0.0137%	6,549	0.0103%	57%	43%
My Home Energy Report	38,733	0.0025%	-	0.0000%	100%	0%
Residential Energy Assessments	386,925	0.0254%	-	0.0000%	100%	0%
Residential Smart $aver®	5,735,203	0.3770%	-	0.0000%	100%	0%
Power Manager®	-	0.0000%	-	0.0000%	100%	0%
Power Manager® for Apartments	-	0.0000%	-		100%	0%
Total Residential	6,597,757	0.4337%	10,763	0.0169%		
Total Residential (Rate RS) Sales For July 2018 Through June 2019	1,521,283,243	100%	63,811,024	100%		

(1) Load Impacts Net of Free Riders at Meter

Allocation Factors Projected

Summary of Load Impacts July 2020 Through June 2021 (1)

Residential Programs	kWh	% of Total Res Sales	ccf	% of Total Res Sales	Elec % of Total Sales	% of	Gas % of Total Sales	% of
Low Income Neighborhood	224,406	0.0148%	-	0.0000%	100%		0%	
Low Income Services	255,140	0.0168%	3,917	0.0061%	73%		27%	
My Home Energy Report	1,534,687	0.1009%	-	0.0000%	100%		0%	
Residential Energy Assessments	671,931	0.0455%	-	0.0000%	100%		0%	
Residential Smart $aver®	2,260,897	0.1486%	-	0.0000%	100%		0%	
Power Manager®	-	0.0000%	-	0.0000%	100%		0%	
Total Residential	4,947,061	0.3266%	3,917	0.0061%				
Total Residential (Rate RS) Sales Projected	1,475,582,438	100%	62,137,848	100%				

(1) Load Impacts Net of Free Riders at Meter

KY.P.S.C. Electric No. 2
Twenty-~~Eighth~~ Ninth Revised Sheet No. 78
Duke Energy Kentucky
1262 Cox Road~~4580 Olympic Blvd.~~
Revised Sheet No. 78
Erlanger, KY 41018

Cancels and Supersedes
Twenty-~~Seventh~~ Eighth
Page 1 of 1

RIDER DSMR

DEMAND SIDE MANAGEMENT RATE

The Demand Side Management Rate (DSMR) shall be determined in accordance with the provisions of Rider DSM, Demand Side Management Cost Recovery Rider, Sheet No. 75 of this Tariff.

The DSMR to be applied to residential customer bills is ($0.~~003143~~002863) per kilowatt-hour. (~~R~~I)

A Home Energy Assistance Program (HEA) charge of $0.30 will be applied monthly to residential customer bills. ~~(I)~~

The DSMR to be applied to non-residential distribution service customer bills is $0.~~001768~~ 002405 per kilowatt-hour. (~~R~~I)

The DSMR to be applied for transmission service customer bills is $0.000537 per kilowatt-hour.

Issued by authority of an Order by the Kentucky Public Service Commission dated ~~May 4, 2020~~ ___ in Case No. ~~2019~~2020-~~00366~~00~~xxx~~266.

Issued: ~~May~~ August 15, 2020
Effective: ~~June 30~~September 15, 2020
Issued by Amy B. Spiller, President /s/ Amy B. Spiller

Duke Energy Kentucky
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Erlanger, KY 41018

KY.P.S.C. Electric No. 2
Twenty-Ninth Revised Sheet No. 78
Cancels and Supersedes
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RIDER DSMR

DEMAND SIDE MANAGEMENT RATE

The Demand Side Management Rate (DSMR) shall be determined in accordance with the provisions of Rider DSM, Demand Side Management Cost Recovery Rider, Sheet No. 75 of this Tariff.

The DSMR to be applied to residential customer bills is ($0.002863) per kilowatt-hour. (I)

A Home Energy Assistance Program (HEA) charge of $0.30 will be applied monthly to residential customer bills.

The DSMR to be applied to non-residential distribution service customer bills is $0.002405 per kilowatt-hour. (I)

The DSMR to be applied for transmission service customer bills is $0.000537 per kilowatt-hour.

Issued by authority of an Order by the Kentucky Public Service Commission dated ___ in Case No. 2020-00266.

Issued: August 15, 2020
Effective: September 15, 2020
Issued by Amy B. Spiller, President /s/ Amy B. Spiller

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Smart $aver® Non-Residential Custom Program Years 2015-2017 Evaluation Report

Submitted to Duke Energy Kentucky
in partnership with Tetra Tech

February 6, 2020

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1 Executive Summary

1.1 Program Summary

Duke Energy's Non-Residential Smart $aver® Custom Incentive Program (NR Custom) offers financial assistance to qualifying commercial, industrial and institutional customers in the Duke Energy Kentucky (DEK) service territory to enhance their ability to adopt and install cost-effective electrical energy efficiency projects.

The program is designed to meet the needs of the Company's non-residential customers with electrical energy saving projects involving more complicated or alternative technologies, or those measures not covered by the non-residential Smart $aver Prescriptive Program. The intent of the program is to encourage the implementation of energy efficiency projects that would not otherwise be completed without the company's technical or financial assistance.

1.2 Evaluation Objectives and High Level Findings

This report presents the results and findings of evaluation activities for Duke Energy Kentucky's NR Custom program conducted by the evaluation team, collectively Nexant Inc. and our subcontracting partner, Tetra Tech, for the period of August 2015 through December 2017.

1.2.1 Impact Evaluation

The overarching goals for the NR Custom impact evaluation were to:

- Quantify accurate and supportable energy impacts (kWh) and summer and winter demand (kW) savings for energy efficient measures and equipment implemented in participants' facilities.
- Assess the rate of free riders from customer and contractor perspective.
- Determine spillover effects
- Consider and verify measure installation-vintage aligned with measure baseline definitions, i.e. early replacement, burnout on failure, etc.
- Leverage the Duke Energy Ohio (DEO) sample to reduce the cost of the DEK evaluation while improving the confidence and precision of the DEK results.

Evaluation activities included in-depth reviews and on-site verification of a representative sample of projects, in-person or phone interviews with program participants, deploying metering equipment, collecting building automation system/energy management system (BAS/EMS) data, and engineering analyses to estimate gross and net savings for all implemented measures attributed to the NR Custom Program.

The sample projects selected and analyzed as part of the DEO NR Custom evaluation were combined with a sample of DEK NR Custom projects to increase the total number of sample projects used for the DEK evaluation. The DEO projects are considered representative of the

DEK NR Custom project due to the similarities in the program design, trade ally networks involved in the program and the geographic location.

1.2.2 Process Evaluation Objectives

Process evaluations are designed to support continuous program improvement by identifying successful program elements that can be expanded upon as well as underperforming/inefficient processes that could be holding back program performance. The process evaluation for the NR Custom Program sought to:

- Assess how participant characteristics compare to segments targeted for the program
- Assess the sources of customer engagement and most effective marketing source
- Assess influence the program has on customers' decisions to install EE measures
- Assess whether sufficient documentation and information are provided to customers
- Assess persistence of program engagement with participants
- Assess satisfaction with the program and its components including suggestions for program changes

To meet these objectives, the evaluation team conducted interviews with key program staff, reviewed program documentation, and utilized telephone surveys to ask program participants and trade allies about their experiences with the program.

1.2.3 High Level Findings

1.2.3.1 Gross Impact Evaluation Key Findings

The impact evaluation results indicate that program internal processes for project review, savings estimation, and installation verification are producing quality estimates of project impacts. Energy realization rates exceed 86% for three of the four strata (Lighting - Large, Lighting - Small, and Non-lighting - Small). The realization rate for the Non-lighting-Large strata was 74.8%. Realization rates for Summer and Winter demand at the program level were 106.1% and 101.4%, respectively. Findings from the gross impact evaluation are summarized in Table 1-1, Table 1-2, and Table 1-3.

Table 1-1 DEK Program Reported and Verified Gross Energy Impacts for Projects Completed August 2015 – December 2017

Measure Category	Strata	Gross Reported Energy Savings (kWh)	Gross Verified Energy Savings (kWh)	RR (%)
Lighting	Large (>400 MWh)	7,189,149	8,379,246	116.6%
	Small (<400 MWh)	2,661,560	2,589,783	97.3%
Non-lighting	Large (>1,000 MWh)	2,145,140	1,603,562	74.8%
	Small (<1,000 MWh)	941,167	817,871	86.9%
Total		**12,937,016**	**13,390,463**	**103.5%**

Table 1-2 DEK Program Reported and Verified Gross Summer Demand Impacts for Projects Completed August 2015 – December 2017

Measure Category	Strata	Gross Reported Summer Demand Savings (kW)	Gross Verified Summer Demand Savings (kW)	RR (%)
Lighting	Large (>400 MWh)	853	990	116.1%
	Small (<400 MWh)	324	323	99.6%
Non-lighting	Large (>1,000 MWh)	149	94	62.8%
	Small (<1,000 MWh)	291	309	106.4%
Total		**1,617**	**1,716**	**106.1%**

Table 1-3 DEK Program Reported and Verified Gross Winter Demand Impacts for Projects Completed August 2015 – December 2017

Measure Category	Strata	Gross Reported Winter Demand Savings (kW)	Gross Verified Winter Demand Savings (kW)	RR (%)
Lighting	Large (>400 MWh)	853	945	110.8%
	Small (<400 MWh)	310	277	89.4%
Non-lighting	Large (>1,000 MWh)	128	83	64.9%
	Small (<1,000 MWh)	68	72	106.2%
Total		**1,358**	**1,377**	**101.4%**

1.2.3.2 Net Impact Evaluation Key Findings

The results of the net impact evaluation show that the gross energy savings are largely attributable to the program's activities. Customers did not report implementing efficient projects outside of the program, which suggests that the program is effective at getting customers to participate when they are considering efficiency projects. The free-ridership identified through this evaluation primarily stemmed from customers who reported they planned to complete the same project prior to learning about the program and would have paid the additional incentive amount to complete the efficient version of the project. Findings from the net impact evaluation are summarized in Table 1-4.

Table 1-4 Net-to-Gross Evaluation Results

Net-to-Gross Component	Rate
Net of Free-ridership	84.6%
Program-influenced Spillover	0.1%
Net-to-Gross	**84.7%**

1.2.3.3 Process Evaluation Key Findings

Overall, the program is operating as intended, and customers and trade allies are satisfied with their experiences with the program as well as with Duke Energy. Contractors play a key role in the program by making customers aware of the program offerings, and contractors have utilized the program to encourage customers to purchase high efficient equipment. Contractors felt the program, specifically the rebate, was influential in customers moving forward with projects where they would not have otherwise. Participants provide similar feedback, stating they have appreciated the support they received from trade allies and Duke Energy and that the incentive was valuable helping more projects forward.

Additional high-level findings include the following:

- The primary source of participants' program awareness is Duke Energy (Duke Energy in general and their account representative). This was followed by their contractor.
- Satisfaction with the program overall and its components is high among participants and trade allies
- The technical assistance provided by the contractor was the most valuable program component as rated by participant respondents
- The program-provided calculators were used by participant and contractor respondents with contractors indicating that the calculators were useful[1].
- Contractors value the program and use the incentives as a sales tool to encourage customers to purchase high efficient equipment
- The tracking database was missing some key information for evaluation activities and program/project tracking

[1] Participant respondents were not asked to rate the usefulness of the calculators (only contractors were).

1.3 Evaluation Conclusions and Recommendations

Based on evaluation activities and findings, the evaluation team concluded the following and provides several recommendations for program improvement.

1.3.1 Impact

Conclusion 1: The evaluation team's analysis resulted in a 103.5% realization rate (energy) for the DEK NR Custom Program. The strong realization rate indicates that Duke Energy's internal processes for project review, savings estimation, and installation verification are working to produce high quality estimates of project impacts. Reported energy and demand savings could be increased by incorporating interactive factors into ex-ante impact estimates for lighting measures.

Recommendation 1: The evaluation team recommends that Duke continue to operate this program with the current level of rigor. For interior lighting projects, Duke should consider developing and applying deemed interactive factors to quantify the interactive effects between lighting retrofits and their associated HVAC systems.

Conclusion 2: Assumptions used in ex ante energy savings estimates are well-documented, but there are opportunities for improvement on new construction lighting projects and some non-lighting projects.

Recommendation 2: The evaluation team recommends that any adjustments made to baseline assumptions on new construction projects be well-documented within the incentive calculation spreadsheet developed by the program. This will provide better transparency when deviations from a lighting power density approach are used in ex-ante energy savings estimates.

Conclusion 3: The NR Custom Program uses T12 baseline fixture wattages in ex-ante energy savings estimates for applicable linear fluorescent to LED tube retrofit measures. This practice is defensible given the availability of high color rendering index (CRI) replacement lamps; however, peer Demand Side Management (DSM) programs no longer credit energy or demand savings beyond a T8 baseline.

Recommendation 3: It is recommended that the Duke NR Custom Program consider using a T8 equivalent when developing ex-ante energy and demand savings estimates for T12 to LED tube retrofit measures.

1.3.2 Process

Conclusion 1: The program is operating as intended and has resulted in high satisfaction across participant and contractor respondents. The most common source of program awareness from customers was through their contractor, which is consistent with how the program is marketed.

Recommendation 1: Continue to engage contractors in the program and keep them informed of the program to increase awareness among customers and encourage the installation of program-qualifying equipment.

Conclusion 2: As part of the application process, an appropriate worksheet or calculator must be submitted. Duke Energy provides access to two types of calculators: Classic Custom and

Custom-to-go. About one-third of participant and two-thirds of contractor respondents indicated they have used Duke's tools to calculate savings. Contractors who used Duke's provided tools rated their usefulness high.

Recommendation 2: Continue to keep the Custom-to-Go and Classic Custom calculators updated and available to customers and contractors who need a tool to estimate savings.

Conclusion 3: Interviews with program staff indicated the pre-approval review process could take as much as six weeks for review. While Duke staff felt the review process could be improved, program participants were generally satisfied with the review process. Contractor respondents were slightly less satisfied than participant respondents in the pre-approval process although they still provided high satisfaction scores. While no respondents reported being dissatisfied with the application process, it is something to watch to make sure the length of time to review applications is not taking too long.

Recommendation 3: Monitor the time it takes to review applications to ensure the time does not exceed six weeks.

2 Introduction and Program Description

2.1 Program Description

Duke Energy's Non-Residential Smart $aver® Custom Incentives program (NR Custom) offers financial assistance to qualifying commercial, industrial and institutional customers (that have not opted-out) in the Duke Energy Kentucky (DEK) service territory to enhance their ability to adopt and install cost-effective energy efficiency projects.

The program is designed to meet the needs of the Company's non-residential customers with electrical energy saving projects involving more complicated or alternative technologies, or those measures not covered by the non-residential Smart $aver Prescriptive Program. The intent of the program is to encourage the implementation of energy efficiency projects that would not otherwise be completed without the company's technical or financial assistance. The program requires pre-approval prior to the project implementation. Proposed energy efficiency measures may be eligible for customer incentives if they clearly reduce electrical consumption and/or demand.

The two approaches for applying for incentives for this program are Classic Custom and Custom-to-Go. The difference between the two approaches focuses on the method by which energy savings are calculated. The documents required as part of the application process vary slightly.

The custom application forms are located on the company's website under the Smart $aver® Incentives (Business and Large Business tabs). The application forms are offered in Word (doc) and Adobe (pdf) format with the designated worksheet in Excel format for projects saving more than 700,000 kWh annually. Customers can utilize provided calculation tools (Custom-to-Go) for energy management system (EMS) projects savings less than 700,000 kWh annually or request worksheets in another format if preferred. Customers or their vendors submit the forms with supporting documentation. Forms are designed for multiple projects and multiple locations. Custom incentive applications (doc or pdf) are submitted with one or more of the following worksheets:

- Classic Custom approach (> 700,000 kWh or no applicable Custom-to-Go calculator)
  - Lighting worksheet (Excel)
  - Variable Speed Drive (VFD) worksheet (Excel)
  - Compressed Air worksheet (Excel)
  - Energy Management System (EMS) worksheet (Excel)
  - General worksheet (Excel), to be used for projects not addressed by or not easily submitted using one of the other worksheets

- Custom-to-Go Calculators (< 700,000 kWh and applicable Custom-to-Go calculator)
  - Energy Management Systems
  - Lighting
  - Process VFDs
  - Compressed Air

The Company contracts with Alternative Energy Systems Consulting (AESC) to perform technical review of applications. All other analysis is performed internally at Duke Energy, including DSMore runs for every custom measure that is recorded by the program.

2.1.1 Participation Summary

Table 2-1 summarizes program participation and reported energy savings for the full evaluation period of August 2015 through December 2017. There was a total of 37 projects completed during the evaluation period. For the purposes of this report a project is defined as a unique enrollment ID. These 37 projects collectively accounted for a total of 94 unique database line items. Database line items typically represent single-measure projects or an individual measure implemented as part of a multi-measure project. There are also a few instances where a line item in the tracking database represents a unique project site where a common scope of work was completed as part of a larger portfolio of sites. Table 2-2 outlines the reported summer and winter demand (kW) for the evaluation period.

Table 2-1 DEK NR Custom Program Participation and Reported Energy Summary

Category & Strata		Database Line Items		Enrollment IDs		Reported Savings	
		Custom-To-Go	Classic	Custom-To-Go	Classic	Custom-To-Go Gross kWh	Classic Custom Gross kWh
Lighting	Large (>400 MWh)	0	21	0	5	0	7,189,149
	Small (<400 MWh)	8	55	6	22	625,415	2,036,145
Non-lighting	Large (>1,000 MWh)	0	1	0	1	0	2,145,140
	Small (<1,000 MWh)	7	2	1	2	169,068	772,099
Total		**15**	**79**	**7**	**30**	**794,483**	**12,142,533**
Grand Total		**94**		**37**		**12,937,016**	

Table 2-2 DEK NR Custom Program Reported Demand Savings Summary

Category & Strata		Enrollment IDs		Reported Summer Demand (kW) Savings		Reported Winter Demand (kW) Savings	
		Custom-To-Go	Classic	Custom-To-Go	Classic	Custom-To-Go	Classic
Lighting	Large (>400 MWh)	0	5	0	853	0	853
	Small (<400 MWh)	6	22	80	244	72	238
Non-lighting	Large (>1,000 MWh)	0	1	0	149	0	128
	Small (<1,000 MWh)	1	2	205	86	0	68
Total		**7**	**30**	**285**	**1,332**	**72**	**1,286**
Grand Total		**37**		**1,617**		**1,358**	

Figure 2-1, Figure 2-2, and

Figure 2-3 summarize the distribution of reported energy (kWh) and demand (kW) savings at the program level by technology category.

Figure 2-1 Distribution of Reported Energy Savings from NR Custom Program Projects by Technology

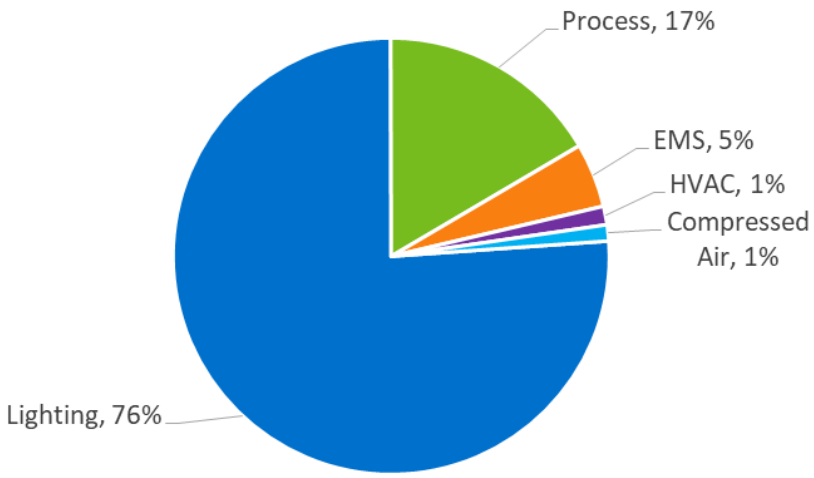


Figure 2-2 Distribution of Reported Summer Demand Savings from NR Custom Projects by Technology

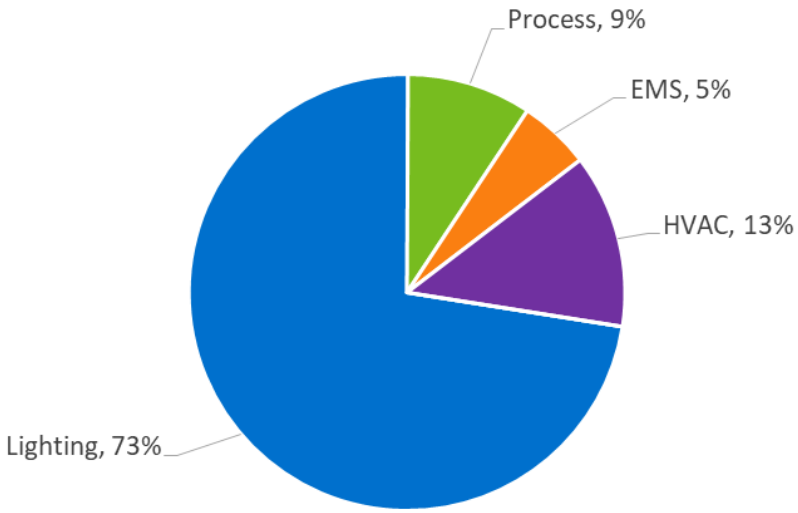
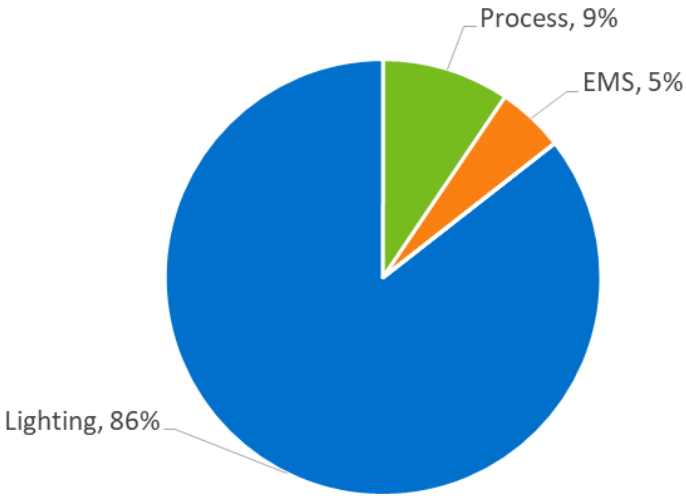


Figure 2-3 Distribution of Reported Winter Demand Savings (kW) from NR Custom Projects by Technology



3 Key Research Objectives

3.1 Gross Impact

The impact evaluation followed standard industry protocols and definitions, where applicable, and include the Department of Energy Uniform Methods Protocol[2], as an example. As part of evaluation planning, the evaluation team outlined the following activities for this program evaluation:

- Quantify accurate and supportable energy (kWh) and demand (kW) savings for measures and equipment being implemented in customer facilities attributed to the NR Custom Program;
- Assess the rate of free riders from customer and contractor perspectives and determine spillover effects; and,
- Consider and verify measure installation vintage aligns with measure baseline definitions, i.e. early replacement, burnout on failure, new construction etc.

3.2 Net Impact

The goal of the net impact evaluation was to estimate the overall energy impacts that are attributable to the program. This estimate comprises two components: free-ridership and spillover.

Free-ridership is the estimate of what proportion of the program's savings would have happened in the absence of the program. Free-ridership takes into account the customers' plans prior to engaging in the program and the various influences the program can have on the customer such as incentives and other interactions with the program staff, contractors, and marketing materials.

Spillover estimates additional energy savings for efficiency projects that were completed without receiving a program incentive, but were influenced by the program in some other way.

Net program results are calculated through a net-to-gross ratio, as follows:

Net-to-gross = (1 – Free-ridership %) + Spillover %

Net Savings = Net-to-gross (%) * Gross Verified Savings

[2] The DOE's Uniform Methods Project for Determining Energy Efficiency Program Savings can be found at http://www1.eere.energy.gov/office_eere/de_ump.html.

3.3 Process

The evaluation team collected data from a variety of sources to address the researchable questions identified at the beginning of the study. Table 3-1 contains the list of research objectives and the data sources used to investigate each one.

Table 3-1 Process Evaluation Research Questions and Activities

Preliminary Research Questions	Document Review	Interviews with Key Contacts	Participant Survey	Trade Ally Survey
How is the program promoted? How important are account representatives? Are contractors or vendors identifying potential projects?	✓	✓	✓	✓
Understand participant experience. What steps are involved in identifying and scoping projects and obtaining pre-approval? What issues emerge during the process? How are these addressed?		✓	✓	✓
Why do potential projects drop out? Are there opportunities to make the process simpler or more streamlined while maintaining robust quality control (QC)?		✓		✓
Is the uptake of custom vs. custom-to-go projects as expected? How do the projects and/or the customer experience differ between the two participation paths?	✓	✓	✓	✓
What is the customer's decision-making process regarding energy efficiency upgrades or equipment? How influential were various aspects of the program in their decision? How influential was the contractor they worked with?	✓		✓	✓

4 Impact Evaluation

4.1 Approach

The primary determinants of impact evaluation costs are the sample size and the level of rigor employed in collecting the data used in the impact analysis. The accuracy of the study findings is in turn dependent on these parameters. Techniques that we used to conduct the evaluation, measurement, and verification (EM&V) activities, and to meet the goals for this evaluation, include on-site inspections and measurements, utility billing analysis, telephone surveys, documentation review, best practice review, and interviews with implementation staff, trade allies, program participants, and general business customers.

The evaluation team's impact analysis focused on the energy and demand savings attributable to the NR Custom Program for the period of August 2015 through December 2017. A variety of techniques were used to develop independent assessments of gross and net energy savings for each sampled project. All sampled custom projects received both a desk review and on-site verification. Figure 4-1 provides a high-level process flow diagram of all impact evaluation activities and a brief summary of each step in the process is provided below.

Figure 4-1 Process Flow Diagram of Impact Evaluation Activities

The evaluation team verified energy and demand savings attributable to the program by conducting the following impact evaluation activities:

- **Sample:** Conduct review of NR Custom Program participant database on a quarterly basis, identify all new projects, and draw representative sample of projects for on-site M&V.
- **Soft Recruit:** Attempt to reach all sampled participants by phone or email, prior to conducting an in-depth review of project documentation or developing a site-specific

measurement and verification plan (SSMVP), to inform participants of the ongoing evaluation and request permission to conduct an on-site inspection. Nothing would be formally scheduled during this call.

- **Document (Doc) Review:** Request, receive, and review all project documentation available for those sites successfully recruited.
- **Develop SSMVP:** Develop document providing general overview of the project, reported benefits and costs, proposed level of rigor, M&V equipment, and key data to be gathered in the field.
- **Schedule On-site:** Schedule on-site inspection with participant after Duke team provides comments and approves SSMVP. The purpose of the Duke team reviews was to verify that all measures were included in the plan, reported energy and demand savings were accurate, and proposed M&V approaches were appropriate.
- **On-site M&V:** Verify measure implementation, deploy metering equipment, interview key project personnel, and obtain trend data from existing BAS/EMS systems.
- **Analysis:** Estimate gross verified energy and demand savings for sampled measures and projects using data collected from on-site measurement and verification.
- **M&V Report:** Compare gross-verified energy and demand savings to program-reported values to determine project-level realization rates and summarize findings for each sampled site in M&V report.
- **Gross Verified Savings:** Summarize project-level results to stratum-level for determining program-level realization rates and verified gross energy and demand savings.
- **Net Verified Savings:** Apply attribution survey data to estimate net-to-gross ratios and net-verified savings at the program level.

4.2 Database Review

The program participation database informed many of the evaluation activities including sample design, project-level savings review, and estimating program-level gross verified energy and demand savings. Participation database extracts were requested and received quarterly in real time with the program implementation. After the first round of participation recruitment in 2016, it became evident that a census of participants would need to be incorporated into the “soft-recruiting” effort, in order to achieve sample targets from the Evaluation Plan (discussed further in Section 4.3).

Once all newly completed projects were identified, the evaluation team would receive site contact information and sufficient project details so as to initiate preliminary “soft-recruiting” effort by the evaluation team. Once a participant was successfully recruited into the evaluation, the impact team requested detailed project documentation for each project and conducted an in-depth review of all information. While reviewing project documentation, the evaluation team would verify whether parameters such as reported energy and demand savings, energy conservation measure (ECM) quantities, and measure descriptions matched those indicated in the tracking database. Any identified discrepancies between the two sources were then

identified in the SSMVP and later resolved based on feedback provided by the Duke program team.

At the conclusion of the project, the evaluation team requested a full database extract for the entire evaluation period (August 2015 through December 2017) for comparison to the compiled database maintained by the evaluation team throughout the course of the evaluation for reconciliation. There were a number of inconsistencies in the database revealed through the reconciliation. Common inconsistencies included:

- Lighting projects where ECM quantity was indicated as "1" in the tracking database for non one-for-one retrofit measures or measures involving multiple post installation fixture types, but a common baseline fixture type. The actual quantity was usually determined from project documents or the "Measure Name" field within the tracking database itself. [3]
- No email address for site contact. This issue was generally resolved through follow-up information requests if participant could not be reached by phone.

The inconsistencies identified do not have a direct impact on overall program performance, but it is recommended that these issues be addressed by the Duke team internally, when feasible, so as to improve the overall evaluability of the program and eliminate lost effort chasing and correcting them.

4.3 Sampling and Estimation

The gross and net verified energy and demand savings estimates presented in this report were generally determined through the observation of key measure parameters among a sample of program participants. A census evaluation would involve surveying, measuring, or otherwise evaluating the entire population of projects within a population. Although a census approach would eliminate the sampling uncertainty for an entire program, the reality is that M&V takes many resources both on the part of the evaluation team and the program participants who agree to be surveyed or have site inspections conducted in their business. When a sample of projects is selected and analyzed, the sample statistics can be extrapolated to provide a reasonable estimate of the population parameters. Therefore, when used effectively, sampling can improve the overall quality of an evaluation study. By limiting resource-intensive data collection and analysis to a random sample of all projects, more attention can be devoted to each project surveyed. Sampling also reduces the overall cost of an evaluation compared to a census approach while still maintaining representativeness.

For the NR Custom impact evaluation the most important sampling objective was representativeness – that is the projects selected in the evaluation were representative of the population and would produce unbiased estimates of population parameters. The evaluation team used a ratio estimation technique for this evaluation. This technique assumes that the ratio of the sum of the verified savings estimates to the sum of the reported savings estimates within

[3] It should be noted that the baseline and post-retrofit quantities are well-documented elsewhere by the program team outside of the participation tracking database. In fact standard policy is to verify installed equipment quantities prior to issuing payment. The pre- and post-retrofit quantity information isn't considered by the program to be critical to include in the participation database.

the sample is representative of the program as a whole. This ratio is referred to as the realization rate, or ratio estimator, and is calculated in Equation 1:

Equation 1: Realization Rate

$$Realization\ Rate = \frac{\sum_i^n Verified\ Savings}{\sum_i^n Reported\ Savings}$$

Where *n* is the number of projects in the evaluation sample. The realization rate is then applied to the claimed savings of each project in the population to calculate gross verified savings.

Stratification

The evaluation team used sample stratification with ratio estimation techniques for the NR Custom Program. Stratification is a departure from simple random sampling (SRS), where each sampling unit (customer/project/rebate/measure) has an identical likelihood of being selected in the sample. Stratified random sampling refers to the designation of two or more sub-groups (strata) from within a program population prior to the selection process.

The evaluation team took great care to ensure that each sampling unit within the population belonged to one (and only one) stratum.

The evaluation team felt that stratification was advantageous and utilized it in the sample design for a variety of reasons:

- Increased precision of the within-stratum variability was expected to be small compared to the variability of the population as a whole. Stratification in this case allows for increased precision and smaller total sample sizes.
- It enabled the evaluation team to ensure that a minimum number of units within a particular stratum were verified.

Presentation of Uncertainty

There is an inherent risk, or uncertainty, that accompanies sampling, because the projects selected in the evaluation sample may not be representative of the program population as a whole with respect to the parameters of interest. As the proportion of projects in the program population that are sampled increases, the amount of sampling uncertainty in the findings decreases. The amount of variability in the sample also affects the amount of uncertainty introduced by sampling. A small sample drawn from a homogeneous population will provide a more reliable estimate of the true population characteristics than a small sample drawn from a heterogeneous population. Variability is expressed using an error ratio for programs that use ratio estimation.

When ratio estimation is utilized, standard deviations will vary for each project in the sample. The error ratio is an expression of this variability and is analogous to the coefficient of variation, C_v, for simple random sampling.

Equation 2 provides the formula for estimating error ratio.

Equation 2: Error Ratio

$$Error\ Ratio = \frac{\sum_{i=1}^{n} \sigma_i}{\sum_{i=1}^{n} \mu_i}$$

Equation 3 shows the formula used to calculate the required sample size for each evaluation sample, based on the desired level of confidence and precision. Notice that the *Error Ratio* term is in the numerator, so required sample size will increase as the level of variability increases.

Equation 3: Required Sample Size

$$n_0 = \left(\frac{z * Error\ Ratio}{D}\right)^2$$

Where:

n_0 = *The required sample size before adjusting for the size of the population*

Z = *A constant based on the desired level of confidence (equal to 1.645 for 90% confidence two-tailed test)*

D = *Desired relative precision*

The sample size formula shown in Equation 3 assumes that the population of the program is infinite and that the sample being drawn is reasonably large. In practice, this assumption is not always met. For sampling purposes, any population greater than approximately 7,000 may be considered infinite for the purposes of sampling. For smaller, or finite, populations, (such as the Duke Energy Kentucky NR Custom participant population) the use of a finite population correction factor (FPC) is warranted. This adjustment accounts for the extra precision that is gained when the sampled projects make up more than about 5% of the program savings. Multiplying the results of Equation 3 by the FPC formula shown in Equation 4 will produce the required sample size for a finite population.

Equation 4: Finite Population Correction Factor

$$fpc = \sqrt{\frac{N - n_0}{N - 1}}$$

Where:

N = *Size of the population*

n_0 = *The required sample size before adjusting for the size of the population*

The required sample size (*n*) after adjusting for the size of the population is given by Equation 5.

Equation 5: Application of the Finite Population Correction Factor

$$n = n_0 * fpc$$

Verified savings estimates always represent the point estimate of total savings, or the midpoint of the confidence interval around the verified savings estimate for the program. Equation 6 shows the formula used to calculate the margin of error for a parameter estimate.

Equation 6: Error Bound of the Savings Estimate

$$Error\ Bound = se * (z - statistic)$$

Where:

se = *The standard error of the population parameter of interest (proportion of realization rate, total energy savings, etc.) This formula will differ according to the sampling technique utilized.*

$z - statistic$ = *Calculated based on the desired confidence level and the standard normal distribution.*

The 90% confidence level is a widely accepted industry standard for reporting uncertainty in evaluation findings. The confidence levels and precision values presented in this report are at the 90% confidence level. The z-statistic associated with 90% confidence is 1.645.

When evaluators or regulators use the term “90/10”, the 10 refers to the relative precision of the estimate. The formula for relative precision shown in Equation 7:

Equation 7: Relative Precision of the Savings Estimate

$$Relative\ Precision_{Verified\ Savings} = \frac{Error\ Bound_{(kWh\ or\ kW)}}{Verified\ Impact_{(kWh\ or\ kW)}}$$

An important attribute of relative precision to consider when reviewing achieved precision values is that it is “relative” to the impact estimate. Therefore programs with low realization rates are likely to have larger relative precision values because the error bound (in kWh or kW) is being divided by a smaller number. This means two programs with exactly the same reported savings and sampling error in absolute terms, will have very different relative precision values, as shown in Table 4-1.

Table 4-1 Relative Precision Example

Program	Reported kWh	Realization Rate	Error Bound (kWh)	Verified kWh	Relative Precision (90%)
Program #1	4,000,000	0.5	400,000	2,000,000	± 20%
Program #2	4,000,000	1.0	400,000	4,000,000	± 10%

In many cases a program-level savings estimate requires summation of the verified savings estimates from several strata. In order to calculate the relative precision for these program-level savings estimates, the evaluation team used Equation 8 to estimate the error bound for the program as a whole from the stratum-level error bounds.

Equation 8: Combining Error Bounds across Strata

$$Error\ Bound_{Program} = \sqrt{Error\ Bound^2_{Stratum1} + Error\ Bound^2_{Stratum2} + Error\ Bound^2_{Stratum3}}$$

Using this methodology, the evaluation team developed verified savings estimates for the program and an error bound for that estimate. The relative precision of the verified savings for the program is then calculated by dividing the error bound by the verified savings estimate.

4.4 Targeted and Achieved Sampling

Table 4-2 presents the final achieved sample size for Duke's Kentucky service territory based on data collection activity (verification and M&V) and the program delivery stream method (Classic versus Custom-to-Go). Impact sample sizes targeted a 90/10 confidence precision based on the expected participation counts for the evaluation period. Samples were selected on an on-going basis across the evaluation period (August 2015 - December 2017) to help ensure proper representation of measure types and program approaches as the program progressed.

Table 4-2 NR Custom Sampling Plan Custom-to-Go vs. Custom Classic - Achieved

Utility	Data Collection Activity	Custom to Go	Classic	Total
Duke Energy Kentucky	Share of Participation	19%*	81%*	100%
	Site Visits – On-site Measurement	16	20	36
	Site Visits – On-site Verification	8	14	22
	Total	**24**	**34**	**58**

* Percentages are representative of project counts (7 of 37 enrollment IDs went through Custom-to-Go track). Distribution of program-level savings was 6% Custom-to-Go / 94% Custom Classic.

The evaluation team stratified the participant population by technology category (lighting vs. non-lighting) and relative magnitude of savings (kWh) to ensure that the evaluated sample represented the population make-up of the total program-level savings and in order to achieve higher statistical precision by reducing the variability within the sample. Our stratification approach and achieved sample sizes are summarized in Table 4-3.

Table 4-3 NR Custom Stratified Sampling - Achieved

Strata	Population	Pop Reported Savings (kWh)	Achieved Sample Size
L-Large (>400 MWh)	5	7,189,149	3
L-Small (<400 MWh)	28	2,661,560	40
NL-Large (>1,000 MWh)	1	2,145,140	3
NL-Small (<1,000 MWh)	3	941,167	12
Total	**37**	**12,937,016**	**58**

The number of achieved samples exceed the number of projects in the DEK population due to the inclusion of the DEO sample projects into the DEK sample.

4.5 Data Collection

As outlined in prior sections, the gross impact evaluation process began with a thorough review of project documentation. This information was provided upon formal request. Documents commonly provided by the program team include:

- Smart $aver Incentive Calculation workbooks
- DSMore Summary workbooks
- Custom Incentive Application Forms
- Contractor Proposals
- Detailed project narratives
- Product specifications and invoices
- Customer utility data (billing history)
- Incentive payment request forms
- Email correspondence between members of the program management team and participants
- Other documents commonly provided on lighting project include:
  - Smart $aver Custom Incentive Program Lighting Calculators
  - Specification sheets for retrofit lighting systems
- Other documents commonly provided for non-lighting projects include:
  - Customer submitted energy and demand savings calculations
  - Detailed reports developed by third-party engineering consultants
  - Building energy simulation model output files

After reviewing all program-supplied project documentation the evaluation team engineer assigned to each project then developed a site-specific measurement and verification plan (SSMVP) for each unique premise. These were developed in order to create a standardized, rigorous process for the verification of project claims while on-site. Each SSMVP was specifically tailored to verify the equipment that was installed and measures that were implemented per the provided project documentation. The SSMVP also identified baseline assumptions for verification with on-site personnel in order to validate ex-ante, forecasted savings estimates.

Each SSMVP also identified the specific parameters to be gathered in the field for each measure. These plans followed guidelines set forth in multiple Department of Energy Uniform Methods Project (DOE UMP) protocols including:

- Chapter 2: Commercial and Industrial Lighting Evaluation Protocol

- Chapter 14: Chiller Evaluation Protocol
- Chapter 18: Variable Frequency Drive Evaluation Protocol
- Chapter 19: HVAC Controls (DDC/EMS/BAS) Evaluation Protocol
- Chapter 22: Compressed Air Evaluation Protocol
- Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol

The plans also identify a preferred and one or two alternate analysis approaches (level of rigor) along with the critical data to be gathered for each. Regardless of the method ultimately selected for the savings analysis, field engineers were instructed to gather the data necessary for all methods identified in the SSMVP. Table 4-4 provides a few examples of the data points typically gathered for several of the more commonly-encountered energy conservation measures (ECMs).

Once completed each SSMVP was then submitted to the Duke EM&V Team for review and approval. Upon approval from Duke an on-site inspection was then scheduled with the participant.

4.5.1 On-site Verification Activities

During on-site verification, field engineers would verify that measures were appropriately implemented in accordance with the SSMVP developed for the site. Field engineers would also deploy metering equipment for short-term monitoring of parameters such as lighting hours of use, energy consumption (amps or kW), and loads. They also requested copies of equipment specifications and sequences of operation, as appropriate. Any available historic trend data (when available) was also obtained from existing HVAC control and central plant sequencing control systems.

Table 4-4 Key Data Points Gathered for Commonly Encountered ECMs

Measure Name	Baseline or Retrofit
Interior Lighting Retrofits	Quantity of existing and retrofit fixtures Fixture type of existing and retrofit fixtures Existing fixture controls, if any New fixture controls, if any Typical schedule and hours of operation Space temperature Type of heating and cooling equipment/specifications
HVAC Control/EMS	Determine baseline setpoints and schedules through customer interviews Determine post-retrofit setpoints and schedules through central BAS Obtain any available trend data Verify occupancy and equipment schedules Gather nameplate information from primary heating and cooling systems
Variable Speed Drive on Pump	Determine baseline method of pump control Determine conditions that dictate the speed of the VSD Determine whether loads modulate or are fairly constant If loads modulate, determine load profile (% load bins) Nameplate information from pump Nameplate information from VSD Gather any available trend data Deploy metering equipment capable of measuring true polyphase RMS power Perform spot power measurements (kW) of pump while running under normal operating conditions
VSD Air Compressor	Determine baseline method of control Gather information on baseline air compressor system (kW/CFM, hp, CFM output, system type, etc.) Determine how loads vary daily, weekly, seasonally, annually for VSD compressor Nameplate information from new air compressor Gather any operational parameters displayed on control panels Gather any available trend data from central controls system Determine whether compressor serves central plant with multiple compressors or is stand-alone. If part of multi-compressor plant determines role and sequences of operation (primary, secondary, trim, etc.) Deploy metering equipment capable of measure true polyphase RMS power

4.6 Level of Rigor

A variety of analysis approaches were utilized for the impact evaluation. The approach applied was decided based upon the methods used by the participant, trade ally, or program in generating the ex-ante[4] savings estimates, the availability of information, and the extent of interactive effects. An overview of each analysis approach applied is provided in Sections 4.6.1 through 4.6.3.

4.6.1 Basic Rigor: Simple Engineer Model (SEM) with On-Site Measurement

Consistent with IPMVP Option A (Partially Measured Retrofit Isolation), this approach was used for the majority of lighting, custom process, and compressed air measures. This method uses engineering calculations, along with site measurements of a limited number of important parameters, to verify the savings resulting from specific measures. This was the most prevalent level of rigor applied for this evaluation.

An overview of the key inputs and algorithms used to develop energy and demand savings estimates for lighting measures and compressed air measures is provided in Section 4.6.1.1 and 4.6.1.2.

4.6.1.1 Lighting Measures

Equation 9 and Equation 10 were used to calculate energy and demand savings for all lighting retrofit measures.

Equation 9: Lighting Demand Savings

$$\Delta kW = (Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) / 1000 \times WHF_d$$

Equation 10: Lighting Annual Energy Savings

$$\Delta kWh/yr = (Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) / 1000 \times HoursWk \times Weeks \times WHF_e$$

Where:

Qty_{BASE} = *Quantity of baseline fixtures*

$Watts_{BASE}$ = *Watts of baseline fixture (based on the specified existing fixture type) (Watts)*

Qty_{EE} = *Quantity of energy efficient fixtures*

$Watts_{EE}$ = *Watts of energy efficient fixture (based on the specified installed fixture type) (Watts)*

HoursWk = *Weekly hours of equipment operation (hrs/week)*

Weeks = *Weeks per year of equipment operation (weeks/year)*

WHF_d = *Waste heat factor for demand to account for cooling savings from efficient lighting**

[4] The term “ex ante” represents the forecasted energy and demand savings rather than the actual results.

WHF_e = *Waste heat factor for energy to account for cooling savings from efficient lighting**

1000 = *Conversion: 1000 Watts per kW*

Fixture Wattages

The pre-existing fixture wattages were quoted from industry standards and commercial literature for the applicable type of fixtures.

The installed light fixture wattages were taken from the manufacturer's cut sheets.

Hours of Use

Nexant verified hours of use assumptions by deploying lighting loggers. The lighting operating hours may exceed the facility's posted hours of business.

4.6.1.2 Compressed Air Measures

Energy use reduction for all compressor projects can be calculated by the difference between the energy consumed in the baseline operation minus the energy consumed in the post-retrofit operation. Generally, information is required for compressor capacity in both the baseline and post-retrofit scenarios. Appropriate adjustments are made to ensure the flow profile is equivalent between pre- and post-retrofit conditions unless demand improvements have been made that result in a change in the flow profile. Compressor power at full load can be calculated using Equation 11 and Equation 12.

Equation 11: Compressor Power at Full Load (No VSD)

$$Full\ Load\ kW_{rated} = \frac{(Compressor\ hp) \times LF_{rated} \times (0.746\ kW/hp)}{(\eta_{motor})}$$

Equation 12: Compressor Power at Full Load (w/ VSD)

$$Full\ Load\ kW_{rated} = \frac{(Comp\ hp) \times LF_{rated} \times (0.746\ kW/hp)}{(\eta_{motor}) \times (\eta_{VSD})}$$

Where:

Comp hp = *compressor horsepower, nominal rating of the prime mover (motor)*

0.746 = *horsepower to kW conversion factor*

η_{moto} = *motor efficiency (%)*

η_{VSD} = *variable-speed drive efficiency (%)*

LF_{rated} = *load factor of compressor at full load (typically 1.0 to 1.2)*

The above methods for determining the instantaneous demand of an air compressor at a given load is then repeated for many bins of hour-CFM operation. This is commonly referred to as a CFM demand profile. A demand profile is developed to provide accurate estimates of annual energy consumption. A demand profile typically consists of a CFM-bin hour table summarizing hours of usage under all common loading conditions throughout a given year.

The annual CFM profile is used to determine base case and proposed case energy use. For both, compressor electricity demand for each CFM-bin is determined from actual metering data, spot power measurements, historical trend data or CFM-to-kW lookup tables.

The difference in energy consumption between an air compressor operating in idling mode and being physically shut down can be significant depending on the base case and post-retrofit case methods of system control. For example, a rotary screw compressor with inlet valve modulation (w/blowdown) controls will draw 26% of full-load power (kW) when operating in idling mode; whereas a VSD-controlled system (w/stopping) has zero load for the same bin-hours. Table 4-5 shows the average percent power versus percent capacity for rotary screw compressors with various control methods[5].

Table 4-5 Average Percent Power versus Percent Capacity for Rotary Screw Compressors with Various Control Methods

	% Power							
% Capacity	On/Off Control	Load/Unload (1 gal/CFM)	Load/Unload (10 gal/CFM)	Inlet Valve Modulation (w/o Blowdown)	Inlet Valve Modulation (w/Blowdown)	Variable Displacement	VSD w/Unloading	VSD w/Stopping
0%	0%	27%	27%	71%	26%	25%	12%	0%
10%	10%	32%	35%	74%	40%	34%	20%	12%
20%	20%	63%	42%	76%	54%	44%	28%	24%
30%	30%	74%	52%	79%	62%	52%	36%	33%
40%	40%	81%	60%	82%	82%	61%	45%	41%
50%	50%	87%	68%	86%	86%	63%	53%	53%
60%	60%	92%	76%	88%	88%	69%	60%	60%
70%	70%	95%	83%	92%	92%	77%	71%	71%
80%	80%	98%	89%	94%	94%	85%	80%	80%
90%	90%	100%	96%	97%	97%	91%	89%	89%
100%	100%	100%	100%	100%	100%	100%	100%	100%

[5] Source: Department of Energy Uniform Methods Project: Chapter 22: Compressed Air Evaluation Protocol

The energy consumption for each CFM-bin is determined from the product of the average compressor demand and the number of hours in each bin (Equation 13). The sum of the kWh bin values gives the annual consumption (Equation 14).

Equation 13: Energy Consumption of CFM-bin

$$\Delta kWh_{bin1} = (Base\ kW_{operating\_bin1} - Post\ kW_{operating\_bin1}) \times CFM\text{-}bin\ 1\ Hours$$

$$\Delta kWh_{binN} = (Base\ kW_{operating\_binN} - Post\ kW_{operating\_binN}) \times CFM\text{-}bin\ N\ Hours$$

Where:

$Base\ kW_{operating\_bin1}$ = *baseline demand at part-load associated with CFM-bin 1*

$Post\ kW_{operating\_bin1}$ = *post demand at part-load associated with CFM-bin 1*

$Base\ kW_{operating\_binN}$ = *baseline demand at part-load associated with CFM-bin N*

$Post\ kW_{operating\_binN}$ = *post demand at part-load associated with CFM-bin N*

Equation 14: Total Energy Consumption of All CFM-bins

$$Total\ Energy\ Reduction\ (kWh/yr) = \sum_{o\text{-}n} [\ \Delta kWh_{bin1} + \Delta kWh_{bin2} + \ldots + \Delta kWh_{binN}\ ]$$

Where:

ΔkWh_{bin1} = *energy reduction for CFM-bin 1*

ΔkWh_{binN} = *energy reduction for CFM-bin N*

4.6.2 Basic Rigor: Simple Engineer Model (SEM) with On-Site Verification Only

This approach is very similar to SEM with On-site Measurement, but without direct measurement of key parameters. This approach was generally applied to measures that are not conducive to direct measurement such as outdoor lighting or building envelope improvements. This approach was also used in instances where process equipment could not be de-energized for the purposes of deploying metering equipment. The algorithms and inputs described in Section 4.6.1 are still applicable to this approach.

4.6.3 Enhanced Rigor: Billing Analysis with On-Site Verification Only

Consistent with IPMVP Option C (Whole Building), this approach was used for projects involving multiple HVAC control measures with interactive effects, when final ex ante building simulation models could not be obtained from the trade ally. It was also used for large industrial custom process measures involving equipment that could not be de-energized to accommodate installation of data logging equipment. This approach was only applied on projects where the reported gross energy savings exceeded 10% of annual energy consumption. This approach entailed a pre- and post-retrofit comparison of weather-normalized whole facility energy consumption. This approach adhered to guidelines set forth in the Department of Energy Uniform Methods Project Protocols for HVAC Controls (Chapter 19) and Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol (Chapter 8).

Our general approach consisted of the following:

1. Fit a premise-level degree-day regression model separately for the pre- and post-periods.

2. For each period (pre- and post-) use the coefficients of the fitted model with normal year degree days to calculate weather-normalized annual consumption (NAC) for that period.

3. Calculate the difference between the pre- and post-period NAC for the site.

This approach was used for four of the Custom Incentive Participant projects. Outlined below is the step-by-step process for this analysis:

Step 1. Fit the Regression Model: The degree-day regression for the site and year (pre or post) are modeled as:

Equation 15: Average Consumption per Day

$$E_m = \mu + \beta_H H_m + \beta_C C_m + \varepsilon_m$$

Where:

E_m = *Average consumption per day during interval m*

H_m = *Specifically, $H_m(\tau_H)$, average daily heating degree days at the base temperature (τ_H) during meter read interval m, based on daily average temperatures on those dates*

C_m = *Specifically, $C_m(\tau_C)$, average daily cooling degree days at the base temperature (τ_C) during meter read interval m, based on daily average temperatures on those dates*

μ = *Average daily baseload consumption estimated by the regression*

β_H, β_C = *Heating and cooling coefficients estimated by the regression*

ε_m = *Regression residual*

Step 2. Applying the Model: To calculate NAC for the pre- and post-installation periods for the given site and timeframe, combine the estimated coefficients μ, β_H, and β_C with the annual normal-year or typical meteorological year (TMY) degree days H_0 and C_0 calculated at the site-specific degree-day base, τ_H and τ_C. The example shown below puts all premises and periods on an annual and normalized basis.

Equation 16: Weather-Normalized Annual Consumption

$$NAC = \mu * 365.25 + \beta_H H_0 + \beta_C C_0$$

Step 3. Calculate the Change in NAC: The difference between pre- and post-program NAC values (ΔNAC) represents the change in consumption under normal weather conditions.

4.6.4 Peak Period Definition

Demand savings were evaluated based on the definition of the peak period provided by Duke Energy, as summarized in Table 4-6.

Table 4-6 Definition of Peak Demand Periods

	Summer	Winter
Month	July	January
Hour	4pm – 5pm	7pm – 8pm

4.7 Measurement & Verification Reports

Once a savings analysis was complete all findings from on-site verification and each project-level savings analysis was summarized in a standalone Measurement and Verification Report. Each report contained the full contents of the original SSMVP (Sections 1 through 3) prepared in advance of the on-site inspection as well as a new section (Section 4) summarizing all site visit findings, the chosen approach for quantifying energy savings, the verified energy and demand savings, and commentary on reasons for differences between the reported and verified savings values. Each individual M&V Report was then submitted to the Duke EM&V Team for review, comment, and approval. The 58 individual M&V Reports[6] developed as part of this evaluation were provided under separate cover.

4.8 Impact Evaluation Analysis and Findings

4.8.1 High Level Findings

4.8.1.1 Continue with Current Work

Based upon the results of the gross impact evaluation it is evident that the level of rigor being applied to each project as it goes through the application process of the NR Custom Program is resulting in accurate estimates of energy and demand savings. The practice of subjecting each project to a thorough engineering review by the program implementer followed by a high-level review by the program team is providing a level of quality control that minimizes calculation errors or instances of over-claimed energy or demand savings. The strata-level realization rates also indicate that an appropriate level of rigor is being applied to every project regardless of its size (magnitude of energy /demand savings) or measure category (lighting vs. non-lighting). Although the lower realization rates for the two non-lighting strata indicates that additional attention to those projects may be warranted.

4.8.1.2 Interactive Energy Changes for Lighting Retrofits

How energy-efficiency projects change the energy use of other equipment, not associated directly with the projects themselves, should be a consideration in estimating the energy efficiency program benefits. These interactive energy changes can be challenging to quantify, but should be accounted for whenever possible.

[6] Five M&V reports were complete for DEK projects and fifty three M&V reports were completed for DEO projects.

Interactive energy changes come in a number of forms and affect different fuel types. A measure that directly saves electricity may cause another building system to consume less energy. Alternatively, a measure that directly saves electricity could cause another building system to consume more energy. Sometimes, a single project can have both positive and negative interactive effects on other systems. For example, upgrading to energy efficient lighting reduces the electricity that a participant uses on lighting; the associated reduction in waste heat reduces the burden on the cooling system in the summer – but increases the burden on the heating system in the winter.

Lighting projects produce relatively predictable interactive energy changes enabling the development of stipulated factors through building energy simulation modeling. For this evaluation building energy simulation models were developed for 18 facility types using DOE-2 based modeling software and Database of Energy Efficiency Resources (DEER) building prototypes. A single set of models was developed for the DEO and DEK service territories using TMY3 weather data from the Cincinnati/Northern Kentucky International Airport (CVG) weather station. Table 4-7 presents the interactive factors developed by the evaluation team for each building type and weather station. The CVG weather station aligns with Duke Energy Kentucky's service territory.

Table 4-7 Interactive Factors by Facility Type and Weather Station

Building Type	CVG Interactive Factors (IF)
Assembly	106.3%
Bio Tech Manufacturing	109.6%
Community College	104.8%
Hospital	107.7%
Hotel	110.2%
Light Industrial Manufacturing	102.6%
Motel	119.9%
Nursing Home	126.6%
Office Large	103.2%
Office Small	102.8%
Primary School	101.8%
Restaurant Fast Food	102.6%
Restaurant Sit Down	98.5%
Retail Large	104.0%
Retail Small	102.2%
Secondary School	102.6%
University	109.9%
Warehouse Conditioned	107.0%

Interactive effects were estimated for each facility type by simulating a reduction in annual lighting end use energy consumption of approximately 4%. This value was chosen based upon Nexant's experience with evaluating other custom and prescriptive lighting programs across the country.

Table 4-8 provides an overview of the verified energy savings attributed to interior lighting measures within conditioned spaces and the relative contribution to savings by interactive effects estimated by the evaluation team. Total savings attributable to interactive effects within the evaluated sample is estimated to be approximately 115,431 kWh or 2.5% of total verified energy savings for all lighting projects. Interactive effects account for approximately 6.4% of verified energy savings for projects with space cooling.

Table 4-8 Verified Energy Savings (kWh) and Relative Contribution of Interactive Effect Savings by Facility Type from Evaluated Sample for Facilities with Space Cooling

Building Type	Verified Energy Savings (kWh)	Interactive Effects Savings (kWh)	% Savings Attributable to Interactive Effects
Assembly	358,745	7,034	2.0%
Hospital	1,000	72	7.1%
Light Industrial Manufacturing	679,221	17,110	2.5%
Nursing Home	332,993	69,965	21.0%
Office Large	8,234	257	3.1%
Restaurant Fast Food	39,489	2,116	5.4%
Retail Large	65,302	2,511	3.8%
Retail Small	42,388	919	2.2%
Secondary School	47,534	1,198	2.5%
Warehouse Conditioned	234,344	14,250	6.1%
Total	**1,809,250**	**115,431**	**6.4%**

4.8.1.3 Documentation of Baseline Assumptions on New Construction Lighting Projects

Assumptions used in ex ante energy savings estimates are fairly well-documented, but there are opportunities for improvement on new construction lighting projects as well as some non-lighting projects. Through the course of the evaluation and in correspondence with the Duke EM&V Team it was discovered that the approach to baseline assumptions on new construction lighting projects is not necessarily uniform.

Baseline lighting demand (kW) is either estimated using the area (ft^2) and the maximum allowable lighting power density ($Watts/ft^2$) for the applicable space type, or an assumed baseline fixture type specified by the participant in the Custom Lighting Worksheet. As a general practice the EM&V Team uses whichever approach results in the most conservative estimate of project-level savings.

The evaluation team agrees with this practice, but it is recommended that any adjustments made to baseline assumptions on new construction projects be well-documented within the incentive calculation spreadsheet. This will provide better transparency to the evaluator when assessing project-level savings.

Figure 4-2 provides a hypothetical example of how baseline assumptions on a new construction lighting project could be documented within the incentive calculation spreadsheet utilized by the Duke program team.

Figure 4-2 Example of Documenting Baseline Assumption in Smart $aver Custom Incentive Calculation Workbook

Notes:
FINAL: ECM#1 removed because it was not installed. Project cost adjusted for ECM#4 based on invoice. Corrected standard nighttime hours form 4368 to 4380
Rev2: Incentive amounts updated
NOTE: Elected to use customer-specified baseline fixture types in lieu of space-by-space Lighting Power Density approach as this results in more conservative estimate of savings.

									Before Implementation			
	EI	Technology	Sub-Technology	Monthly Data Provided	Unit of Measure	Applicant estimated annual kWh savings	Perf. Incentive Weight %	ECM Quantity	Summer Peak kW per Unit	Winter Peak kW per Unit	Customer Peak kW per Unit	Annual hours use
6		Lighting	LED	NO	Per Lamp/Fix	#DIV/0!		0				
6		Lighting	LED	NO	Per Lamp/Fix	46		27	0.120	0.120	0.120	3,796
6		Lighting	LED	NO	Per Lamp/Fix	822		4	0.000	0.291	0.291	4,380
6		Lighting	LED	NO	Per Lamp/Fix	563		50	0.000	0.452	0.452	4,380
6		Lighting	LED	NO	Per Lamp/Fix	987		30	0.452	0.452	0.452	3,796

4.8.2 Gross Impacts

Table 4-9, Table 4-10, and Table 4-11 summarize gross impact results for energy (kWh), Summer demand (kW), and Winter demand (kW). Detailed results for each sampled project are provided in the standalone M&V Reports.

The realization rates for the Non-Lighting – Large stratum were lower than the other three strata primarily due to two large projects that had realization rates below 70%. On one of the projects the low realization rate was ultimately attributed to the customer and program using a top-down approach to estimating project-level savings based upon results from a similar scope of work implemented at a similar manufacturing facility. The evaluation team used a bottom-up approach based upon historic production data and trend data available from the central control system.

The other Non-Lighting – Large project that had a lower realization rate was an HVAC-EMS project where a weather-normalized analysis of pre- and post-retrofit billing data (IPMVP Option C) showed that achieved energy savings were approximately 34% lower than claimed savings.

Table 4-9 Gross Verified Energy Savings (kWh) by Stratum

Stratum	Population (N)	Sample Count (n)	Gross Reported Energy Savings (kWh)	Gross Verified Energy Savings (kWh)	Realization Rate (%)	Relative Precision @ 90% Confidence
L-Large (>400 MWh)	5	3	7,189,149	8,379,246	116.6%	5%
L-Small (<400 MWh)	28	40	2,661,560	2,589,783	97.3%	41%
NL-Large (>1,000 MWh)	1	3	2,145,140	1,603,562	74.8%	24%
NL-Small (<1,000 MWh)	3	12	941,167	817,871	86.9%	20%
Total	**37**	**58**	**12,937,016**	**13,390,462**	**103.5%**	**9%**

Table 4-10 Gross Verified Summer Demand Savings (kW) by Stratum

Stratum	Population (N)	Sample Count (n)	Gross Reported Summer Demand Savings (kW)	Gross Verified Summer Demand Savings (kWh)	Realization Rate (%)	Relative Precision @ 90% Confidence
L-Large (>400 MWh)	5	3	853	990	116.1%	6%
L-Small (<400 MWh)	28	40	324	323	99.6%	68%
NL-Large (>1,000 MWh)	1	3	149	94	62.8%	17%
NL-Small (<1,000 MWh)	3	12	291	309	106.4%	9%
Total	**37**	**58**	**1,617**	**1,716**	**106.1%**	**13%**

Table 4-11 Gross Verified Winter Demand Savings (kW) by Stratum

Stratum	Population (N)	Sample Count (n)	Gross Reported Winter Demand Savings (kW)	Gross Verified Winter Demand Savings (kW)	Realization Rate (%)	Relative Precision @ 90% Confidence
L-Large (>400 MWh)	5	3	853	945	110.8%	12%
L-Small (<400 MWh)	28	40	310	277	89.4%	94%
NL-Large (>1,000 MWh)	1	3	128	83	64.9%	9%
NL-Small (<1,000 MWh)	3	12	68	72	106.2%	31%
Total	**37**	**58**	**1,358**	**1,377**	**101.4%**	**21%**

4.8.2.1 Custom-to-Go vs. Custom Classic

Custom-to-Go realization rates were slightly higher primarily based upon the fact that the non-lighting Custom Classic realization rate was lower than the Custom-to-Go non-lighting realization rate. The split between lighting and non-lighting reported savings was fairly equal between the two tracks with lighting measures representing 76% and 79% of the total reported savings in the Classic Custom and Custom-to-Go tracks, respectively.

Table 4-12 indicates the reported and verified energy (kWh) savings stratified by technology category (lighting vs. non-lighting) and participation track (Custom Classic vs. Custom-to-Go) for the evaluated sample. Realization rates were generally higher for Custom-to-Go projects since the majority of the energy savings comes from lighting retrofits.

Table 4-12 Comparison of Strata-Level Realization Rates - Classic vs. Custom-to-Go[7]

Track	Measure Category	Sample	Sample Reported (kWh)	Sample Verified (kWh)	Realization Rate (%)
Classic	Lighting	20	4,368,853	4,891,050	112.0%
	Non-lighting	14	7,429,531	5,842,836	78.6%
	Total	**34**	**11,798,383**	**10,733,887**	**91.0%**
Custom-to-Go	Lighting	23	1,539,294	1,465,653	95.2%
	Non-lighting	1	11,247	12,656	112.5%
	Total	**24**	**1,550,540**	**1,478,309**	**95.3%**

4.8.2.2 Baseline Assumptions for Linear Fluorescent T12 Fixture Retrofits

Starting in 2017, the evaluation team agreed to ask participants and trade allies about the continued use of linear fluorescent T12 lamps. The evaluation team sought to understand how claimed energy savings for linear fluorescent to LED retrofit measures would be estimated with a T8 baseline as opposed to a T12 baseline, even if the pre-existing fixture was a T12. Additionally, the research sought to understand how high Color Rending Index (CRI) T12s are still readily available in the marketplace enabling participants to continue using T12 lighting systems. This research was completed in a cross-cutting manner for NR Custom evaluations for multiple Duke jurisdictions including Indiana, Ohio, North Carolina, and South Carolina.

In an effort to gain direct insights on this issue from participants and trade allies, the evaluation team developed a battery of survey questions for each program participant and incorporated them into the survey instruments developed for this evaluation. The set of survey questions developed for participants was only fielded by those who implemented lighting retrofits involving linear fluorescent T12s, which was very limited (total of four participants across all jurisdictions being evaluated). The questions asked and a summary of the responses received are summarized below.

Participant Surveys

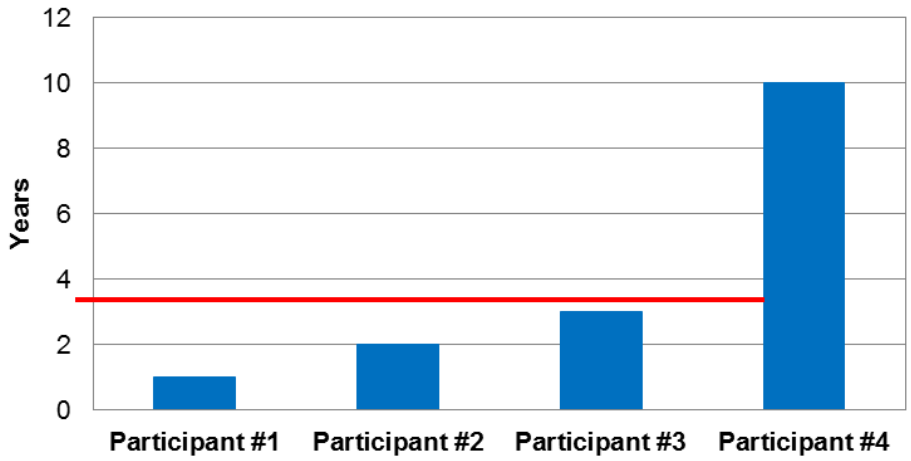
Sampled participants with projects involving T12 retrofits (4) were asked:

- **Question #1:** *"Would you have continued using linear fluorescent T12 fixtures if you had not received a financial incentive to upgrade to LED?"*
  - Two respondents said *"Yes"*
  - Two respondents said *"No"*

[7] Note that all savings presented in Table 4-13 reflect sampled projects only.

- **Question #2:** *"Were you previously purchasing high Color Rendering Index (CRI) T12 replacement lamps as a means of postponing full fixture replacements?"*
  - Two respondents said *"Yes"*
  - Two respondents said *"No"*
- **Question #3:** "How long could replacement lamps have allowed you to continue to use T12 fixtures?" (Responses in Figure 4-3)

Figure 4-3 How Long Participant Could Have Continued Using T12 Fixtures

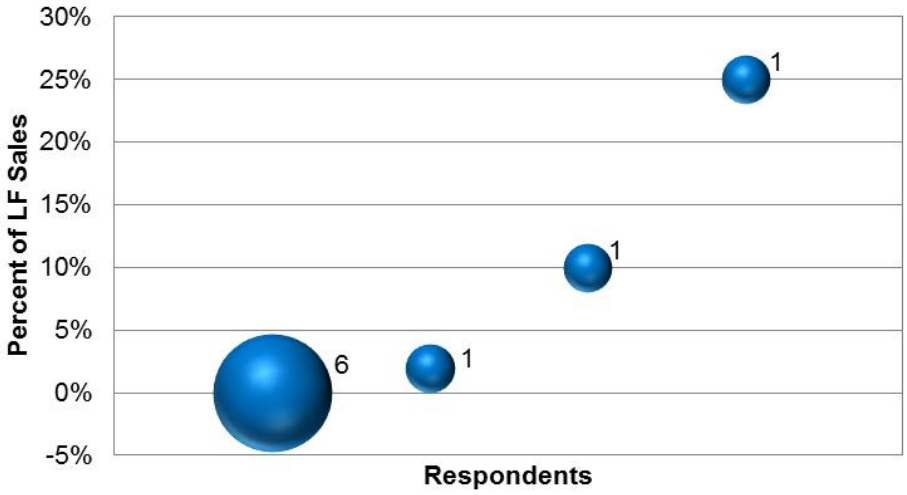


Trade Ally Surveys

Trade allies were asked the following questions regarding historic 2017 sales and forecasted 2018 sales for linear fluorescent T12 lamps and fixtures:

- **Trade Ally Question #1: "**Of your linear fluorescent lighting system sales in 2017, what percent were T12s?" (Responses in Figure 4-4)

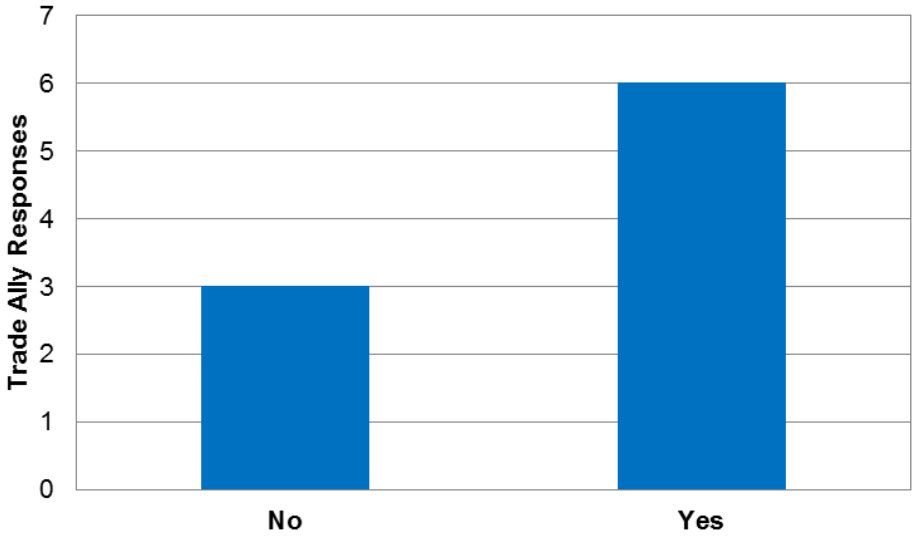
Figure 4-4 Percentage of 2017 Linear Fluorescent Lighting Sales that were T12 According to Surveyed Trade Allies



Trade ally responses to Question #1 suggest that the majority of the market has already shifted away from linear fluorescent T12s. Six of the nine trade allies surveyed reported that 0% of 2017 linear fluorescent sales were of the T12 variety.

- **Trade Ally Question #2:** "Are you still stocking and selling linear fluorescent T12 lighting systems and replacement lamps?" (Responses in Figure 4-5)

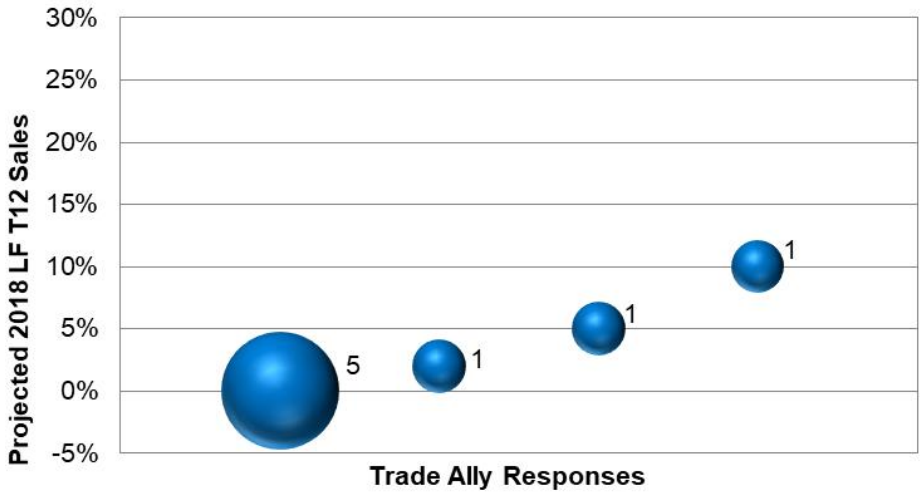
Figure 4-5 Are Trade Allies Still Stocking Linear Fluorescent T12 Replacement Lamps



Responses to Trade Ally Question #2 were also mixed. Six of the surveyed trade allies reported that they are still stocking linear fluorescent T12 lamps; however, only three of the trade allies surveyed reported to have sold T12s in 2017. This indicates that T12 lamps are being stocked, but not sold.

- **Trade Ally Question #3**: "Thinking of your 2018 sales of linear fluorescent lighting system sales, what percent will be T12s?" (Responses in Figure 4-6)

Figure 4-6 Estimated Percentage of 2018 Linear Fluorescent Lamps Sales That Will Be T12



Responses to Trade Ally Question #3 suggest that linear fluorescent T12 sales are expected to decline even further in 2018. Five of the eight trade allies surveyed indicated that 0% of 2018 linear fluorescent sales would be T12s.

In addition to asking participants and trade allies about linear fluorescent T12 lamps and fixtures, the evaluation team also quantified the difference in verified energy savings for all T12 measures sampled. For this analysis the evaluation team calculated the measure level savings using two scenarios. The first approach used a T12 baseline which is consistent with what the program uses in ex-ante energy savings estimates. The second approach used a reduced baseline fixture wattage consistent with a linear fluorescent T8 equivalent. The results of this analysis are summarized in Figure 4-7.

Figure 4-7 Comparison of Verified Energy Savings (kWh) and Realization Rates when Using T12 vs. T8 Baseline for Linear Fluorescent Retrofits

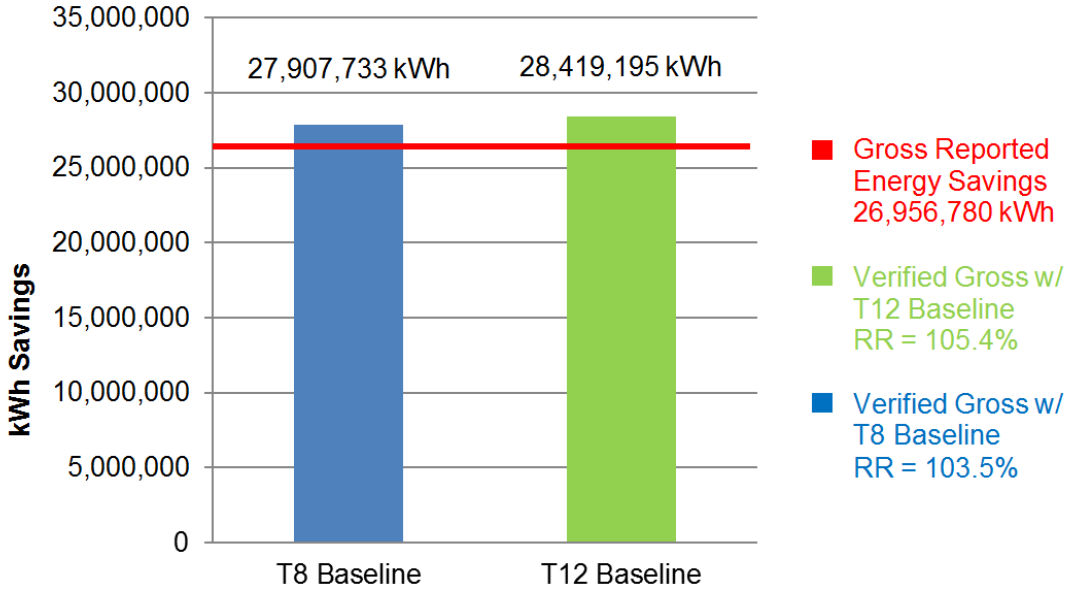


Figure 4-7 indicated that the overall impact on verified energy savings at the program level is very small regardless of whether a T12 or a T8 baseline is used for linear fluorescent fixture retrofits. Verified energy savings would reduce by approximately 511,462 kWh or 1.8%. Due to the relative minimal impact and in keeping with current industry standards, it is recommended that the NR Custom Program adopt a T8 baseline standard.

5 Net-to-Gross

5.1 Methodology

The evaluation team based the net-to-gross evaluation on customer self-report surveys, as described in the Uniform Methods Project, Chapter 23: Estimating Net Savings: Common Practices.[8] The survey was designed based on established methodologies outlined in the Pennsylvania Evaluation Framework.[9]

Net-to-gross analysis for this program involved two calculations: free-ridership and spillover. The results of these calculations are combined to produce the program-level net-to-gross ratio as follows:

Equation 17: Net-to-Gross Equation

$$NTG_p = (1 - FR_p) + SO_p$$

Where:

NTG_p = *the program-level net-to-gross ratio*

FR_p = *the program-level free-ridership ratio*

SO_p = *the program-level spillover ratio.*

The program net verified energy savings are calculated by multiplying the program net-to-gross ratio by the gross verified energy savings resulting from the impact evaluation activities as described in Section 4.

Equation 18: Net Verified Energy Savings

$$kWh_{nv} = kWh_{gv} \times NTG_p$$

The calculations of the program-level free-ridership and spillover ratios are detailed in the following sections.

5.1.1 Free-Ridership

The evaluation calculated free-ridership for each survey respondent based on their answers to a series of questions. These questions collected information on the customers' *intention* prior to interacting with the program and the *influence* of the program on changing those intentions.

Survey respondents were asked how the project would have changed if the incentive were not available. Responses were scored on a scale from 0 to 50 as shown in Table 5-1. If the respondent indicated they would do a smaller or less efficient project, they are prompted to categorize it as a small, moderate, or large reduction in scope.

[8] https://energy.gov/sites/prod/files/2015/02/f19/UMPChapter23-estimating-net-savings_0.pdf, Section 3.2.

[9] http://www.puc.state.pa.us/Electric/pdf/Act129/SWE_PhaseIII-Evaluation_Framework082516.pdf, Appendix B.

Table 5-1 Net-to-Gross Intention Score Methodology

Response	Intention Score
Done nothing	0
Canceled or postponed the project	0
Done a smaller or less efficient project	Small = 37.5 Moderate = 25 Large = 12.5 Don't know = 25
Done exactly the same project	Would have paid = 50 Would not have paid = 25 Don't know = 37.5

To recognize the direct points of influence that the program has on customers' decisions, the survey asked respondents to rate the influence of several program aspects (where 10 is extremely influential and 0 is not at all influential). The highest rating for each customer was scored, again on a scale of 0 to 50. The rationale is that if any aspect of the program is highly influential on a customer's decision, then the program overall was equally influential (see Table 5-2).

Table 5-2 Net-to-Gross Influence Score Methodology

Program Aspect	Max Rating → Influence Score
Incentive provided by Duke Energy	0-1 → 50 2 → 43.75
Interactions with Duke Energy	3 → 37.5 4 → 31.25
Duke Energy marketing materials	5 → 25 6 → 18.75
Previous experience with Duke Energy programs	7 → 12.5 8 → 6.25
Contractor or vendor recommendation	9-10 → 0

The intention and influence scores are added together to produce each respondent's free-ridership ratio using Equation 19.

Equation 19: Respondent Free-ridership Ratio

$$FR_i = \frac{Intention + Influence}{100}$$

The ratio is multiplied by that respondent's verified gross savings to result in free rider savings, or savings that would have occurred without the program. The program free-ridership ratio is the sum of free rider savings divided by the sum of verified gross savings as shown in Equation 20.

Equation 20: Program Free-ridership Ratio

$$FR_p = \frac{\sum(FR_i \times kWh_{gv})}{\sum kWh_{gv}}$$

5.1.2 Spillover

Spillover is an estimate of savings resulting from the installation of energy efficient projects that were completed without a program incentive but that still were influenced by the program. There are two components to arriving at these program-attributable savings.

First, the survey collects information on the type of energy-efficiency equipment that was installed but for which an incentive was not received. This is used to estimate energy savings through the application of established calculation methodologies, often a technical reference manual.

Second, the survey asks the respondent to rate the influence of the program on their decision to implement the project despite not receiving an incentive. That score is used to prorate the total project savings, recognizing that the program may not have been the only influence in the completion of the project. The result of this calculation is program-attributable spillover, shown in Equation 21:

Equation 21: Program-Attributable Spillover

$$kWh_{aso} = kWh_{gso} \times Influence$$

Where:

kWh_{aso} *is the program-attributable spillover savings*

kWh_{gso} *is the gross spillover savings*

Influence is the value based on the respondent's rating of the program influence, as shown in Table 5-3.

Table 5-3 Participant Spillover Program Influence Values

Reported SmartSaver Program Influence	Influence Value
0	0.0
1	0.1
2	0.2
3	0.3
4	0.4
5	0.5
6	0.6
7	0.7
8	0.8
9	0.9
10	1.0
Don't know / Refused	Sector-level measure average

This number is divided by the total verified gross energy savings for the program to produce a program spillover ratio (Equation 22):

Equation 22: Program Spillover Ratio

$$Program\ SO\ Ratio = \frac{\sum kWh_{aso}}{kWh_{gv}}$$

5.2 Net-to-Gross Analysis and Findings

The evaluation team conducted interviews with 36 customers who completed 57 projects at locations in Kentucky and Ohio.[10] Customers reported that for most projects (46 of 57 surveyed projects) they would have put off the work, canceled it entirely, or reduced the scope or efficiency of the project. The remaining customers said they planned to do the same project before learning about the Smart $aver Custom Program, and all of those customers said they would have paid the full cost of the upgrade if the incentive were not available. The full distribution of responses is shown in Table 5-4.

[10] Program participants in the Kentucky territory were combined with those in the Ohio territory to present more robust figures. The net-to-gross evaluation completed surveys with 8 of the 13 projects, which were combined with the 49 project completes from the Ohio territory.

Table 5-4 What Would You Have Done Had You Not Received an Incentive?

Response	Respondents
Canceled or postponed the project	37
Done a smaller or less efficient project	9 Large reduction (2) Moderate reduction (5) Small reduction (1) Don't know (1)
Done exactly the same project	9 Would have paid (9)
Don't know	2

The evaluation team reviewed the nine responses that indicated the customer would have completed the same project, including paying the incentive amount on their own. There were no systematic project characteristics (measure type or project size) within these nine projects.

When asked to rate the influence of the program on their decision to complete the energy-efficiency project, all respondents rated at least one program aspect a 7 or higher on a 0 to 10 scale, where 0 means "not at all influential" and 10 means "extremely influential." The program incentive and contractors' recommendations were the program aspects most commonly given a high rating.

The resulting free-ridership, spillover, and net savings are shown in Table 5-5 below. These results indicate that the program is extremely effective in encouraging customers to complete projects they would not otherwise do.

Table 5-5 Net-to-Gross Evaluation Results

Measurement	Gross Verified Energy Savings (MWh)	Ratio	Net Verified Energy Savings (MWh)
Net of Free-ridership	13,390	84.6%	11,328
Program-influenced Spillover		0.1%	13
Net-to-Gross		84.7%	**11,341**

6 Process Evaluation

6.1 Summary of Data Collection Activities

Process evaluation activities are designed to support continuous program improvement by identifying successful program elements that can be expanded or built upon, as well as underperforming or inefficient program processes that could be holding back program performance or participation. The data collection activities for the process evaluation of the NR Custom Program included a database review, and interviews with key contacts involved in program operations, participating customers, and contractors who assisted customers with projects.

The evaluation team developed data collection instruments designed to explore the research questions identified in Table 3-1. Table 6-1 summarizes the process evaluation data collection activities for Duke Energy Kentucky.

Table 6-1 Summary of Process Evaluation Data Collection Activities

Target Group	Completes
Staff	5 In-depth interviews
Participants	57 Telephone surveys with participant projects (36 unique participant respondents)
Contractors	6 In-depth interviews 21 Telephone surveys

6.1.1 Program Staff Interviews and Database Review

Five interviews were conducted in June 2016 with Duke Energy's NR Custom program staff so that the evaluation team had a good understanding of the program and to get background information on program design and implementation practices. The program staff provided valuable feedback on intended operations, processes of the program's stated (and unstated) goals and objectives, perceived barriers to program up-take, and modifications to any program components based on the previous program cycle as well as the rationale for those modifications. The information the team gathered assisted in the design of the interview guides and surveys for customers and contractors.

In addition to the program staff interviews, the evaluation team reviewed the program tracking database to ensure necessary data and information was being collected to track program progress.

6.1.2 Contractor Interviews and Surveys

Custom programs include a variety of types of contractors and projects that require preapproval. For these programs to be successful, contractors must be able to access and use calculation tools, navigate preapproval processes, and communicate the steps involved to project

representatives. Contractors are important market actors, especially in large custom programs, and a good understanding of their experience with program processes, preapprovals, customer decision making, and persistent barriers to additional projects is crucial to the success of custom programs.

Six in-depth interviews were conducted in January and February 2017 to gain an in-depth understanding of contractors' experience with the program. The input from these interviews helped the team design the guide for the telephone survey, which was completed in November 2017. The evaluation team selected implementation contractors associated with customer projects from the tracking database provided by Duke Energy. Discussion topics in the survey included program awareness among customers, program guidelines and processes, interactions with customers, and suggestions for improving the program. Surveys were completed with 21 of 62 program contractors who participated in the program. The average survey length was 21 minutes and average number of telephone attempts was 9. Table 6-2 outlines the contractor response for the evaluation.

Table 6-2 Contractor Response Rate

Disposition	Contractor Count
Starting Sample	**62**
Does not recall participating	8
Refusal	14
Incompletes (partial surveys)	1
Language barrier	1
Wrong number	4
Not completed	13
Completes	**21**
Response Rate (Complete/Starting Sample)	**33.9%**

6.1.3 Participant Surveys

Collecting survey data from program participants provides data suitable for quantitative analyses on participant characteristics, and key aspects of the program. The evaluation team conducted a telephone survey with program participants, defined as customers who received a rebate through Duke Energy's NR Custom Program between August 2015 and July 2017.[11] Surveys were conducted with program participants in two waves; the first in November 2016 and the second in October 2017. Surveys focused on customers' experience with the program, sources of awareness, decisions to install equipment, barriers to participation, satisfaction with various aspects of the program, and any program improvement suggestions. Surveys were

[11] In order to meet the original reporting deadline outlined in the evaluation plan, the participant surveys utilized all sampled received through July 2017. The team does not believe the projects received after this date were systematically different than those included in the participant survey.

completed regarding 57 of 87 projects completed through the program (36 unique respondents). Table 6-3 outlines the participant response rate for the evaluation.

Table 6-3 Participant Response Rate

Disposition	Participants
Starting Sample	**87**
Does not recall participating	1
Refusal	7
Incompletes (partial surveys)	2
Wrong number	1
Not completed	19
Completes	**57**
Response Rate (Complete/Starting Sample)	**65.5%**

Wave 1 calling started November 2, 2016 and ended November 18, 2016

Wave 2 calling started October 5, 2017 and ended October 26, 2017

6.2 Process Evaluation Findings

6.2.1 Program Staff and Database Review

The program staff interviews were extremely useful in helping the evaluation team understand how the program operates, and to design the interview guides and surveys for program participants and contractors. Information from staff interviews has been used throughout the findings section to add context around respondent answers.

An additional part of the evaluation activities included reviewing the program database to ensure the necessary information needed to track the program and conduct evaluation activities existed. Program staff uses the tracking database to document customers who participated in the program, the details of the equipment being installed, and the savings associated with the project. Once the application is received, this information is passed to AESC, the vendor responsible for the technical review. AESC verifies the accuracy of the savings calculations and provides Duke Energy with verification in a systematic format. Duke Energy engineers also review the application information to verify savings calculations.

The evaluation team utilized this same database to select samples for impact and process evaluation activities. When using information for evaluation purposes, the information included in the file was accurate and thorough although some areas were not electronically documented. Specifically, some contact information was missing from the file, specifically contact phone numbers and email addresses. Additionally, the quantities of installed equipment (particularly for

lighting) and some savings values associated with projects was missing or incorrect.[12] Understanding which customers received a Custom incentive is critical in evaluating progress towards program goals and conducting an independent review of program participants.

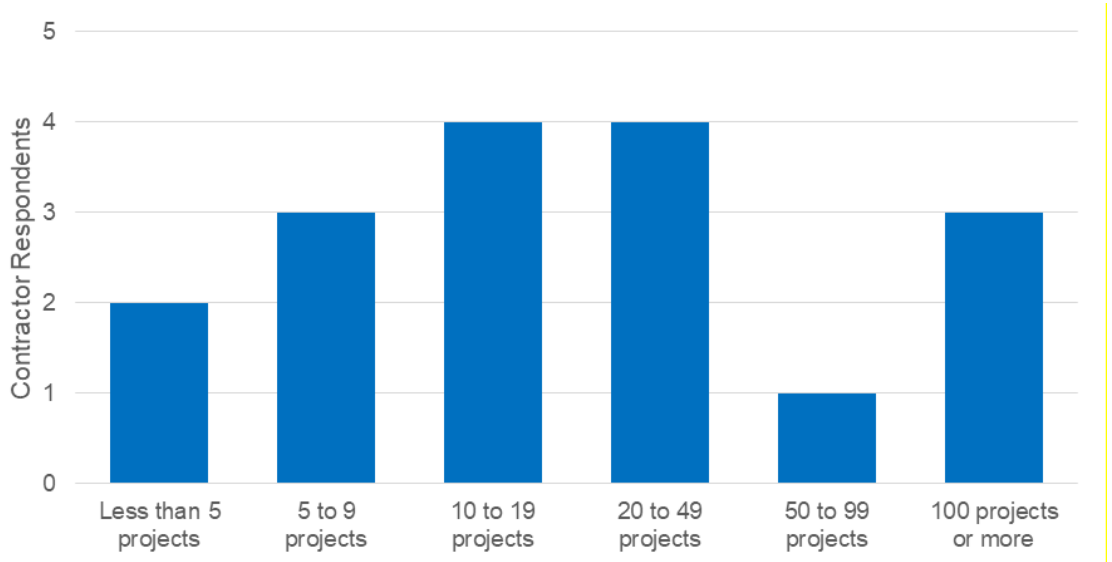
In conducting the process evaluation telephone efforts, some contact information associated with some participants was out of date. Given that evaluation activities went back to 2015, some level of personnel turnover at companies is expected, resulting in having contact information for people who no longer work for listed companies.

6.2.2 Contractors

The evaluation team surveyed 21[13] contractors who were involved in the installation of participating customer's projects during the evaluation period. The amount of time these contractors have been involved in the program varied with one contractor indicating they have participated in Duke Energy's programs for one to two years, seven contractors indicating they have been involved between three to five years and 11 have been involved for more than five years. Two contractors could not recall how long they have been participating in Duke's NR Custom program.

Responses regarding the number of projects contractors have completed during their time with the program varied from less than 5 projects to more than 100. Figure 6-1 shows the number of contractors and an estimate of the number of projects they recall completing through the program since they began. As expected, contractors involved in the program longer completed more projects while those only involved in the program a few years completed fewer.

Figure 6-1 Number of Total Completed Projects



Source: Question TA5, Don't know responses are excluded.

[12] It should be noted that the baseline and post-retrofit quantities are well-documented elsewhere by the program team outside of the participation tracking database. In fact, standard policy is to verify installed equipment quantities prior to issuing payment. The pre- and post-retrofit quantity information isn't considered by the program to be critical to include in the participation database.

[13] The 21 contactors include contractors from both KY and OH, because of low number of KY respondents.

When asked about their 2018 project plans, 6 of 21 contractors felt their program participation would be higher compared to their 2017 participation. The most mentioned reason was an expected increase in projects (3 respondents), e.g. as a result of increased interest in energy efficiency projects by building owners. Two respondents added that "*the program is good and fits well*" or that "*the business is better*." Two respondents described financial reasons related to the program and its benefits: "*will add to the bottom line and profitability*," and "*is another sales tool that offers incentives*." The last respondent felt the economy was doing better so that he felt customers would be *"upgrading their system retrofit and new construction."*

Eight contractors felt that their program participation in 2018 would be about the same because they do not anticipate a change in the number of projects (based on their customers interests and needs), especially if there are no major changes in the prescriptive program. Six contractor respondents thought the participation would be lower in 2018 due to potential changes in the program (program not being offered, change in the incentives, or moving equipment currently offered through custom to the prescriptive program), or anticipated reduction in number of projects based on the needs of major clients.

When asked if they were registered with Duke Energy's contractor network and appear on Duke's website, 15 of 21 contractors indicated they were. The remaining six contractor respondents were not sure.

6.2.2.1 Communication

Most contractors reported that communication with Duke Energy program staff was effective (8 respondent rated it very effective and 7 said it was somewhat effective). Almost two-thirds of respondents (13 of 21) indicated they have received training and information from Duke Energy about the Smart $aver Custom Incentive program. Two of the 13 contractors indicated additional trainings/information could be provided, in one case "*more in-depth process training from start to end*" while the second contractor indicated *"additional contractor trainings applicable to available rebates."*

6.2.2.2 Customer Interaction

On average, contractor respondents felt about 45 percent of their customers were aware of the Custom program prior to them telling them about it. Most contractors (14 respondents) felt they were at least partially responsible for the awareness. Other sources of awareness mentioned by contractors included other contractors or vendors (5 respondents), Duke Energy website (4 respondents), Duke Energy advertisements (3 respondents), Duke Energy staff (2 respondents). When talking with contractors, 5 of 21 respondents indicated that customers do not have any concerns about the program. The remaining 16 contractors had a variety of customer concerns about participating, as outlined in Table 6-4.

Table 6-4 Contractor Reported Customer Concerns About the Program

Concern	Respondents
If they will get the rebate and how long it will take	6
Unsure if the savings will be achieved	5
Unsure if the incentive will be as high as estimated	4
Uncertainty around the approval	2
Unsure who is getting the incentive	2
Unsure if the program will continue to be funded	2
Unsure if the equipment qualifies	1
Unsure about electricity cost reduction	1
Program not keeping up with the industry	1
Skeptic	1
Respondents	**21**

Source: Question PI5, Don't know responses are excluded.

Seventeen of the 21 contractor respondents indicated that they use the program as a sales tool and that the program is helpful in selling energy efficient equipment (14 very helpful and 3 somewhat helpful)[14].

When asked about the factors that influence the type of equipment nonresidential customers purchase, the most common response from respondents was equipment cost (8 respondents) and the efficiency and reliability of the equipment (6 respondents), as outlined in Table 6-5.

[14] Response options where very helpful, somewhat helpful, neither helpful nor unhelpful, not very helpful and not at all helpful.

Table 6-5 Factors on NR Customer's Purchase

Factor	Respondents
Equipment costs	8
Efficiency and reliability of equipment	6
Payback or return on investment (ROI)	5
Warranty, quality, and design of equipment	4
Desire to reduce energy bills	3
General need	2
Interest in new technology	1
Equipment specifications	1
Rebate and incentive availability	1
Availability of equipment for emergency replacement	1
Respondents	**19**

Source: Question CI1, Don't know responses are excluded.

Some contractor respondents felt manufacturing, industrial, and commercial (4 respondents) customers were more receptive to high-efficiency equipment. Other contractors, however, felt it was not about the sector but rather if the customer-owned the building (2 respondents), if they have longer operation hours such as warehouses (2 respondents), if customers are concerned about reducing their costs (3 respondents), or if they are educated and value saving energy (4 respondents).

Based on the contractor respondents, the main reason some customers do not move forward with projects is financing or equipment cost (15 respondents). This was followed by project not meeting payback or ROI criteria (5 respondents), the urgency of the project combined with the burden of completing incentive forms (1 respondent), facility operation constraints (1 respondent), and lack of knowledge (1 respondent).

6.2.2.3 Application Process

Most contractor respondents (18 of 21) indicated that they received a request for additional information after submitting their initial application for preapproval. Typical requests were related to providing additional documentation about the equipment or its use (14 respondents), examples include specification sheet, fixture wattage, size of the facility, and confirmation that the equipment is on the Design Lights Consortium (DLC) list. Other requests were regarding calculations or audit information.

When asked if there were any enrollment paperwork or rebate submission processes that could be simplified to encourage customers to complete projects, half the contractor respondents did

not think so (10 respondents). Of the 10 contractor respondents who thought processes could be simplified, responses varied by the contractor. Examples of improvement included the following: more existing lighting could be added to prescriptive rebates so they would not have to be custom (e.g. T8 and T12), remove repetitive information (multiple requests for the same information), the ability to use external calculators for smart control systems, streamline the submittal process, and shorten the preapproval process. One contractor was not able to provide detail on what specifically he would change about the process.

Email applications have been used almost exclusively for the past three years. Although starting in 2016, an online application portal was launched. All but two contractors were aware of the online application portal to submit the application online. Of the 19 contractor respondents who were aware of the online application portal, 17 indicated they have used the portal and rated its usefulness high (average 7.8 on a 0 to 10 scale where 0 was 'not at all useful' and 10 was 'very useful'). The one contractor respondent indicated it was *"too complicated to use it on a customers' behalf."* Another, who was aware of the online portal but has not used it, did not indicate any reasons preventing him from using the portal.

6.2.2.4 Calculators

As part of the application process, and to receive incentives through the Smart $aver Custom program, an appropriate worksheet or calculator must be submitted. Duke Energy provides access to two types of calculators: Classic Custom and Custom-to-go. Classic Custom calculators are Excel-based worksheets available for five different technologies. One Custom-to-go Windows-based calculation tool is also available.

Contractors were asked how they typically estimate savings for projects that were submitted through the program. Fourteen respondents mentioned using Duke Energy provided tools, while 6 mentioned they only use their own/other tools (Table 6-6).

Table 6-6 Tools Used by Contractors to Estimate Savings

Calculators Used	Respondents
Custom-to-go, Classic Custom, and own calculators	9
Own calculators only	6
Custom-to-go and own calculators	2
Own calculators and other calculators	1
Custom-to-go and Classic Custom	1
Custom-to-go, Classic Custom and other calculators	1
Classic Custom, own calculators and other calculators	1
Respondents	**21**

Source: Question PP1

Contractor respondents who used Duke provided calculators were asked to rate their usefulness on a 0 to 10 scale where 0 was 'not at all useful' and 10 was 'very useful.' Both calculators were rated as being useful with mean scores of 8.0 and 7.3 for Custom-to-go and Classic Custom, respectively.

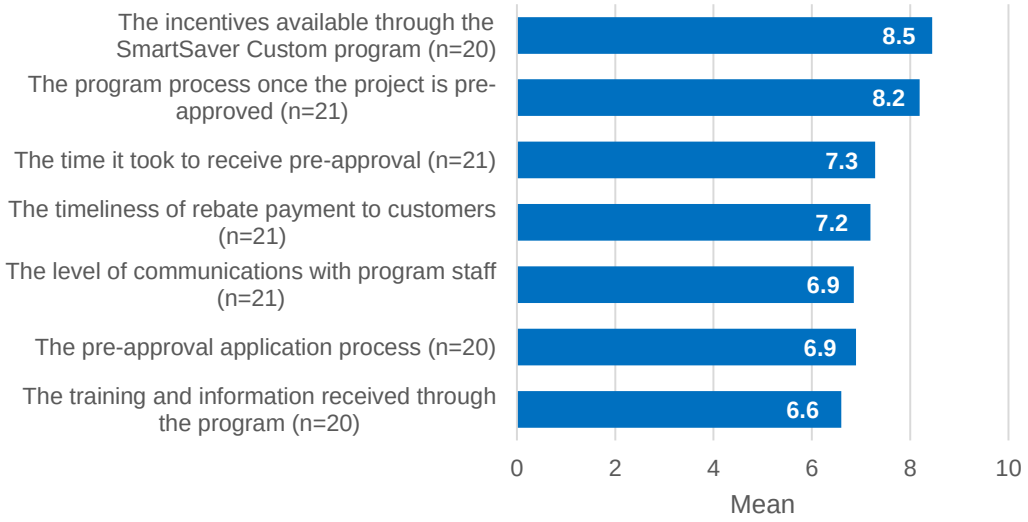
Respondents who did not use the calculators provided by Duke reported not being aware of the calculators (1 respondents) and using their own calculators which they are familiar with or customized to their company (3 respondents) as reasons for not using the Custom-to-go and Classic Custom calculators. Two contractors indicated Duke's calculators did not fit their specific project or equipment category, and another contractor mentioned that the Duke's calculators are not complex enough. Two contractors were not able to provide detail on why they have not used Duke calculators.

6.2.2.5 Satisfaction

Overall, contractor respondents were satisfied with the NR Custom program and with Duke Energy. Respondents were asked to rate their satisfaction on a 0 to 10 scale where 0 was 'not at all satisfied' and 10 was 'very satisfied.' On average, contractor respondents rated their satisfaction with the program 7.6 and their satisfaction with Duke Energy 7.0.

Using the same scale, contractors were also asked to rate their satisfaction with different program components. Contractors were generally satisfied with the program with most mean scores over 6.6. The lowest rated item was the training and information received through the program while the highest rated item was the incentives available through the program, as shown in Figure 6-2.

Figure 6-2 Contractor Satisfaction with Program Components



Source: Question SA1
Don't know responses are excluded.

Most contractor respondents felt the program aspect that was most influential in customers' decision to move forward with projects was the incentive (14 of 20 respondents). Additionally,

contractor respondents felt the program incentive was the most valuable part of the NR Custom program (13 of 20 respondents).

As far as improvements with the program, four contractor respondents indicated no changes were needed. For the remaining 17 respondents: 9 contractors proposed increased communications, especially related to future changes in rebates (5 respondents), clarity about initial stages, initial M&V requirements, and incentives (4 respondents); 5 contractors indicated shortening the application review or the time it takes to receive the incentives; 2 contractors suggested increasing the incentives; 1 contractor proposed updating the application instructions in relation to smart control systems; and 2 contactors suggested moving more equipment to prescriptive.

6.2.3 Participants

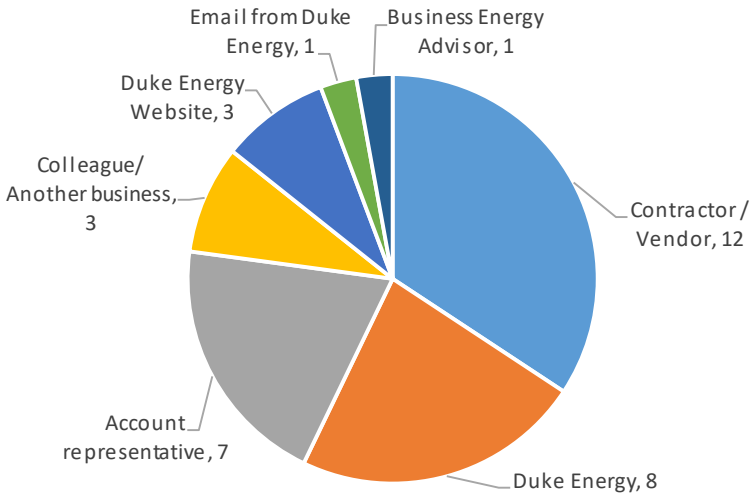
Surveys were conducted with program participants or customers who received a rebate through the NR Custom Program. This section provides detailed findings from 31[15] customer respondents who completed the surveys.

6.2.3.1 Marketing Practices

Before 2016, the program largely focused on account managers as the primary source of program promotion. In 2016, traditional marketing channels were used such as direct mail, ads on social media or other websites and emails to a subset of customers by segment. Contractor outreach representatives market the program directly to contractors, which Duke staff indicates accounts for a significant percentage of projects. When asked how they heard about the program, the three primary sources of awareness of the NR Custom Program reported by participant respondents were from their contractor or vendor (12 respondents), Duke Energy (8 respondents), or their account representative (7 respondents), which is consistent with how the program was marketed. Figure 6-3 shows breakdown of the awareness sources customer respondents.

[15] The 31 respondents includes respondents from KY and OH because of the low number of KY-only respondents.

Figure 6-3 Participant Source of Program Awareness



Source: Question Q1
Don't know responses are excluded.

For respondents who heard about the program from their contractor, account representative, or business energy advisor, all respondents indicated they were provided with enough information about the program and no additional follow-up or information was needed. This supports what was reported by the surveyed contractors and the role they play in increasing program awareness. This also shows that contractors, in addition to Duke staff, are well-versed on the program and can answer customer questions.

Program website materials note that the NR Custom incentives “can help you offset up-front costs and improve your bottom line.” When respondents were asked what made them decide to apply for the NR Custom program, needing new equipment was mentioned most. Ten participant respondents mentioned the return on investment, and several others mentioned contractor recommendation and monetary savings. Other reasons are included in Table 6-7.

Table 6-7 Reasons for Participating in the Smart $aver Custom Incentive Program

Reason	Respondents
Needed new equipment	16
ROI/payback/cost-benefit	10
Contractor recommendation	8
Monetary savings	6
Energy savings	3
The rebate/incentive	2
Ability to get a better product cheaper	1
Respondents	**35**

Source: Question Q6, Don't know responses are excluded.

6.2.3.2 Application Process

According to program staff, the review process takes about four to six weeks. Staff mentioned they would like to improve the turnaround and are currently tracking the timing and looking for ways to improve the internal review process. While Duke staff felt the review process could be improved, program participants were generally satisfied with the review process (Table 6-8). When asked about their satisfaction with various aspects of the application process, respondents rated their satisfaction highly, with mean scores 8.0 or higher (using a 0 to 10 scale where 0 is 'very dissatisfied' and 10 is 'very satisfied'). Over half of participant respondents (18 of 30 respondents) indicated their contractor filled out the Smart $aver Custom Incentive program application, 6 respondents indicated someone within their organization filled out the application, and 6 respondents reported someone within their company worked on the application with the contractor.

Table 6-8 Satisfaction with Application Process

Application Aspect	Mean	Respondents
Process to fill out and submit your application	8.20	35
Staff time it took to submit the application	8.03	33
Duke Energy's processing and preapproval of your application	8.15	33

Source: Questions Q8, Q9, Q10,Don't know responses are excluded.

Only two respondents rated their satisfaction low for an aspect of the application process (less than 4) due the complexity of the application: one respondent indicated that the application is hard to fill out when involving the supplier and vendor, the other respondent explained that the application requires "*so much information and justification*."

About half of participant respondents (13 of 29 respondents) indicated they received a request for additional information after submitting their initial application for preapproval. Most respondents could not recall the specifics around the request although some noted that it was additional equipment information (3 respondents), or calculation justifications (3 respondents).

6.2.3.3 Calculators

As mentioned above, as part of the application process and to receive incentives through the program, an appropriate worksheet or calculator must be submitted. In addition to the feedback contractors provided, participant respondents were also asked if they used any of the calculators provided by Duke Energy or if they used their own methods to calculate energy savings. About one-third of respondents reported using the tools Duke provided while the remaining used their own tool or relied on their contractor to calculate savings (Table 6-9). This is slightly lower than the feedback received from contractors where 14 of the 21 contractors indicated they used Duke tools to calculate savings.

Table 6-9 Calculators Used by Participants

Calculators Used	Respondents	Percent
Own methods only	12	38%
Custom-to-go only	9	28%
Contractor calculated only	10	31%
Custom-to-go and own methods	1	3%
Respondents	**32**	

Source: Question Q12, Don't know responses are excluded.

6.2.3.4 Participating Customer Characteristics

Facility types varied across the 36 participant respondents' locations. The most mentioned type of businesses was Industrial/Manufacturing (19 respondents, 53 percent), followed by Education (4 respondents, 11 percent). The facility types are consistent with how the program was

marketed, which initially targeted larger industrial customers. When participants were asked how their companies make budget decisions and whether they were decided locally, regionally, nationally, worldwide or something else, most respondents reported that decisions are made locally (24 respondents, 67 percent). Most respondents tended to plan one year (10 of 34 respondents) or 5 years (8 of 34 respondents) into the future when creating budget and financial plans. Table 6-10 shows the participant business characteristics.

Table 6-10 Smart $aver Custom Incentive Program Participant Characteristics

	Respondents	Percent
Business Activity		
Industrial/manufacturing	19	53%
Education	4	11%
Retail (other than mall)	2	6%
Warehouse or distribution center	2	6%
Public assembly	2	6%
Service	2	6%
Parking Garage	1	3%
Food sales	1	3%
Respondents (n)	**36**	
How budget decisions are made		
Locally	24	67%
Regionally	3	8%
Nationally	3	8%
Worldwide	3	8%
Other	3	8%
Respondents (n)	**36**	
Length of time into the future company plan when creating budgets		
Less than 1 year	4	12%
One year	10	29%
Two years	3	9%
Three years	4	12%
Four years	0	0%
Five years	8	24%
More than 5 years	1	3%
Other	4	12%
Respondents (n)	**34**	
Business cycle impacts when energy efficiency projects can be implemented		
Yes	22	76%
No	15	52%
Respondents (n)	**29**	

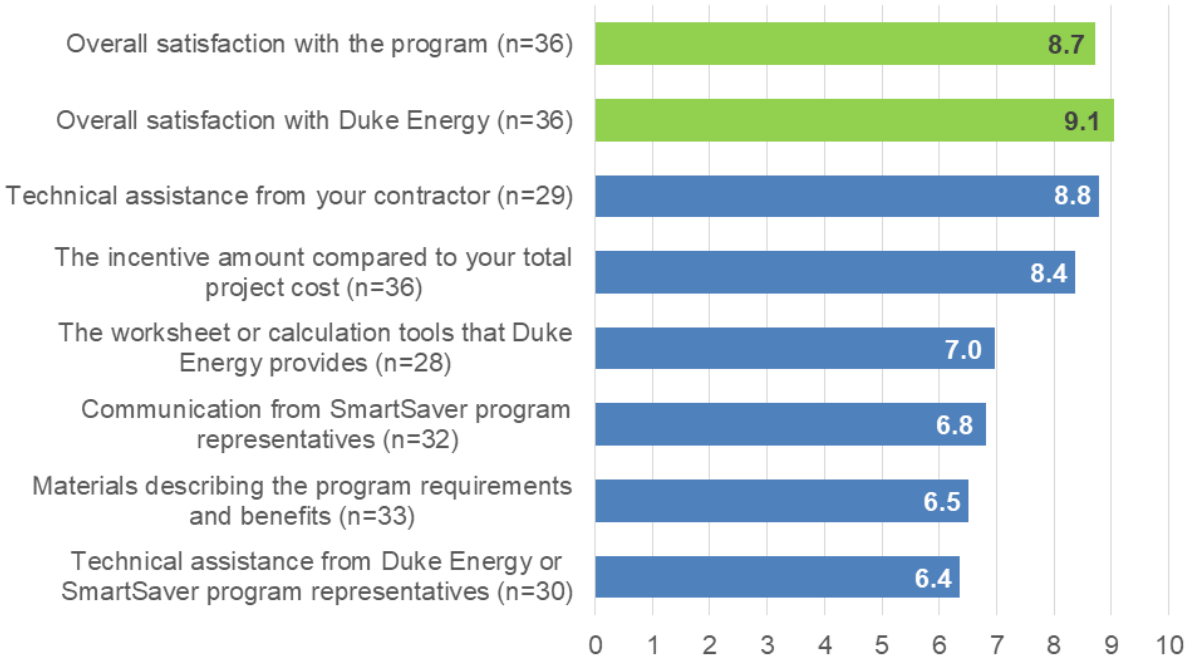
Source: Questions C1, C2, C3, C4, Don't know responses are excluded.

6.2.3.5 Program Satisfaction

Overall, program participants were highly satisfied with the NR Custom program. Respondents were asked to rate their overall experience with the program and with Duke Energy on a scale of 0 to 10, where 0 is 'very dissatisfied' and 10 is 'very satisfied.' Respondents rated their overall satisfaction with the program overall highly (8.7 out of 10) and rated Duke Energy highly as their service provider (9.1 out of 10). Respondents were also asked to rate the value of different

program components on a similar 0 to 10 scale. All program aspects were rated an average of 6.4 or higher (see Figure 6-4).

Figure 6-4 Program Participant Satisfaction and Value of Program Aspects

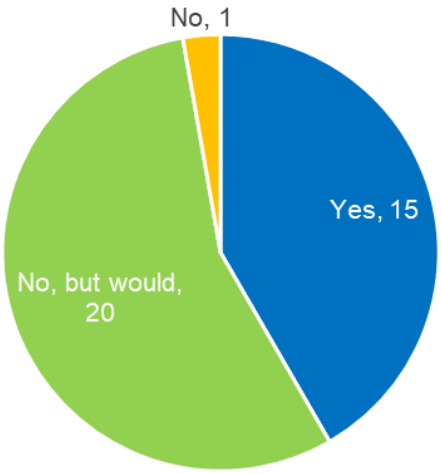


Source: Question SAT5, SAT11, SAT13
Don't know responses are excluded.

As far as the program aspect that is most valuable to their organization, 17 of the 36 participant respondents indicated the incentive compared to their total project cost (which correlates with the contractor responses). This was followed by 10 respondents indicating the technical assistance they received from their contractor, and 6 respondents saying the worksheet or calculation tools that Duke Energy provides.

As another gauge of satisfaction, customers were asked if they have recommended the program to others. As shown in Figure 6-5, 15 participants reported that they had already recommended the program. If provided the opportunity, 20 of the remaining 21 respondents said they would recommend the program. Furthermore, all respondents indicated they would participate in the program again. The one respondent who did not indicate he would recommend the program if given the opportunity provided no indication of dissatisfaction throughout the survey.

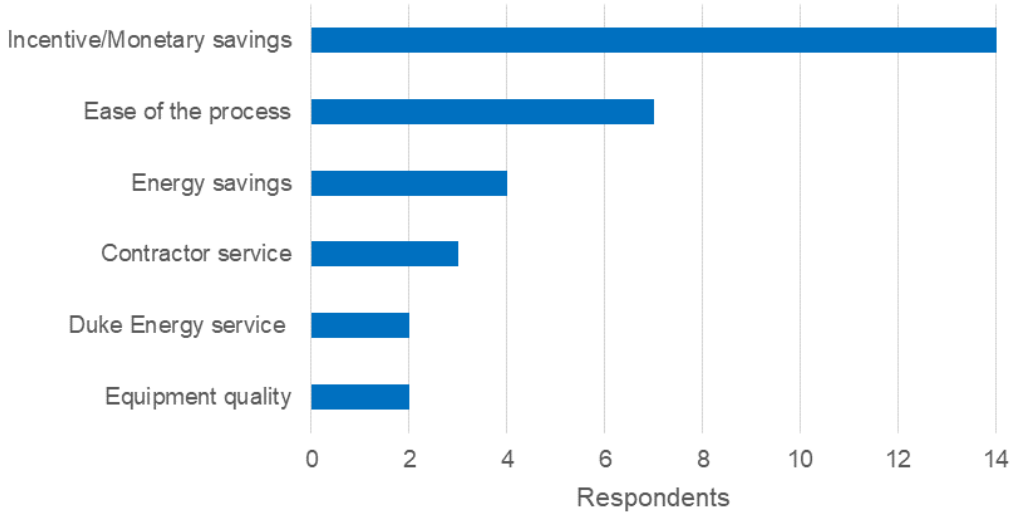
Figure 6-5 Have You Recommended the Program to Others?



Source: Questions SAT8, SAT9

Respondents reported many reasons for rating the program highly (Figure 6-6); those include mainly availability of the incentive and money savings (14 respondents), and ease of the process (7 respondents). Three of the 14 respondents indicated that they would have not done the projects without the incentives provided through the program.

Figure 6-6 Reasons for Rating the Program Highly



Source: Question SAT12o
Don't know responses are excluded.

When asked what they would change about the Smart $aver Custom Incentive program, 13 of 35 respondents indicated they would not change anything. Of the remaining 22 respondents,

seven respondents felt the paperwork was too complex and six respondents asked for improving the initial processing time. Other responses included reducing the amount of paperwork (1 respondent) and removing the preapproval requirement (1 respondent). These suggestions align with opportunities for improvement reported by the contractors.

7 Conclusions and Recommendations

7.1 Impact Evaluation

Conclusion 1: The evaluation team's analysis resulted in a 103.5% realization rate (energy) for the DEK NR Custom Program. The strong realization rate indicates that Duke Energy's internal processes for project review, savings estimation, and installation verification are working to produce high quality estimates of project impacts.

Recommendation 1: The evaluation team recommends that Duke continue to operate this program with the current level of rigor. For interior lighting projects, Duke should consider developing and applying deemed interactive factors to quantify the interactive effects between lighting retrofits and their associated HVAC systems.

Conclusion 2: Assumptions used in ex-ante energy savings estimates are well-documented, but there are opportunities for improvement on new construction lighting projects and some non-lighting projects.

Recommendation 2: The evaluation team recommends that any adjustments made to baseline assumptions on new construction projects be well-documented within the incentive calculation spreadsheet developed by the program. This will provide better transparency when deviations from a lighting power density approach are used in ex-ante energy savings estimates.

Conclusion 3: The NR Custom Program still uses T12 baseline fixture wattages in ex-ante energy savings estimates for linear fluorescent to LED tube retrofit measures. This practice is defensible given the availability of high color rendering index (CRI) replacement lamps; however, peer DSM programs no longer credit energy or demand savings beyond a T8 baseline.

Recommendation 3: It is recommended that the Duke NR Custom Program consider using a T8 equivalent when developing ex-ante energy and demand savings estimates for T12 to LED tube retrofit measures.

7.2 Process Evaluation

Conclusion 1: The program is operating as intended and has resulted in high satisfaction across participant and contractor respondents. The most common source of program awareness from customers was through their contractor, which is consistent with how the program marketed.

Recommendation 1: Continue to engage contractors in the program and keep them informed of the program to increase awareness among customers and encourage the installation of program-qualifying equipment.

Conclusion 2: As part of the application process, an appropriate worksheet or calculator must be submitted. Duke Energy provides access to two types of calculators: Classic Custom and Custom-to-go. About one-third of participant and two-thirds of contractor respondents indicated

they have used Duke's tools to calculate savings. Contractors who used Duke's provided tools rated their usefulness high.

Recommendation 2: Continue to keep the Custom-to-Go and Classic Custom calculators updated and available to customers and contractors who need a tool to estimate savings.

Conclusion 3: Interviews with program staff indicated the pre-approval review process could take as much as six weeks for review. While Duke staff felt the review process could be improved, program participants were generally satisfied with the review process. Contractor respondents were slightly less satisfied than participant respondents in the pre-approval process although they still provided high satisfaction scores. While no respondents reported being dissatisfied with the application process, it is something to watch to make sure the length of time to review applications is not taking too long.

Recommendation 3: Continue to monitor the time it takes to review applications to ensure the time does not exceed six weeks.

Appendix A Summary Form

Duke Energy Ohio Smart $aver NR Custom Program

Completed EMV Fact Sheet

Description of Program

Duke Energy's Non-Residential Smart $aver® Custom Incentive Program (NR Custom) offers financial assistance to qualifying commercial, industrial and institutional customers in the Duke Energy Kentucky (DEK) service territory to enhance their ability to adopt and install cost-effective electrical energy efficiency projects. The Program targets energy saving projects involving more complicated or alternative technologies, or those measures not covered by the non-residential Smart $aver Prescriptive Program. The intent of the program is to encourage the implementation of energy efficiency projects that would not otherwise be completed without the company's technical or financial assistance. The program requires pre-approval prior to the project implementation.

Summary		Strata	Verified Net Savings (kWh)
Region(s)	*Kentucky*	*Lighting*	*9,290,768*
Evaluation Period	*Aug 1, 2015 – Dec 31, 2017*		
Annual kWh Net Savings	*11,341,721*	*Non-lighting*	*2,050,954*
Coincident kW Net Impact - Summer	*1,453*		
Coincident kW Net Impact - Winter	*1,166*		
Net-to-Gross Ratio	*84.7%*		
Process Evaluation	*Yes*		
Previous Evaluation(s)	*N/A*		

Evaluation Methodology

Impact Evaluation Activities

- *58 On-site Measurement & Verification*

Impact Evaluation Findings

- *Energy Realization Rate: 103.5%*
- *Summer Demand Realization Rate: 106.1%*
- *Winter Demand Realization Rate: 101.4%*
- *Net-to-gross: 84.7%*

Process Evaluation Activities

- *Program Staff; 5 interviews with program staff*
- *Trade Allies; 6 in-depth interviews with high volume contractors, telephone surveys with representative sample of 17 trade allies*
- *Participants; 57 telephone surveys*

Process Evaluation Findings

- *Primary source of program awareness is Duke Energy followed by contractors*
- *Satisfaction with program is high among participants and trade allies*
- *Contractor assistance was most valuable program component as rated by participants*
- *Program-provided calculators are being used by participants and contractors*
- *Contractors value the program and use incentives to encourage customers to purchase high efficiency equipment*

Appendix B Survey Instruments

Duke Energy Nonresidential Custom Program
Participant Survey

Sample Variables

CONTACT NAME Primary customer contact name

MEASURE Summary of project measure implemented
1 lighting
2 process
3 compressed air
4 HVAC

MEASURETYPE Type of measure sampled

LIGHTFLAG Customers who will get asked the T12 lighting questions

LIGHTINGTYPE Specific lighting type rebated through the program
QTY Number of measures installed

YEAR The year the measure was completed and paid

MAIL_ADDR, MAIL_CITY, MAIL_ST, MAIL_ZIP The address of the site where the measure was installed

INCENTIVE The amount of the incentive paid for the measure

CONTRACTOR Flag that customer worked with external contractor

1 Worked with contractor
0 Implemented within company

FASTTRACK Flag that customer went through the Custom Fast Track application process

1 Fast track customer
0 Standard process customer

STRATUM
1 Indiana
2 Kentucky
3 Ohio

TOTAL_KWH

PROGRESS

Introduction and Screening

INT01 Hello, my name is [NAME], and I am calling on behalf of Duke Energy. May I speak with [CONTACT NAME]?

01 Yes
02 No

MULTCHK [ASK IF MULTFLAG=1] [INTERVIEWER: Is this the first case of a multiple?

01 Yes, first case
02 No, subsequent case [SKIP TO Q1]

PREAMBLE I'm calling from Tetra Tech, an independent research firm. We were hired by Duke Energy to talk with some of their customers about their participation in the SmartSaver Custom Incentive Program.

Our records indicate that you participated in Duke Energy's SmartSaver Custom Incentive Program that included a [MEASURE] project in [YEAR] at [PREMISE_ADDR]. Are you able to answer questions about your company's participation in this program?

01 Yes, I'm able to answer SKIP TO SCREEN1
02 Yes, but information isn't quite right (specify) SKIP TO SCREEN1
03 No, I'm not able to answer
04 We have not participated [THANK AND TERMINATE 82]
99 Refusal [THANK AND TERMINATE 91]

OTHER_R Is it possible that someone else in your organization would be more familiar with the program or the project that was completed?

01 Yes
02 No [THANK AND TERMINATE 81]
99 Refusal [THANK AND TERMINATE 91]

AVAILABLE_R May I please speak with that person?

01 Yes
02 No (When would be a good time to call back?)
03 We have not participated [THANK AND TERMINATE 82]
99 Refusal [THANK AND TERMINATE 91]

SCREEN1 Were you involved in the decision to complete the [MEASURE] project?

01	Yes	
02	No	[SKIP TO OTHER_R]

PREAMBLE2 Great, thank you. I'd like to assure you that I'm not selling anything, I would just like to ask your opinion about this program. Your responses will be kept confidential and your name will not be revealed to anyone. For quality and training purposes, this call will be recorded.

Program Awareness and Marketing

Q1 [IF MULTCHK=2 SKIP TO MEASCHK] How did you first hear about the SmartSaver Custom Incentive Program? (Select one)

01	Account representative	
02	Business Energy Advisor	
03	Contractor or Vendor	[CONTRACTOR = 1]
04	Email from Duke Energy	
05	Mail from Duke Energy	
06	Colleague/Another business	
07	Conference/Trade Show/Expo	
08	Duke Energy website	
09	Other (specify)	
88	Don't know	

Q2 [ASK IF Q1 = 1, 2 or 3] Did the [response from Q1] provide you with enough information about the program?

01	Yes	SKIP TO Q4
02	No	

Q3 [ASK IF Q1 = 1, 2 or 3] What additional information would you have liked [response from Q1] to provide?

[RECORD VERBATIM]

Q4 [ASK IF Q1<>3] Did you work with a contractor or vendor to implement the [MEASURE] project or did you work with internal staff at your company?

01	Worked with a contractor / vendor	[CONTRACTOR = 1]
02	Internal staff at company	[CONTRACTOR = 0]
03	Both the contractor and internal staff	[CONTRACTOR = 1]
88	Don't know	[CONTRACTOR = 0]

Q5 Before your [MEASURE] project in [YEAR], had you participated in the SmartSaver Program before?

01 Yes
02 No
88 Don't know

Q6 What made you decide to apply to the SmartSaver program?

[RECORD VERBATIM]

Q7 [IF CONTRACTOR=1] Did someone at your company fill out your application for the SmartSaver Custom Incentives program or did your contractor or vendor?

01 Someone at my company
02 Contractor / Vendor
03 Both someone at our company and the contractor
88 Don't know

Q8 Using a scale of 0 to 10, where 0 is "very dissatisfied" and 10 is "very satisfied", how satisfied are you with the process to fill out and submit your application?

___ [RECORD RESPONSE]
77 Does not apply
88 Don't know
99 Refused

Q9 Using the same scale of 0 to 10, where 0 is "very dissatisfied" and 10 is "very satisfied", how satisfied are you with the staff time it took to submit the application and necessary paperwork?

___ [RECORD RESPONSE]
77 Does not apply
88 Don't know
99 Refused

Q10 Using the same scale [OPTIONAL: "of 0 to 10, where 0 is "very dissatisfied" and 10 is "very satisfied"], how satisfied are you with Duke Energy's processing and preapproval of your application?

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

Q11 [IF Q8<=3 OR Q9<=3 OR Q10<=3] What could the program have done differently to make the application process easier?

[RECORD VERBATIM]

Q12 Did you use the Custom-to-Go calculators provided by Duke Energy, or did you calculate energy savings using your own methods? (Select all that apply)

01 Custom-to-Go
02 Own methods
03 Other (specify)
04 Contractor/vendor calculated
88 Don't know

Q12a [ASK IF Q12 = 4] How did the contractor / vendor calculate the energy savings? (Select all that apply)

01 Custom-to-Go calculators provided by Duke Energy
02 Own methods
03 Other (specify)
88 Don't know

Q13 After submitting your initial application for preapproval, did you receive any requests for additional information while Duke Energy was processing your application?

01 Yes (What additional information was requested?)
02 No
88 Don't know

Q14 Was your project under pressure to be completed in a short amount of time?

01 Yes
02 No

Equipment Questions

E1 Was the [MEASURE] part of a newly constructed building or major renovation of an existing facility?

01 Yes [SKIP TO MeasChk]
02 No
88 Don't know
99 Refused

E2 Did the [MEASURE] you purchased replace an existing [MeasureType]?

01 Yes
02 No [SKIP TO MeasChk]
88 Don't know [SKIP TO MeasChk]
99 Refused [SKIP TO MeasChk]

E3 About how old was your existing [MEASURE]?

___ Years
888 Don't know

E4 What condition was your existing [MEASURE] unit when you decided to purchase a new one? (Read list)

01 Operating with no performance issues
02 Operating but in need of repair
03 No longer operating (broken, did not work)
88 Don't know
99 Refused

Net-to-Gross

MeasCHK [ASK IF MULTCHK = 2 ELSE SKIP TO FR1]
[INTERVIEWER QUESTION: Is this case's MEASURE variable the same as a previous case's MEASURE variable?]

1 Yes; Duplicate measure
2 No, New measure [SKIP TO Q4_MULT]

DecisionCHK [ASK IF MeasCHK=1]
Now, thinking about the [MEASURE] project at [PREMISE_ADDR], was the decision making process the same or different from the previous [MEASURE] project we discussed?

1 Same decision making process [SKIP TO INT99]
2 Different decision making process

Q4_MULT [ASK IF MULTCHK=02] Did you work with a contractor or vendor to implement the [MEASURE] project or did you work with internal staff at your company?

01	Worked with a contractor / vendor	[CONTRACTOR = 1]
02	Internal staff at company	[CONTRACTOR = 0]
03	Both the contractor and internal staff	[CONTRACTOR = 1]
88	Don't know	[CONTRACTOR = 0]

FR1 Which of the following is most likely what would have happened if you had not received the incentive from Duke Energy? (Read list)

01 Canceled or postponed the project at least one year
02 Reduced the size, scope, or efficiency of the project
03 Done exactly the same project
04 Done nothing
88 [DO NOT READ] Don't know

FR2 [ASK IF FR1=2] By how much would you have reduced the size, scope, or efficiency of the project? Would you say a small amount, a moderate amount or a large amount?

01 Small amount
02 Moderate amount
03 Large amount
88 Don't know

FR3 [ASK IF FR1=3] Would your business have paid the additional [INCENTIVE AMOUNT] to complete the project on your own?

01 Yes
02 No
88 Don't know

FR4 On a scale of 0 to 10, with 0 being "not at all influential" and 10 being "extremely influential", how would you rate the influence of the following factors on your decision to complete the [MEASURE] project? [RANDOMIZE ORDER]

FR4A The incentive provided by Duke Energy
FR4B The interaction with Duke Energy SmartSaver program representatives
FR4C SmartSaver marketing materials
FR4D [IF Q5=1] Previous experience with the SmartSaver program
FR4E [IF CONTRACTOR=1] Your contractor's or vendor's recommendation

___ Record influence [0-10]
77 Not applicable
88 Don't know
99 Refused

FR5 [ASK IF CONTRACTOR=1] Was there anything your contractor or vendor said to make you choose the equipment that you ended up installing?

01 Yes [SPECIFY: What did they say?]
02 No
88 Don't know

T12 Questions

[Ask if LightFlag = 1, Else skip to SP1]

TL1 Would you have continued using linear fluorescent T12 fixtures if you had not received a financial incentive to upgrade to [LightingType]?

01 Yes
02 No
88 Don't know

TL2 [If TL1 = 1] How long could replacement lamps have allowed you to continue to use T12 fixtures?

___ Months
___ Years

TI3 Were you previously purchasing high Color Rendering Index (CRI) T12 replacement lamps as a means of postponing full fixture replacements?

01 Yes
02 No
88 Don't know

Spillover

[IF MULTCHK=02 SKIP TO INT99]

SP1 Since your participation in the SmartSaver program, did you complete any additional energy efficiency projects at this facility or another facility served by Duke Energy that did not receive incentives through a Duke Energy program?

01	Yes	
02	No	SKIP TO SAT1
88	Don't know	SKIP TO SAT1
99	Refused	SKIP TO SAT1

SP2 What energy efficient products, equipment, or improvements did you install or implement? (Select all that apply)

01 Lighting
02 Heating / Cooling
03 Hot Water
04 Appliances / Office
05 Insulation
06 Motor / Variable Frequency drives (VFDs)
07 Compressed Air
08 Refrigeration
09 Other1 [SPECIFY]
10 Other2 [SPECIFY]
88 Don't know SKIP TO SAT1

[ASK SP3-SP4 FOR EACH MENTIONED IN SP2]

SP3 Can you describe the [SP2] equipment? For example: What was the brand or model? Efficiency rating? Dimensions? or Capacity?

[RECORD VERBATIM]

SP4 How many [SP2] units did you install?

____ [RECORD RESPONSE]

SP5 On a scale of 0 to 10, with 0 meaning "not at all influential" and 10 meaning "extremely influential", how influential was your participation in the SmartSaver program on your decision to complete the additional energy efficiency project(s)?

___ [RECORD RESPONSE]

Customer Satisfaction

SAT1 What would you change about the SmartSaver Custom Incentive Program, if anything? (DO NOT READ, Select all that apply)

01 Would not change anything
02 Remove pre-approval requirement
03 Improve initial processing time
04 Increase rebate amount
05 Other (specify)
88 Don't know

SAT2 [ASK IF SAT1=3] What would you consider to be a reasonable amount of time for processing the initial application?

___ [RECORD VERBATIM]

SAT3 [ASK IF SAT1=4] What percent of the project's cost do you think would be reasonable for the SmartSaver program to pay?

___ [RECORD PERCENT]
888 Don't know
999 Refused

SAT4 Was the incentive you received close to the amount you originally calculated when completing your application?

01 Yes
02 No
88 Don't know

Fast Track Feedback

FT1 [IF FastTrack=1 ELSE SKIP TO SAT5] Our records indicate that your project was reviewed under the SmartSaver program's Custom Fast Track option, where you paid for an accelerated review of your project's application. Is this correct?
[IF NEEDED: "There is typically a several hundred dollars fee for the accelerated review."]

01	Yes	
02	No	[FastTrack = 0] SKIP TO SAT5
88	Don't know	SKIP TO SAT5

FT2 How did you hear about the Smart $aver Custom FastTrack option?

01 Account representative
02 Business Energy Advisor
03 Contractor
04 Other (specify)
88 Don't know

FT3 Why did you choose the Custom Fast Track option?

[RECORD VERBATIM]

FT4 Did you have any difficulty responding to the Custom Fast Track questions or requests?

01 Yes
02 No
03 No follow-up questions were asked
88 Don't know

FT5 [ASK IF FT4=1] What was challenging about responding to the SmartSaver program's requests?

[RECORD VERBATIM]

FT6a Were you involved in the kickoff phone call to discuss the scope of the project or to answer any questions Duke Energy had about your project or the building?

01 Yes
02 No SKIP TO FT8
88 Don't know SKIP TO FT8

FT6b Were you notified in advance of the kickoff phone call what would be discussed or any information you would need available?

01 Yes
02 No
88 Don't know

FT7 [ASK IF FT6b=1] What was discussed during the kickoff call?

[RECORD VERBATIM]

FT8 Did your participation in the Fast Track option allow you to complete your project on schedule?

01 Yes
02 No
88 Don't know

FT9 [ASK IF FT8 = 2] What drove the delay in your project being completed as planned?

[RECORD VERBATIM]

FT9a Will you use the Fast Track option again if you have a project under a tight timeline?

01 Yes
02 No [SPECIFY: Why not?]
88 Don't know

SAT5 Using a scale of 0 to 10, where 0 is "not at all valuable" and 10 is "very valuable", how valuable are the following SmartSaver program components to your organization? [RANDOMIZE LIST]

FOR SAT5A through SAT5G

__ Record value [1-10]
NA Not applicable
DK Don't know
RE Refused

SAT5A Materials describing the program requirements and benefits
SAT5B Communication from SmartSaver program representatives
SAT5C Technical assistance from Duke Energy or SmartSaver program representatives
SAT5D [IF CONTRACTOR=1] Technical assistance from your contractor or vendor
SAT5E The incentive amount compared to your total project cost
SAT5F The worksheet or calculation tools that Duke Energy provides
SAT5G [IF FastTrack=1] The Custom Fast Track application option

[ASK IF MULTIPLE SAT5 COMPONENTS RATED EQUALLY VALUABLE]
[SKIP IF ONE SINGLE COMPONENT IS RATED HIGHEST]
[SKIP IF ALL SAT5 COMPONENTS ARE EQUAL TO ZERO]
SAT7 Which of the following SmartSaver program components is most valuable to your organization? [READ LIST, SELECT ONE] [RANDOMIZE CHOICES]

01 Materials describing the program requirements and benefits
02 Communication from SmartSaver program representatives
03 Technical assistance from Duke Energy or SmartSaver program representatives
04 Technical assistance from your contractor or vendor
05 The incentive amount compared to your total project cost
06 The worksheet or calculation tools that Duke Energy provides
07 The Custom Fast Track application option
88 [DO NOT READ] Don't know
99 [DO NOT READ] Refused

SAT8 Have you recommended the SmartSaver Custom Incentive Program to anyone?

01 Yes SKIP TO SAT10
02 No
88 Don't know

SAT9 If provided the opportunity, would you recommend the SmartSaver Custom Incentive Program to anyone?

01 Yes
02 No
88 Don't know

SAT10 Would you consider participating in the SmartSaver Custom Incentive Program again in the future?

01 Yes
02 No [SPECIFY: Why not?]
88 Don't know [SPECIFY: Please explain.]

SAT11 Considering all aspects of the program, using a scale of 0 to 10, where 0 is "very dissatisfied" and 10 is "very satisfied", how would you rate your overall satisfaction with the SmartSaver Custom Incentive program?

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

SAT12 Why do you say that?

[RECORD VERBATIM]

SAT13 Using a scale of 0 to 10, where 0 is "very dissatisfied" and 10 is "very satisfied", how would you rate your overall satisfaction with Duke Energy?

___ [RECORD RESPONSE]

SAT14 [ASK IF SAT13<=3] Why do you say that?

[RECORD VERBATIM]

FT10 [ASK IF FastTrack = 0 ELSE SKIP TO C1] Duke Energy offers a fast track option where customers can pay a fee to accelerate the review of a project from 4 to 6 weeks to about one week. Before today, were you aware this is now offered?

01 Yes
02 No SKIP TO FT13
88 Don't know SKIP TO FT13

FT11 How did you become aware of the offering?

01 Account representative
02 Business Energy Advisor
03 Contractor / Vendor
04 Other (specify)
88 Don't know

FT12 Why did you choose not to participate in the offering?

[RECORD VERBATIM]

FT13 If you have a project under a tight timeline, would you be willing to pay several hundred dollars for an accelerated review of your SmartSaver application?

01 Yes
02 No [SPECIFY: Why not?]
88 Don't know

FT14 Would you be willing to participate in a meeting or teleconference and respond to requests about the project specifications in a timely manner?

01 Yes
02 No
88 Don't know

FT15 Using a scale of 0 to 10, where 0 is "not at all valuable" and 10 is "very valuable", how valuable would the fast track application option be for future projects?

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

Customer Characteristics

C1 What is the main business activity at [PREMISE_ADDR]?

01 Office/Professional
02 Warehouse or distribution center
03 Food sales
04 Food service
05 Retail (other than mall)
06 Mercantile (enclosed or strip malls)
07 Education
08 Religious worship
09 Public assembly
10 Health care
11 Lodging
12 Public order and safety
13 Industrial/manufacturing [SPECIFY]
14 Agricultural [SPECIFY]
15 Vacant (majority of floor space is unused)
16 Other [SPECIFY]
88 Don't know

C2 Are your company's budget decisions made locally, regionally, nationally, worldwide, or something else?

01 Locally
02 Regionally
03 Nationally
04 Worldwide
05 Other (specify)
88 Don't know

C3 When creating budgets and financial plans, how far into the future does your company plan?

00 Less than 1 year
01 One year
02 Two years
03 Three years
04 Four years
05 Five years
06 More than 5 years
07 Other (specify)
88 Don't know

C4 Does your business' production schedule or business cycle affect when you can implement energy efficiency projects?

[PROBE: A business cycle refers to time periods when your business' activities might be significantly different. For example, a school might have to wait until summer to implement projects, while a manufacturing facility might wait until production is lower."]

01 Yes (Please describe that schedule or cycle)
02 No
03 Don't know

C7 Would you like someone from Duke Energy to contact you directly to provide more information or answer any questions you might have about their energy efficiency programs?

[PROBE: We will not share your responses to this survey, only pass along your contact information]

01 Yes
02 No [SKIP TO C9]

C8_phone To confirm, what's the best number to reach you at?

[RECORD VERBATIM]

C8_name And who should they get in touch with? [Can you spell your name?]

[RECORD VERBATIM]

C9 [IF MULTFLAG=1 SHOW: "[INTERVIEWER, If R has more surveys to complete read: Now I'd like to ask you a smaller selection of questions about another location we have on record for your firm." OTHERWISE READ: "Those are all the questions I have. I'd like to thank you for your help with this survey."]
Do you have any comments you would like to share with Duke Energy?

01 Yes [SPECIFY]
02 No

INT99 That completes the survey, thank you very much for your time.

Duke Energy Midwest SmartSaver Custom Incentive Program
Participating Trade Ally Survey

Sample Variables

CONTACT Primary customer contact name

Company Customer company name

Territory Territory state

Introduction and Screening

INT01 Hello, my name is <NAME> and I am calling on behalf of Duke Energy. May I speak with <CONTACT_NAME, or> the person most familiar with your company's participation in <PROGRAM>?

01 Yes
02 No

PREAMBLE I'm calling from Tetra Tech, an independent research firm. We were hired by Duke Energy to talk with contractors such as yourself about their participation in the SmartSaver Custom Incentive program.

[If needed: We are working with Duke Energy to evaluate their SmartSaver Custom Incentive program. As part of this evaluation, we are speaking to contractors such as yourself. We will be asking about your experience with the program in the past and improvements you would suggest for the future.]

I'd like to assure you that I'm not selling anything, I would just like to ask your opinion about this program. Your responses will be kept confidential and your name will not be revealed to anyone. For quality and training purposes, this call will be recorded.

01 Continue

I1 Are you familiar with the Duke Energy SmartSaver Custom Incentive Program?

01	Yes, I'm able to answer	[SKIP TO C_QAL]
02	Yes, but information isn't quite right (specify)	[SKIP TO C_QAL]
03	No, I'm not able to answer	
04	We have not participated	[THANK AND TERMINATE]
99	Refused	[THANK AND TERMINATE]

OTHER_R Is it possible that someone else in your organization would be more familiar with the program or the project that was completed?

01	Yes	[SKIP TO AVAILABLE_R]
02	No	[THANK AND TERMINATE]
88	Don't' know	[THANK AND TERMINATE]
99	Refused	[THANK AND TERMINATE]

AVAILABLE_R May I please speak with that person?

01	Yes	[SKIP TO INT01]
02	Yes, but R is not currently available	
03	No, we have not participated	[THANK AND TERMINATE]
88	Don't know	[THANK AND TERMINATE]
99	Refused	[THANK AND TERMINATE]

Trade Ally Background

TA1 I want to begin by asking you a few background questions about you and your company.

What is your role at <company>? (Select one)

01	Owner, partner
02	President, vice president
03	Sales
04	Incentive manager
05	Engineer
06	Other (specify)
88	Don't know
99	Refused

TA2 What equipment and services does your company provide to your customers? (Select all that apply)

01 Application completion assistance
02 Architectural and engineering firm
03 Building shell (insulation, window film, windows, doors, etc.)
04 Cool roof
05 Food service
06 HVAC (heating, ventilation, air conditioning, chillers)
07 Information technology
08 Lighting
09 Motors, pumps or drives
10 Performance
11 Plumbing
12 Process (air compressors, injection molding, etc.)
13 Other (specify)
88 Don't know
99 Refused

TA3 In what states do you provide these services? (Select all that apply)

01 Ohio
02 Indiana
03 Kentucky
04 Others (specify)
88 Don't know
99 Refused

TA4 How long has <company> been participating in the Duke Energy SmartSaver Custom Incentive program?

01 Less than 1 year
02 1 to 2 years
03 3 to 5 years
04 More than 5 years
88 Don't know
99 Refused

TA5 About how many projects would you say you have completed through the SmartSaver program since then?

01 Less than 5 projects
02 5 to 9 projects
03 10 to 19 projects
04 20 to 49 projects
05 50 to 99 projects
06 100 projects or more
88 Don't know
99 Refused

TA6 Thinking about the number of projects you did through the program in the last 12 months, do you think the number of 2018 projects will be higher, lower or about the same?

01 Higher
02 Lower
03 About the same
88 Don't know
99 Refused

TA7 Why do you think your 2018 projects will be <TA6 response>?

[RECORD VERBATIM]

TA8 Are you registered with Duke Energy's trade ally network and appear on their website?

[if needed, you would have had to complete a code of conduct and agreement form to appear on Duke Energy's website.]

01 Yes
02 No, [SPECIFY: Why not?]
88 Don't know
99 Refusal

Program Interaction

PI1 Did you receive any training or information from Duke Energy as part of the Custom program?

01 Yes
02 No [SKIP TO PI3]
88 Don't know [SKIP TO PI3]
99 Refusal [SKIP TO PI3]

PI2 Is there any additional training or information Duke Energy could provide?

01 Yes – [SPECIFY: What additional training or information would you like?]
02 No
88 Don't know
99 Refused

PI3 What percent of your customers know about the Custom program prior to you telling them about it?

___ [RECORD 0-100%]
888 Don't know
999 Refused

PI4 Based on your own interactions with customers, how do customers become aware of the SmartSaver Custom program? (Do not read; Select all that apply)

01 Direct contact from <company>
02 Contractor marketing materials such as direct mail, ad, etc.
03 Another contractor
04 Duke Energy bill insert
05 Duke Energy website
06 Duke Energy employee, account representative, customer service representative
07 Colleague, family or friends
08 Program brochure
09 Other (specify)
88 Don't know
99 Refused

PI5 What types of concerns do customers have about the program, if any? (Select all that apply)

01 No concerns
02 Unsure if the equipment qualifies
03 Unsure if the savings will be achieved
04 Unsure if the incentive will be as high as estimated
05 Uncertainty around the preapproval
06 Other (specify)
88 Don't know
99 Refused

PI6 Do you use the program as a sales tool?

01 Yes
02 No SKIP TO AT1
88 Don't know SKIP TO AT1
99 Refusal SKIP TO AT1

PI7 How helpful is the Duke Energy program in selling energy efficient equipment? Do you think it is. . .? [READ LIST]

01 Very helpful
02 Somewhat helpful
03 Neither helpful nor unhelpful
04 Not very helpful
05 Not at all helpful
88 [DO NOT READ] Don't know
99 [DO NOT READ] Refused

Attribution

AT1 Approximately how many projects did you complete through the SmartSaver Custom Incentive program in the past 12 months?

__ [RECORD # OF PROJECTS 0-50]
888 Don't know
999 Refused

AT2 In what percent of your sales situations did you recommend high-efficiency equipment *before* you learned about the SmartSaver Custom Incentive program?

___ [RECORD 0-100%]
888 Don't know
999 Refused

AT3 And in what percent of your sales situations do you recommend high-efficiency equipment now that you have worked with the SmartSaver Custom Incentive program?

___ [RECORD 0-100%]
888 Don't know
999 Refused

AT4 Using a scale from 0 to 10 where 0 is "not at all important" and 10 is "very important", how important was the SmartSaver Custom Incentive program in influencing your decision to recommend high-efficiency equipment to your customers?

__ [RECORD 0-10]
88 Don't know
99 Refused

AT5 And using a scale from 0 to 10 where 0 is “not at all likely” and 10 is “very likely”, how likely is it that you would have recommended the high efficiency equipment to your customers if the SmartSaver Custom Incentive Program had not been available?

__ [RECORD 0-10]
88 Don't know
99 Refused

AT6 And in what percent of your sales situations did the customer choose to go with higher efficiency equipment based on the availability of a Duke Energy rebate?

___ [RECORD 0-100%]
888 Don’t know
999 Refused

AT7 What percent of the projects in the last 12 months where you sold or installed high-efficiency equipment were eligible but DID NOT receive an incentive through a Duke Energy energy-efficiency program?

___ [RECORD 0-100%]
888 Don’t know
999 Refused

AT8 [if AT7 > 0] Did you request an incentive for any of those projects?

01 Yes
02 No [SKIP TO AT10]
88 Don’t know [SKIP TO AT11]
99 Refused [SKIP TO AT11]

AT9 [if AT8 = 1] If you requested an incentive but did not receive one, why was that?

[RECORD VERBATIM RESPONSE]

AT10 [if AT8 = 2] Why did you or your customers not request an incentive for these energy efficiency projects?

[RECORD VERBATIM RESPONSE]

AT11 What percent of your sales in the last 12 months were for each of the following five categories?

a. planned replacement of working equipment?
b. equipment for new facilities?
c. new equipment for existing facilities?
d. failed or emergency equipment replacement?
e. other?

AT11_OTR [if AT11E>0 and AT11E<>888] You mentioned that [from AT11E] percent of your sales were because of some other reason. What were these reasons?

01 Other (Specify)

AT12 [if AT11a > 0 and AT11<>888] Would you say the working equipment you replaced was typically in good, fair, or poor condition?

01 Good
02 Fair
03 Poor
04 Other (specify)
88 Don't know
99 Refused

T12 Lamp Questions

[if TA2 = 8, ask this section, else skip to SA1_INT]

TL1 Next I have a few questions about lighting systems.
Of your linear fluorescent lighting system sales in 2017, what percent were T12s?

___ [RECORD 0-100%]
888 Don't know
999 Refused

TL2 Are you still stocking and selling linear fluorescent T12 lighting systems and replacement lamps?

01 Yes
02 Yes [SPECIFY: Capture any additional contractors comments in TL2 (e.g., yes, but…]
03 No
04 No [SPECIFY: Capture any additional contractors comments in TL2 (e.g., no, but…]
88 Don't know
99 Refused

TL3 [if TL2 = 1 or 2] Thinking of your 2018 sales of linear fluorescent lighting system sales, what percent will be T12s?

___ [RECORD 0-100%]
888 Don't know
999 Refused

Satisfaction

SA1_INT Next I'm going to read a list of aspects related to your experience with the SmartSaver Custom Incentive Program. Using a scale where 0 is "not at all satisfied" and 10 is "very satisfied," how satisfied are you with the following program aspects…

[RANDOMIZE A THROUGH G]

For SA1A THROUGH SA1G
__ [RECORD 0-10]
88 Don't know
99 Refused

a. The time it took to receive pre-approval
b. The pre-approval application process
c. The program process once the project is pre-approved
d. The incentives available through the SmartSaver Custom program
e. The timeliness of rebate payment to customers
f. The training and information received through the program
g. The level of communications with program staff

SA2 Using this same scale (0 being "not at all satisfied" and 10 being "very satisfied"), how satisfied are you with the SmartSaver Custom Incentive program overall?

__ [RECORD 0-10]
88 Don't know
99 Refused

SA3 And how satisfied are you with Duke Energy (if needed: using the same scale where 0 is "not at all satisfied" and 10 is "very satisfied")?

__ [RECORD 0-10]
88 Don't know
99 Refused

SA4 Would you say your communication with Duke Energy program staff was very effective, somewhat effective, neither effective nor ineffective, not too effective, or not at all effective?

01 Very effective
02 Somewhat effective
03 Neither effective nor ineffective
04 Not too effective
05 Not at all effective
88 Don't know
99 Refused

Customer Interaction

CI1 Now I'd like to ask a few questions about your customers.
Based on your experiences, what factors most influence the type of equipment nonresidential customers purchase? (Do not read; Select all that apply)

01 Equipment cost
02 Rebate and incentive availability
03 Contractor recommendation
04 Desire to reduce energy bills
05 Availability of equipment for emergency replacement
06 Equipment specifications
07 Other (specify)
88 Don't know
99 Refused

CI2 Are some nonresidential customers more receptive than others to high efficiency equipment?

01 Yes [PROBE: "What types of customers are more receptive? What types are less receptive?"]
02 No
88 Don't know
99 Refused

CI3 Why do some projects drop out or why do some customers not move forward with projects?

[RECORD VERBATIM RESPONSE]

Program Participation

***Added option of (specify) to choice 03 on 11/08/2017

PP1 How do you typically estimate savings for projects submitted through the SmartSaver Custom program? (Read list; Select all that apply)

[note: the "classic custom calculator" is an Excel sheet (workbook) and the "custom-to-go calculator" is an actual non-Excel based calculator.]

01 Using Duke's custom-to-go calculator
02 Using Duke's classic custom calculator
03 Using your own calculators (specify)
04 Other (specify)
88 Don't know
99 Refused

PP2 [if PP1 = 1] Using a scale from 0 to 10 where 0 is "not at all useful" and 10 is "very useful", how useful is the custom-to-go calculator in estimating energy savings?

[note: the "classic custom calculator" is an Excel sheet (workbook) and the "custom-to-go calculator" is an actual non-Excel based calculator.]

__ [RECORD 0-10]

PP3 [if PP1 = 2] Using a scale from 0 to 10 where 0 is "not at all useful" and 10 is "very useful", how useful is the classic custom calculator in estimating energy savings?

[note: the "classic custom calculator" is an Excel sheet (workbook) and the "custom-to-go calculator" is an actual non-Excel based calculator.]

__ [RECORD 0-10]

PP4 [PP1<>1 OR PP1 <>2, if do not use Duke's custom-to-go or classic custom calculator] Why haven't you used Duke's <fill from PP1: custom-to-go and/or classic custom> calculators?

[RECORD VERBATIM]

PP5 After submitting an application, have you ever received requests for more information?

01	Yes	
02	No	SKIP TO PP7
88	Don't know	SKIP TO PP7
99	Refused	SKIP TO PP7

PP6 [if PP5 = 1] What was the request for?

[RECORD VERBATIM RESPONSE]

PP7 Are there any enrollment paperwork or rebate submission processes that could be simplified to encourage customers to complete projects?

01	Yes	What process could be simplified?
02	No	
88	Don't know	
99	Refused	

PP8 Were you aware there was an online application portal to submit the application online?

01	Yes
02	No
88	Don't know
99	Refused

PP9 [If PP8 = 1] Have you used the online portal?

01	Yes
02	No
88	Don't know
99	Refused

PP10 [if PP9 = 1] Using a scale from 0 to 10 where 0 is "not at all useful" and 10 is "very useful", how useful is the online portal?

__ [RECORD 0-10]

PP11 [if PP9 =02,88,99] Is there anything preventing you from using this portal?

01 Yes What is preventing you from using the portal?
02 No
88 Don't know
99 Refused

PP12 What program aspect is most influential in customers' decision to move forward with the project?

01 The incentive
02 The energy savings
03 The engineering support provided by Duke
04 Other (specify)
88 Don't know
99 Refused

PP13 From your perspective, what is the most valuable part of the SmartSaver Custom Incentive program? (DO NOT READ)

01 The incentive
02 The energy savings
03 The engineering support provided by Duke
04 Other (specify)
88 Don't know
99 Refused

PP14 From your perspective, what part of the SmartSaver Custom Incentive program could be improved?

[RECORD VERBATIM RESPONSE]
77 Nothing

Wrap up

WU1 Do you have any other feedback that you would like to share with Duke Energy about this program?

01 Yes [record comments]
02 No
88 Don't know
99 Refused

INT99 Those are all the questions I have. Thank you for your time.

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DISCLAIMER

This report was prepared by Navigant Consulting, Inc., n/k/a Guidehouse Inc. ("Navigant"),[1] for Duke Energy. The work presented in this report represents Navigant's professional judgment based on the information available at the time this report was prepared. Navigant is not responsible for the reader's use of, or reliance upon, the report, nor any decisions based on the report. NAVIGANT MAKES NO REPRESENTATIONS OR WARRANTIES, EXPRESSED OR IMPLIED. Readers of the report are advised that they assume all liabilities incurred by them, or third parties, because of their reliance on the report, or the data, information, findings, and opinions contained in the report.

[1] On October 11, 2019, Guidehouse LLP completed its previously announced acquisition of Navigant Consulting Inc. In the months ahead, we will be working to integrate the Guidehouse and Navigant businesses. In furtherance of that effort, we recently renamed Navigant Consulting Inc. as Guidehouse Inc.

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. 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:** LED bulbs installed in permanent fixtures. Program measures include A-line, globe, and candelabra lighting products installed onsite at the tenant's premise.
- **Water measures:** Bathroom and kitchen faucet aerators, water-saving showerheads, hot water pipe wrap

For this evaluation cycle, Navigant assessed lighting and water measures installed through the program in the Duke Energy Kentucky (DEK) jurisdiction between July 1, 2017 through July 31, 2019.

Franklin Energy is the implementation contractor for the program. Customers (i.e., property managers) have the option to choose self-installation or direct installation through Franklin Energy. All installation was completed through the direct-install pathway during the period covered by this evaluation. After measures are installed, third-party quality control inspections are completed on about 20 percent of properties in any given month. Within a selected property, the quantity of units to inspect is based on property size as defined by the number of housing units.

1.2 Evaluation Objectives and Program-Level Findings

Navigant's evaluation included assessing the program impacts, structure, and delivery. For this Evaluation, Measurement, and Verification (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 provides 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.

Navigant found that Duke Energy is successfully delivering the Multifamily Energy Efficiency Program to customers, participant satisfaction is favorable, and the reported measure installations are accurate.

For the evaluation period covered by this report, there were a total of 1,122 housing units at 8 participating properties. The program-level evaluation findings are presented in Table 1 and Table 2. As shown in Table 1, Navigant found the realization rate for gross energy savings to be 97 percent, meaning that total verified gross energy savings were found to be slightly lower than claimed in the tracking database provided by Duke Energy.

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 and Demand Impacts

DEK Gross Impacts	Reported (ex ante)	Verified (ex post)	Realization Rate
Energy Savings (MWh)	788	762	97%
Summer Peak Demand Savings (MW)	0.072	0.065	90%
Winter Peak Demand Savings (MW)	0.116	0.085	74%

Source: Navigant analysis, totals subject to rounding.

Table 2. Program Evaluated Net Energy and Demand Impacts

DEK Net Impacts	Verified Net Impact
Energy Savings (MWh)	758
Summer Peak Demand Savings (MW)	0.065
Winter Peak Demand Savings (MW)	0.085

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.[2] The evaluated parameters are summarized in Table 3. For field and phone verification, the expected sampling confidence and precision was 90 percent ± 10 percent, and the achieved was 90 percent ± 7.8 percent.

[2] A billing analysis was also considered, but Navigant determined that the engineering-based approach was appropriate for the evaluation objectives due to the frequency of tenant turnover at multifamily facilities and the small impact of energy savings from program measures relative to annual facility energy consumption.

Table 3. Evaluated Parameters

Evaluated Parameter	Description	Details
Efficiency Characteristics	Inputs and assumptions used to estimate energy and demand savings	1. LED wattage 2. LED operating hours 3. Aerator flow rates (gpm) 4. Showerhead flow rates (gpm) 5. Water temperature (F) 6. Pipe wrap length (ft)
In-Service Rates	The percentage of program measures in use as compared to reported	1. LED, 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	1. Property Manager Interviews
Spillover	Additional, non-reported savings that occurred as a result of participation in the program	1. Property Manager Interviews Tenant Phone Surveys

This evaluation covers program participation from July 1, 2017 through July 31, 2019 and is the first evaluation of this program by Navigant. Table 4 shows the start and end dates of Navigant's sample period for evaluation activities.

Table 4. Sample Period Start and End Dates

Activity	Start Date	End Date
Field Verification	September 16, 2019	October 11, 2019
Tenant Phone Surveys	September 6, 2019	September 20, 2019
Property Manager Interviews	September 9, 2019	October 23, 2019

1.4 Evaluation Considerations and Recommendations

Navigant developed a few recommendations for Duke Energy to consider. 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.

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. Duke Energy should consider improving the program materials distributed to tenants that describe the program measures and energy savings that might be achieved due to the installation of the new equipment. Communicating tips to save energy and water with the new equipment could increase customer satisfaction and continue to build the strong trust and rapport Duke Energy has established with their customer base.
3. Duke Energy should consider leaving a few cases of backup LED bulbs with property managers. Some tenants removed LEDs and burnout was the primary reason for the removal. Leaving additional LEDs with property managers could help increase the customer satisfaction rate for this measure.
4. Duke Energy should consider whether smart thermostats or other HVAC-related measures would be reasonable offerings for this program. About 43 percent of survey respondents who did not have a smart thermostat indicated they would like to get one. Also, three out of four property managers recommended adding exterior and common area lighting to the program, so they can continue to make their properties energy efficient.
5. Duke Energy should consider making modifications to the Multifamily Energy Efficiency Program Direct Installation Service Agreement to include information about EM&V activities that may occur in the months or years following program participation. Navigant experienced significant resistance from property managers while recruiting for onsite field verification and process evaluation interviews. Many property managers indicated they had already received multiple site visits during the implementation phase and subsequent QC inspections, and that it was a challenge to accommodate additional inspections and interviews for EM&V.

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 performing energy efficiency upgrades may be realized by the tenant whereas the incremental costs are absorbed by the owner.

Duke Energy's Multifamily Energy Efficiency Program provides energy efficient equipment at no cost to multifamily housing property owners. 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:** LED bulbs installed in permanent fixtures. Program measures include A-line, globe, and candelabra lighting products installed onsite at the tenant's premise.

- **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[3] 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 the time for Energy Advisors to determine the type of measures along with associated quantities that can be installed. One 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 entered into a tracking database.

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. Franklin Energy records the baseline characteristics (e.g. lamp type wattage, aerator flow rates) for a sample of measures removed and makes that information available to Duke Energy and Navigant for evaluation purposes.

[3] 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.

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 stated 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, a third-party inspector, Thorpe Services, conducts inspections 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.

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. 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 primary purpose of the evaluation, measurement, and verification (EM&V) assessment is to estimate net annual energy and demand impacts associated with participation from July 1, 2017 through July 31, 2019. 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

Key impact and process research questions to be explored include:

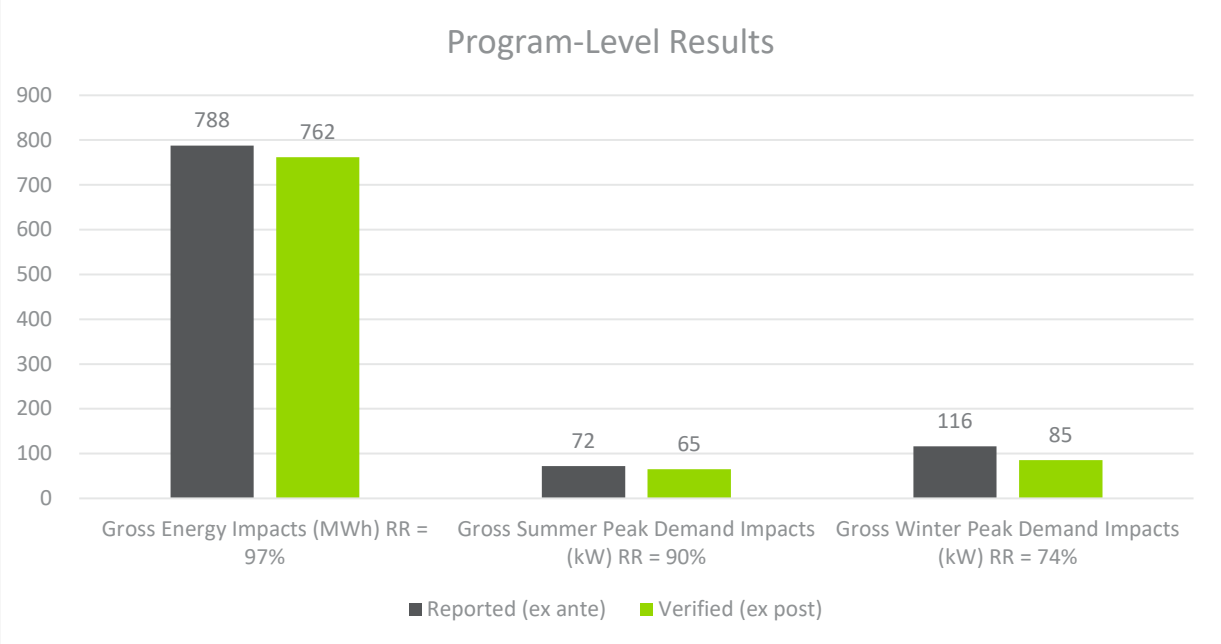
- Is the program achieving targeted energy and demand savings at the measure level?
- How do customers learn about the program, and can participation be increased?
- How is the persistence of savings impacted by participant removal of measures installed through the program?
- Are there opportunities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

4. IMPACT EVALUATION

4.1 Impact Results

Figure 1 shows the program-level results for gross energy and demand savings. Table 5 shows a more complete list of program-level findings. The evaluation team calculated the results in Table 5 by multiplying the measure quantities found in the tracking database by the verified energy and demand savings estimated during the EM&V process 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.

Figure 1. Reported and Verified Gross Program-Level Impacts



Source: Navigant analysis, totals subject to rounding.

Table 5. Summary of Program Impacts

	Energy (MWh)	Summer Coincident Demand (MW)	Winter Coincident Demand (MW)
Verified Gross Impacts	762	0.065	0.085
Verified Net Impacts	758	0.065	0.085

Source: Navigant analysis, totals subject to rounding.

At the measure level, there were considerable differences between ex ante and ex post impacts, which is a result of these measures being evaluated for the first time.

A summary of each measure's contribution to program energy savings and realization rate between reported savings and verified savings is shown in Table 6.

Table 6. Distribution of Program Gross 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
A-Line LED	6,652	174	22%	327	189%
Candelabra LED	1,454	38	5%	45	119%
Globe LED	2,527	64	8%	76	119%
Bathroom Faucet Aerator	833	121	15%	29	24%
Kitchen Faucet Aerator	500	61	8%	69	115%
Low Flow Showerhead	517	139	18%	159	115%
Water Heater Pipe Wrap (ft)	3,270	193	24%	57	30%
Total	15,753	788	100%	762	97%

Source: Navigant analysis, totals subject to rounding.

The results for gross summer coincident demand by measure are shown in Table 7.

Table 7. Distribution of Summer Coincident Demand Savings by Measure

Measure	Total Savings from Tracking Data (kW)	Share of Total Savings from Tracking Data	Total Verified Ex Post Gross Savings (kW)	Realization Rate
A-Line LED	17	24%	27	155%
Candelabra LED	8	10%	7	87%
Globe LED	6	9%	11	174%
Bathroom Faucet Aerator	10	13%	2	26%
Kitchen Faucet Aerator	5	7%	5	95%
Low Flow Showerhead	11	15%	7	63%
Water Heater Pipe Wrap (ft)	15	21%	7	43%
Total	72	100%	65	90%

Source: Navigant analysis, totals subject to rounding.

The results for gross winter coincident demand by measure are shown in Table 8.

Table 8. Distribution of Winter Coincident Demand Savings by Measure

Measure	Total Savings from Tracking Data (kW)	Share of Total Savings from Tracking Data	Total Verified Ex Post Gross Savings (kW)	Realization Rate
A-Line LED	38	33%	43	112%
Candelabra LED	5	5%	8	149%
Globe LED	14	12%	14	99%
Bathroom Faucet Aerator	14	12%	2	18%
Kitchen Faucet Aerator	7	6%	5	66%
Low Flow Showerhead	16	14%	7	44%
Water Heater Pipe Wrap (ft)	22	19%	7	30%
Total	116	100%	85	74%

Source: Navigant analysis, totals subject to rounding.

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:

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. Duke Energy provided Navigant with a spreadsheet containing the deemed savings estimates for LED and water measures, as well as some of the inputs used to develop those estimates. The deemed savings for LED measures are shown in Table 9 below.

Table 9. Ex Ante Savings Estimates for LED Measures

LED Measure	Annual Gross Energy Savings (kWh)	Winter Coincident Demand Impacts (kW)	Summer Coincident Demand Impacts (kW)	Annual Non-Coincident Demand Impacts (kW)
Candelabra (per lamp)	26.0	0.004	0.005	0.005
Globe (per lamp)	25.1	0.006	0.003	0.006
A-Line (per lamp)	26.1	0.006	0.003	0.006

Source: Duke Energy

Duke Energy also provided Navigant with the wattages of LED products, and the average baseline lamp wattages from the sample recorded by Franklin Energy, as shown in Table 10.

Table 10. Baseline and Efficient Wattage Values for LEDs

Measure	Baseline Lamp Wattage	Efficient (LED) Lamp Wattage
Candelabra (per lamp)	40.0	5
Globe (per lamp)	40.5	6
A-Line (per lamp)	59.9	9

Source: Duke Energy, values subject to rounding

The deemed savings values for LEDs were sourced from Duke Energy's Specialty Online Bulb Store and Home Energy House Call programs. Navigant performed a high-level review of the deemed savings and calculated impacts using equations from the 2015 Indiana Technical Reference Manual (TRM), as well as calculation parameters found in a 2018 evaluation report of Duke Energy Ohio's (DEO's) Online Savings Store and Free LED programs.

Similar to other evaluation reports and the 2015 Indiana TRM, Navigant used standard lighting equations to assess impacts for LED measures, as shown in Equation 1 and Equation 2.

Equation 1. Energy Savings Algorithm for LEDs

$$kWh\ savings = \left[\frac{(Watts_{base} - Watts_{EE})}{1000}\right] \times ISR \times HOU \times (1 + HVAC_C)$$

Equation 2. Coincident Demand Savings Algorithm for LEDs

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

Where the parameters are defined as:

$Watts_{base}$ = wattage of baseline lamp removed
$Watts_{EE}$ = wattage of LED lamp installed
ISR = in-service rate
HOU = annual operating hours
$HVAC_C$ = HVAC system interaction factor for energy
$HVAC_D$ = HVAC system interaction factor for demand
CF = coincidence factor (summer and winter)

Navigant's review of the LED ex ante savings found that the estimates were reasonable, but that the ex post values were likely to differ because the measures had not been evaluated before. Also, Navigant recognized that the evaluated impacts for LEDs may exceed the ex ante deemed impacts when accounting for the actual wattage of the products removed since the Multifamily Energy Efficiency Program is a direct install program.

Duke Energy also provided Navigant with the deemed savings estimates for water measures shown in Table 11.

Table 11. Ex Ante Savings Estimates for Water Measures

Measure	Annual energy savings (kWh)	Annual Winter Coincident demand savings (kW)	Annual Summer Coincident demand savings (kW)	Annual Non-Coincident demand savings (kW)
Faucet Aerators MF Direct 1.0 GPM - bath (per aerator)	145	0.017	0.012	0.017
Faucet Aerators MF Direct 1.0 GPM – kitchen (per aerator)	121	0.014	0.010	0.014
LF Showerhead MF Direct 1.5 GPM (per showerhead)	268	0.031	0.021	0.031
Pipe Wrap MF Direct (per linear foot)	59	0.007	0.005	0.007

Source: Duke Energy

4.2.2 Onsite Field Verification and Phone Verification

Navigant performed onsite field verification at 68 housing units across 6 participating properties spanning both the DEK and DEO territories.[4] Of these, 32 of the housing units at 3 properties were in DEK, and the remainder in DEO. Navigant also conducted phone verification with 64 tenants, 30 of which were in DEK and the remainder in DEO. Field and phone 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 demand savings for individual measures. Table 12 shows a summary of the parameters assessed by Navigant during field verification, and Table 13 shows the combined field and phone verification sample, which was used to evaluate ISRs for each measure.

[4] Duke Energy has informed Navigant that DEK evaluations can include data gathered from simultaneous evaluation efforts in DEO.

Table 12. Parameters Evaluated During Field Verification

	LEDs	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 length				x
Measure location	x	x	x	x

Table 13. Field and Phone Verification Sample

Program Measure	Number of Housing Units in Sample	Number of Measures Reported in Sample
LEDs	122	1,115
Bathroom Faucet Aerators	72	102
Kitchen Faucet Aerators	78	78
Showerheads	72	77
Pipe Wrap	58	395 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 64 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 LED Lighting Measures

Table 14 shows a summary of Navigant's ex-post, verified findings for LEDs. To calculate verified energy and demand impacts, Navigant applied the parameters from Table 14 to the algorithms from Equation 1 and Equation 2.

Table 14. Summary of LED findings

Evaluation Parameter	Source	A-Line	Candelabra	Globe
In-Service Rate	Navigant field and phone verification	0.97	1.00	0.97
Baseline Lamp Wattage	Duke Energy	60	40	41
Efficient Lamp Wattage	Navigant field verification	9	5	6
Annual Operating Hours	2018 Evaluation Report of DEO's Online Savings Store and Free LED programs	1,001	888	888
Summer Coincidence Factor	2018 Evaluation Report of DEO's Online Savings Store and Free LED programs	0.07	0.11	0.11
Winter Coincidence Factor	2018 Evaluation Report of DEO's Online Savings Store and Free LED programs	0.13	0.16	0.16
$HVAC_C$	2018 Evaluation Report of DEO's Online Savings Store and Free LED programs	-0.0058	-0.0058	-0.0058
$HVAC_D$ (summer)	2018 Evaluation Report of DEO's Online Savings Store and Free LED programs	0.167	0.167	0.167
$HVAC_D$ (winter)	2018 Evaluation Report of DEO's Online Savings Store and Free LED programs	0	0	0
Gross Energy Savings Per Lamp (kWh)		49.2	30.9	30.0
Gross Summer Coincident Demand Savings Per Lamp (kW)		0.0040	0.0045	0.0044
Gross Winter Coincident Demand Savings Per Lamp (kW)		0.0064	0.0056	0.0054

Source: Navigant analysis, totals subject to rounding

4.3.1.1 In-Service Rate

At the 68 housing units inspected by Navigant that had LEDs, there were a total of 523 reported program LEDs in the tracking database. During the inspections, Navigant found 510 of the program LEDs. Additionally, during phone surveys with tenants, Navigant interviewed customers representing an additional 605 LEDs, and respondents indicated having removed 14 program LEDs for reasons ranging from burnout to personal preference. Navigant used a weighted average to combine the ISR from field verification with the ISR from phone surveys to calculate a final ISR.

4.3.1.2 Wattage

Duke Energy provided Navigant with wattage data from lamps removed during the retrofit process. This data was collected by Franklin Energy from a sample of participant sites. Since this program is a direct install program, we used this data for the baseline wattage in the impact calculations.

4.3.1.3 Waste Heat and Coincidence Factors

Navigant used the waste heat factors from the DEO's 2018 evaluation of the Online Savings Store and Free LED programs.

4.3.1.4 Lighting Hours of Use

Navigant used the annual hours of use from DEO's 2018 evaluation of the Online Savings Store and Free LED programs. Those evaluations included lighting logger studies in the DEO territory, and results were similar to those found in the 2015 Indiana TRM.

4.3.1.5 Effect of Baseline Wattage Requirements for EISA

Due to the EISA standards and changing market for lighting, the baseline wattage for energy efficiency lighting programs will continue to decrease. If Duke Energy continues to collect information about the wattage of lamps removed during the retrofit process, Navigant believes it is reasonable to use those values in future evaluations as necessary because this is a direct install program. In the absence of baseline data, it will be reasonable to incorporate EISA standards into baseline wattage values.

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 specified flow rates of the retrofit equipment.

4.3.2.1 In-Service Rate

The ISRs for water measures are shown in Table 15. These were calculated using a weighted average of results from the onsite field verification inspections and the tenant phone surveys.

Table 15. In-Service Rates for Water Measures

Measure	ISR
Kitchen aerators	0.95
Bathroom aerators	0.93
Showerheads	0.97
Pipe wrap	0.94

Source: Navigant analysis, values subject to rounding

4.3.2.2 Energy-Savings

To calculate verified savings for aerators and showerheads, Navigant used the algorithms from the 2015 Indiana Technical Reference Manual, shown in Equation 3, Equation 4, Equation 5 and Equation 6.[5] Navigant subsequently applied inputs collected during field verification or assumptions as listed below in Table 16. The resulting estimates for impacts of aerators and showerheads are presented in Table 17.

Equation 3. Algorithm for Calculating Energy Savings for Faucet Aerators

$$\boldsymbol{Annual\ kWh\ savings\ faucet\ aerators} = \boldsymbol{ISR} \times (\boldsymbol{GPM_{base}} - \boldsymbol{GPM_{low}}) \times \mathbf{MPD} \times \frac{\boldsymbol{PH}}{\boldsymbol{FH}} \times \boldsymbol{DR}\ \times \mathbf{8.3}\frac{\boldsymbol{Btu}}{\boldsymbol{gal}\cdot{}^{\circ}\mathbf{F}} \times (\boldsymbol{T_{mix}} - \boldsymbol{T_{in}})\ \times \frac{\mathbf{365}\frac{\boldsymbol{days}}{\boldsymbol{yr}}}{\boldsymbol{RE}\ \times \mathbf{3,412}}$$

[5] Navigant believes the Indiana TRM is the most appropriate regional source to use for this evaluation because it includes calculation parameters that are specific to the multifamily housing segment.

Equation 4. Algorithm for Calculating Energy Savings for Showerheads

$$\textit{Annual kWh savings for low flow showerheads} = ISR \times (GPM_{base} - GPM_{low}) \times MS \times SPD \times \frac{PH}{FH} \times 8.3\frac{Btu}{gal\cdot°F} \times (T_{mix} - T_{in}) \times \frac{365\frac{days}{yr}}{RE \times 3,412}$$

Equation 5. Algorithm for Calculating Coincident Demand Savings for Faucet Aerators

$$\textit{Coincident kW savings for faucet aerators} = ISR \times (GPM_{base} - GPM_{low}) \times 60 \times DR \times 8.3\frac{Btu}{gal\cdot°F} \times \frac{(T_{mix} - T_{in})}{RE \times 3,412} \times CF$$

Equation 6. Algorithm for Calculating Coincident Demand Savings for Showerheads

$$\textit{Coincident kW savings for low flow showerheads} = ISR \times (GPM_{base} - GPM_{low}) \times 60 \times 8.3\frac{Btu}{gal\cdot°F} \times \frac{(T_{mix} - T_{in})}{RE \times 3,412} \times CF$$

Table 16. Input Parameters and Assumptions for Aerator Savings Calculations

Input	Definition	Value	Source
ISR	In-service rate	Refer to Table 15	Navigant field verification and phone surveys
GPM_{base}	Baseline flow rate	Bathroom Aerators 2.0 Kitchen Aerator 2.2 Shower 2.5	Data Provided by Duke Energy from Franklin Energy Sample
GPM_{low}	Retrofit flow rate	Bathroom Aerators 1.0 Kitchen Aerator 1.0 Shower 1.5	Navigant field verification[a]
MPD	Minutes of aerator use per day	Kitchen 4.5 Bathroom 1.6	2015 Indiana TRM
MS	Minutes of shower use per person per shower	7.8	2015 Indiana TRM
PH	Number of people per household	1.83	2015 Indiana TRM
FH	Average number of aerators or showerheads per household	Kitchen 1.0 Bathroom 1.3 Shower 1.0	Navigant field verification
SPD	Number of showers per person per day	0.6	2015 Indiana TRM
DR	Percent of water flowing down drain	Kitchen 50% Bathroom 70% Shower 100%	2015 Indiana TRM
T_{mix}	Temp of water flowing from faucets (F)	Kitchen 93 Bathroom 86 Shower 101	2015 Indiana TRM
T_{in}	Temp of water entering water heater (F)	60	Building American Benchmark annual mains temp for Cincinnati
RE	Recovery efficiency of water heater	0.98	2015 Indiana TRM
CF	Coincidence Factor	Kitchen 0.0033 Bathroom 0.0012 Shower 0.0023	2015 Indiana TRM
60	Minutes per hour		

a. *Navigant measured flow rates during onsite field verification and found them to be lower than the nameplate value of the program devices. However, since the baseline values provided by Duke Energy are also nameplate and the Indiana TRM equation does not include a throttling factor, Navigant used the nameplate flow rates for impact calculations.*

Table 17. Verified Per Unit Impacts for Aerators and Showerheads[6]

Measure	Kitchen aerator (1.0 GPM)	Bathroom aerator (1.0 GPM)	Low flow showerhead (1.5 GPM)
Gross Energy Savings Per Device (kWh)	138.6	34.3	307.2
Gross Summer Coincident Demand Savings Per Device (kW)	0.0091	0.0030	0.0136
Gross Winter Coincident Demand Savings Per Device (kW)	0.0091	0.0030	0.0136

Source: Navigant analysis, values subject to rounding

4.3.3 Water Heater Pipe Wrap

During field verification, Navigant found some instances where pipe wrap was installed at lengths greater than three feet on cold water pipe. Industry standards are to install pipe wrap on all hot water pipes, and only the first three feet of the cold-water pipe because savings are minimal from insulating cold water pipes.[7] Therefore, when calculating the ISR, Navigant did not count savings from pipe wrap of greater than three feet installed on cold water pipes.

To estimate impacts from the pipe wrap measure, Navigant used algorithms from the 2015 Indiana TRM shown in Equation 7 and Equation 8 below. The ex-post impacts are shown in Table 18.

Equation 7. Energy savings for water heater pipe wrap

$$\Delta kWh = ISR \times \left(\frac{1}{R_e} - \frac{1}{R_n}\right) \times (L \times C) \times \Delta T \times 8760 \div nDHW \div 3413$$

Equation 8. Demand savings from water heater pipe wrap

$$\Delta kW = \Delta kWh \div 8760$$

The following list defines the parameters used in the equations above:

ISR = in-service rate (0.94 from Navigant field and phone verification)
R_e = R-value of existing, uninsulated pipe (R = 1 from Indiana TRM)
R_n = insulation R-value of pipe after retrofit (R = 3 from Indiana TRM)
L = length of pipe (per foot)
C = circumference of pipe (Navigant assumed average of 0.5" and 0.75" diameter pipe)
ΔT = temperature difference between water in pipe and ambient air (65F from Indiana TRM)
nDHW = heat recovery efficiency (0.98 from Indiana TRM)
3,413 = conversion from Btu to kWh

[6] The program may offer aerators and showerheads at other flow rates in the future. 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 17, so a verified savings are shown here for only those measures..

[7] In apartments, Navigant recognizes there's a higher likelihood of limited exposed pipe, therefore pipe wrap may be found on both the hot and cold inlet pipes.http://www.energy.gov/energysaver/projects/savings-project-insulate-hot-water-pipes-energy-savings

Table 18. Verified Impacts for Water Heater Pipe Wrap

Measure	Water Heater Pipe Wrap (per foot)
Gross Energy Savings Per Foot (kWh)	17.5
Gross Summer Coincident Demand Savings Per Foot (kW)	0.0020
Gross Winter Coincident Demand Savings Per Foot (kW)	0.0020

Source: Navigant analysis, values subject to rounding

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 19 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 and very similar to other evaluations or multifamily direct install programs. Navigant chose to present a program-level NTG ratio rather than measure level due to the difficulty in estimating spillover by measure. Navigant believes it is more appropriate to present the NTG ratio in aggregate.

Table 19. NTG Results

Estimated Free Ridership	1.2%
Estimated Spillover	0.7%
Estimated NTG	0.99

Source: Navigant analysis, values subject to rounding

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 several other Duke Energy programs. Navigant primarily targeted property managers for the NTG surveys, because they are the decision makers for participation in the program.[8] 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.

[8] 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.

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 9:

Equation 9. Net-to-Gross Formula

$$NTG = 1 - free\ ridership + spillover$$

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

5.1.2 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 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.[9] Navigant then calculated a weighted average from each respondent based on their share of sample energy savings and divided

by 100 to convert the scores into a free ridership percentage. Next, a timing multiplier was applied to the average of the three scores to reflect the fact that respondents indicating that their energy efficiency actions would not have occurred until far into the future may be overestimating their level of free ridership. Participants were asked 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.[10] 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 Duke Energy.
- **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.

[9] Scores were calculated by the following formulas:

- Likelihood: The likelihood score is 0 for those that "definitely would NOT have installed the same energy efficient measure" and 1 for those that "definitely WOULD have installed the same energy efficient measure." For those that "MAY HAVE installed the same energy efficient measure," the likelihood score is their answer to the following question: "On a scale of 0 to 10, where 0 is DEFINITELY WOULD NOT have installed and 10 is DEFINITELY WOULD have installed the same energy efficient measure, can you tell me the likelihood that you would have installed the same energy efficient measure?" If more than one measure was installed in the project, then this score was also multiplied by the respondent's answer to what share they would have done.
- Prior Planning: If participants stated they had considered installing the measure prior to program participation, then the prior planning score is the average of their answers to the following two questions: "On a scale of 0 to 10, where 0 means you 'Had not yet planned for equipment and installation' and 10 means you 'Had identified and selected specific equipment and the contractor to install it,' please tell me how far along your plans were" and "On a scale of 0 to 10, where 0 means 'Had not yet budgeted or considered payment' and 10 means 'Already had sufficient funds budgeted and approved for purchase,' please tell me how far along your budget had been planned and approved."
- Program Importance: This score was calculated by taking the maximum importance on a 0 to 10 scale of the four program importance questions and subtracting from 10 (i.e., the higher the program importance, the lower the influence on free ridership).

[10] Navigant believes a two-year horizon is appropriate for assessing free ridership as it likely reduces certain types of bias and it becomes difficult for respondents to predict behavior beyond that horizon.

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.[11]

5.1.4 Combining Results Across Respondents

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

- 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. Navigant completed surveys with 7 property managers, who represented 8 of the 26 total participating properties in DEK and DEO.[12] Three of the 7 property managers were from participating properties located in DEK.

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 1.2 percent, which is in-line with other evaluations of direct install programs.

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: Four of the respondents indicated they had some level of prior plans for installing some of the energy efficient measures, but indicated their plans were not well-developed. The other three respondents indicated that they did not have plans.

Program Importance: Respondents stated that the program was very important in having the measures installed. All property managers noted that their decision to install energy efficient equipment at their property was highly influenced by Duke Energy's program.

Likelihood: Respondents were asked in the absence of the program, if they would have had at least some of the work done. Five respondents stated they "definitely would not have" installed the same measures in the absence of the program, one said they "may have" and one said they "definitely would not have" installed any measures in the absence of the program.

[11] 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 LEDs 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.

[12] One property manager was responsible for two properties.

Timing: Of the two respondents who stated they would have done some of the work in the absence of the program, one stated the installation would not have occurred for 2-4 years, and the other stated it would have occurred within one year but that the work would have only applied to water measures and not LED measures.

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, and the free ridership estimates account for those responses.

5.2.3 NTG Results

The NTG ratio was calculated as written in Equation 10:

Equation 10. Net-to-Gross Ratio

$$NTG = 1 - free\ ridership + spillover = 1 - 0.0123 + 0.0070 = 0.9947$$

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

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 64 program participants, detailed surveys with 7 property managers. The property manager interviews and tenant surveys were also used to inform the NTG analysis.

6.1 Key Findings

Overall, property managers and tenants are pleased with the program. Some key findings from the property manager interviews and tenant phone surveys are listed below:

- Most tenants (78 percent) learned about the program through their property managers, while about 2 percent of tenants reported learning about the program through Duke Energy's website. Some participants also recall learning about the program because they saw representatives onsite, indicating that onsite visits are an effective way of marketing the program and reaching new customers.
- 39 percent of tenants reported they noticed savings on their energy bills since the installation of the measures, but 17 percent are unsure if their bill has decreased. The phone survey was conducted shortly after the measure installations at some properties, meaning some customers may not have recognized savings at the time of the survey.
- A majority of program tenants were satisfied with the program. On a scale of 0 to 10, where 0 indicates "very dissatisfied" and 10 indicates "very satisfied":
    - About 66 percent of tenant reported an 8 -10 satisfaction score with the overall program. The mean satisfaction score was 8.0 out of 10.
    - About 76 percent of tenants reported an 8 - 10 satisfaction score with the installer's quality of work.
    - About 86 percent of tenants reported an 8 - 10 satisfaction score 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, such as low water pressure for aerator measures.
- Tenant satisfaction was higher for pipe wrap and kitchen faucet aerators than for LEDs, low flow showerheads and bathroom faucet aerators.
- On a scale of 0 to 10, where 0 indicates "very dissatisfied" and 10 indicates "very satisfied", the average satisfaction rating from property managers was 8.1 for the program.
- Property managers expressed high satisfaction with the free program measures and free installation by an external contractor. Property managers noted the contractor's quality of work as "efficient."
- Three out of the seven property managers mentioned they were slightly frustrated with the number of requests to audit the installation of program measures.
    - "It seems like there are a lot of people wanting to come back to review. I have to keep bothering the tenants. A third party has gone onsite twice to audit this year."
    - "There were multiple requests to come back and get into the units."

- One property manager indicated that installation staff did not properly install aerator equipment, which resulted in leaks.
- General suggestions for program improvement from property managers and maintenance staff included adding exterior or common space lighting.

6.2 Documentation Review

Navigant requested program documentation and tracking data to conduct a complete review of current processes. The program tracking data was sufficient to identify the measure characteristics and quantities of installed measures for each tenant at the participating properties.

Navigant performed a detailed review of the following:

Multifamily Energy Efficiency Program Direct Installation Service Agreement – this document provides a reasonable summary of program expectations, eligibility requirements for each measure, and customer responsibilities. However, it does not include any mention of subsequent EM&V activities, which may be an added benefit for facilitating efficient EM&V.

Site Assessment Reports – these documents include a summary of program measure characteristics and facility floorplan information for each participating property.

6.3 Coordination with Duke Energy Program Manager and Franklin Energy Implantation Staff

Navigant coordinated with Duke Energy's program manager and Franklin Energy implementation staff while recruiting for onsite field verification. Both were helpful with assisting Navigant in customer outreach for EM&V.

6.4 Tenant Surveys

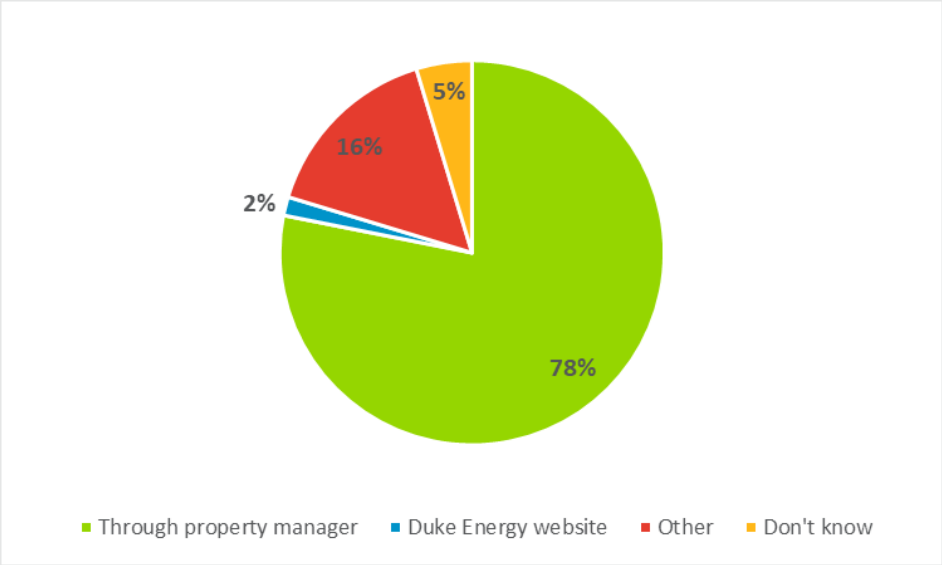
Navigant conducted phone surveys with 64 residential tenants to assess program satisfaction. Navigant had the goal of receiving 100 survey responses. However, due to limited sample and numerous call back attempts through a survey house, overall survey completes fell short of the target. The results of the dialing attempts are outlined in Table 20. The surveys contained a number of questions to assess satisfaction with program participation, satisfaction with new equipment, as well as questions to assess measure baseline and any measures removed by the tenant after participation.

Table 21. Dialing results

Dialing Attempts	Count
Saved Callback (mid survey)	103
No answer	598
Busy	184
Disconnect/Wrong #/Blocked #	132
Business/Government	25
Deaf/Language Barrier	17
Answering machine	3571
Initial refusal (Opted Out)	14
Respondent Refused	381
Callback for correct person	50
Changed number	0
Total Dialings	5161

Customer outreach is a key driver to program participation. 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 these factors. Figure 2 shows how tenants learned about the program. Tenant participants were asked to indicate all of the sources through which they learned about the program, and about 78 percent indicated they heard about the program through property managers as would be expected given the program model. Tenants also indicated they learned about the program though Duke Energy's website, and onsite visits from representatives.

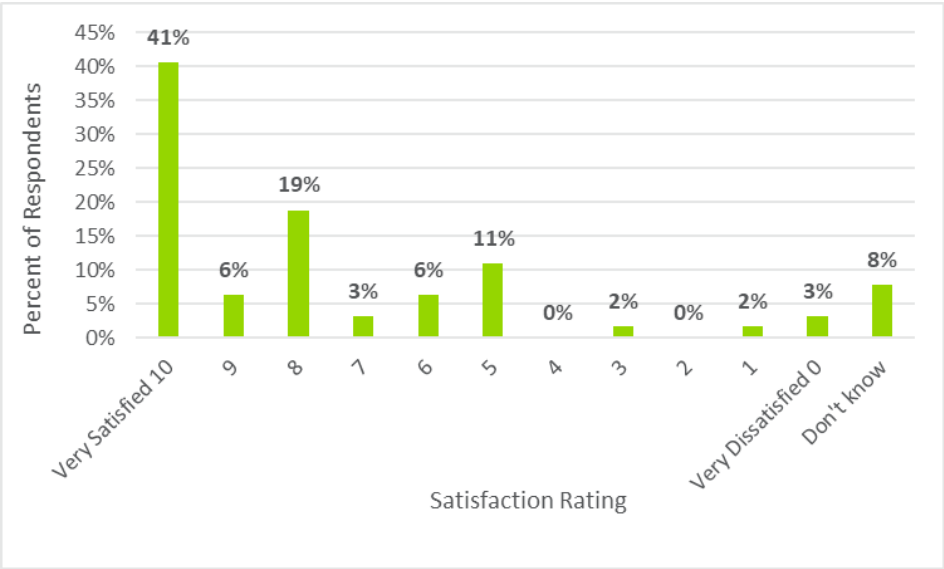
Figure 2. How Tenants Learned About the Program (n=64)



Source: Navigant analysis, values subject to rounding

Survey results showed tenant satisfaction with the program is high. On a scale of 0 to 10, where 0 indicates "very dissatisfied" and 10 indicates "very satisfied," about two-thirds of tenants rated satisfaction with the program as an 8-10 as shown in Figure 3. The average overall tenant satisfaction rating with the program was 8.0 out of 10. Tenants who ranked their overall satisfaction low did so because they disliked the products or did not notice any monetary savings.

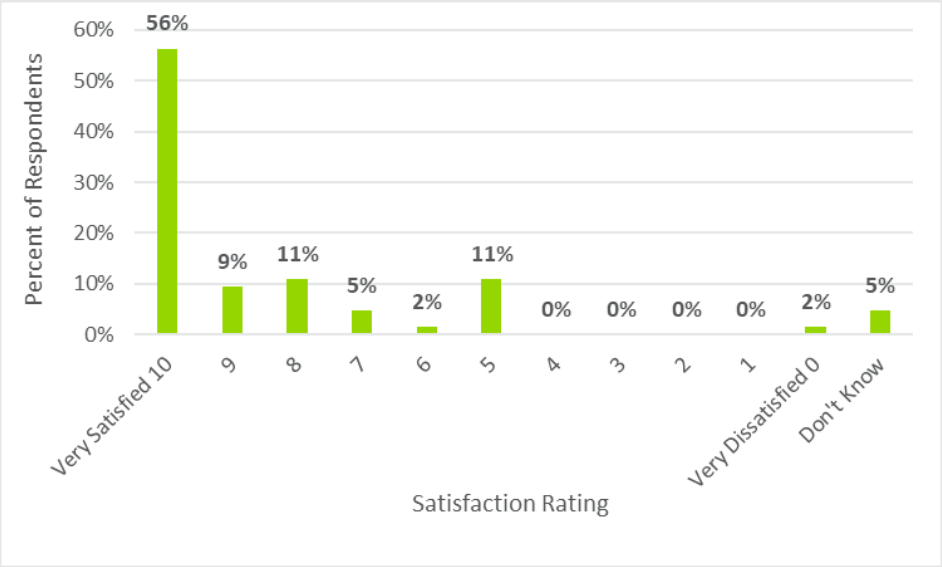
Figure 3. Tenant Satisfaction with Overall Program Experience (n=64)



Source: Navigant analysis, values subject to rounding.

Tenants satisfaction with the contractor's quality of work was also high, as shown in Figure 4. The average satisfaction rating was 8.7 out of 10. one respondent was very dissatisfied with the work of the contractors, indicating they were messy.

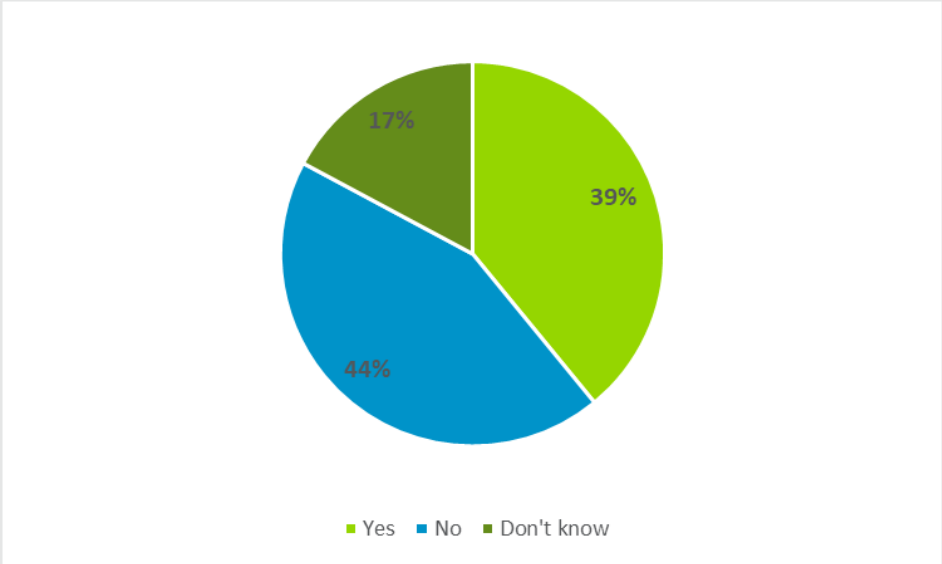
Figure 4. Tenant Satisfaction with Contractor's Quality of Work (n=64)



Source: Navigant analysis, values subject to rounding

As shown in Figure 5, 39 percent of tenants noticed a decrease in their energy bills after the new measures were installed, while 17 percent are unsure if they are saving energy. The surveys were conducted shortly after the measure installations at some properties, which may explain why some tenants many not have recognized monetary savings. Nevertheless, 44 percent of tenants did not notice a decrease in their utility bills. This represents an opportunity for Duke Energy to communicate energy savings to tenants and help provide them with guidance and tips to save energy and water after the new measure have been installed in their home.

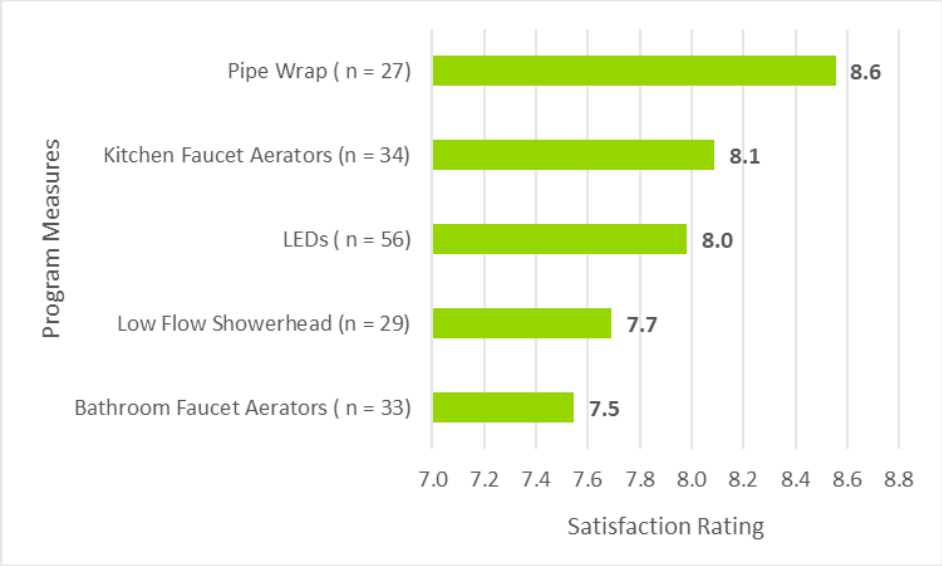
Figure 5. Tenants Who Noticed a Decrease in Their Energy Bill After Installing Program Measures (n=64)



Source: Navigant analysis, values subject to rounding

While a majority of tenants were satisfied with the new measures, some were not. Navigant asked the participants to rate their satisfaction for each measure installed at their home. Pipe wrap had the highest satisfaction rating of 8.6 out of 10, while bathroom faucet aerators had the lowest average satisfaction rating of 7.5 out of 10, as shown in Figure 6.

Figure 6. Tenant Satisfaction Rating for Each Measure



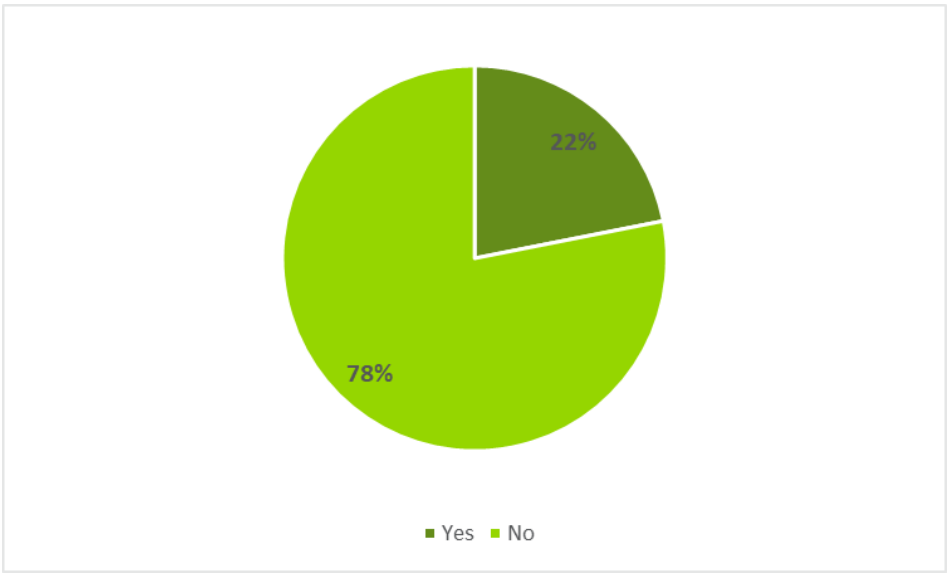
Source: Navigant analysis, values subject to rounding

Tenants report poor water pressure as the primary reason for their dissatisfaction with bathroom faucet aerators and low flow showerheads.

A small percentage of tenants reported they removed some of their program measures. Eight respondents reported removing equipment. Seven respondents reported removing LED bulbs (5 participants removed LED A-lamps and 2 participants removed LED Globe lamps) due to burn out, poor quality, and the product not being bright enough. One respondent removed a kitchen faucet aerator, indicating the device caused water to spray everywhere.

As a result of the tenant's particpation in the program, some tenants (22 percent) are purchasing additional energy efficiency equipment that they did not receive a rebate for, as shown in Figure 7.

Figure 7. Tenants Who Purchased Additional Energy Efficient Equipment (n = 14)



Source: Navigant analysis, values subject to rounding

Of the tenants who reported purchasing additional energy efficient equipment, most tenants (64 percent) indicated they made a behavior change, while 29 percent purchased additional LEDs. One tenant indicating they purchased a water-saving sink faucet. The primary motivation for customers decision to purchase additional equipment and to change their behavior is to save energy and money.

When asked how important their participation was in their decision to install additional energy efficiency measures, the mean important rating was 6.7 out of 10, indicating that the program partially influenced customers. As discussed previously, Navigant incorporated these responses into the spillover calculations used in the NTG analysis.

6.4.1.1 Participant Suggestions

Navigant also included a question in the tenant satisfaction survey that allowed respondents to offer suggestions for improving the program. About 23 percent of respondents offered suggestions, which were as follows:

- Three respondents asked for more information about the program and better advertising it.
- Two respondents mentioned getting different aerator devices that have better water pressure.
- Two tenants requested that different types of light be offered through the program, but did not offer specific suggestions.

- One respondent suggested having a different type of showerhead available as the low flow showerhead product had inconsistent water pressure.
- One respondent requested offering windows as a new program measure.

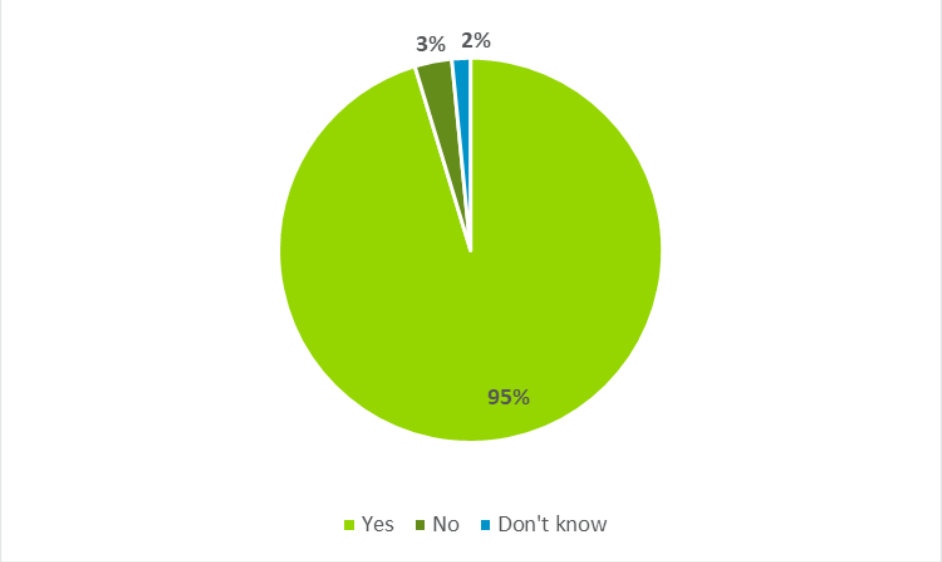
6.4.1.2 Participant Familiarity with Duke Energy

Navigant asked tenants a series of questions about their familiarity with Duke Energy's efficiency program offerings, as well as their preference for additional program offerings. As shown in Figure 8, 95 percent of respondents said they consider Duke Energy a resource for energy efficiency information. However, as shown in Figure 9, about 85 percent of respondents were not able to specifically name other Duke Energy efficiency programs when asked without prompts.

Verbatim responses indicated that tenants trust Duke Energy to provide them with exceptional customer service and reliable information. Duke Energy has built a positive rapport with their tenants.

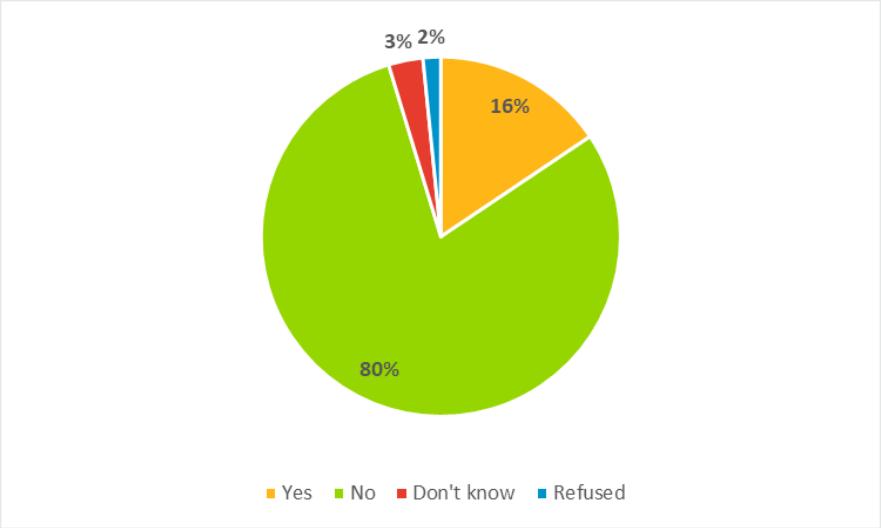
- "I would say because they never let me down."
- "Their website has resources and links, make[ing] these resources available to families shows that they care."
- "Because their response to outages and letting people know that your electric will be back on. They let you know they are aware of the outage."

Figure 8. Tenants Who Consider Duke Energy a Resource for Energy Efficiency Information (n=64)



Source: Navigant analysis, values subject to rounding

Figure 9. Tenants Who Could Name Other Duke Energy Solutions/Programs to Help Them Save Energy and Money (n=64)



Source: Navigant analysis, values subject to rounding

Navigant also asked tenants about their preferences related to other technologies such as smart thermostats, solar and electric vehicles. Responses showed that:

- 16 percent of respondents currently have a smart thermostat (11 percent were unsure or preferred not to respond)
- Of the respondents who do not have a smart thermostat, 43 percent are interesting in getting one
- Nearly 60% of respondents say they would like to see solar PV installed at their property
- None of the respondents reported owning an EV, but about 5 percent are aware of EV charging stations at their properties
- Most respondents, 88 percent, indicated the housing property does not have solar panels (12 did not know or preferred not to respond). However, about 61% of respondents would like to see solar installed at their housing property.

6.5 Property Manager Surveys

Navigant conducted in-depth interviews with 7 of the 25 participating property managers. This section presents details of the interviews.

The surveys contained a number of questions to assess satisfaction with program participation, satisfaction with new equipment, as well as questions to assess measure baseline.

The primary motivations for participating in a program are critical for Duke Energy to know, as these motivations can help shape marketing and outreach material. When the property managers were asked why they decided to participation in the program, common answers were to save energy, to save water, to save money on utility bills, to save money on electric bills, to replace old equipment, and to improve tenant satisfaction.

Property managers reacted positively to their participation in the program and expressed high satisfaction. When asked how they would rate their satisfaction on a 0 to 10 scale with 0 meaning “very

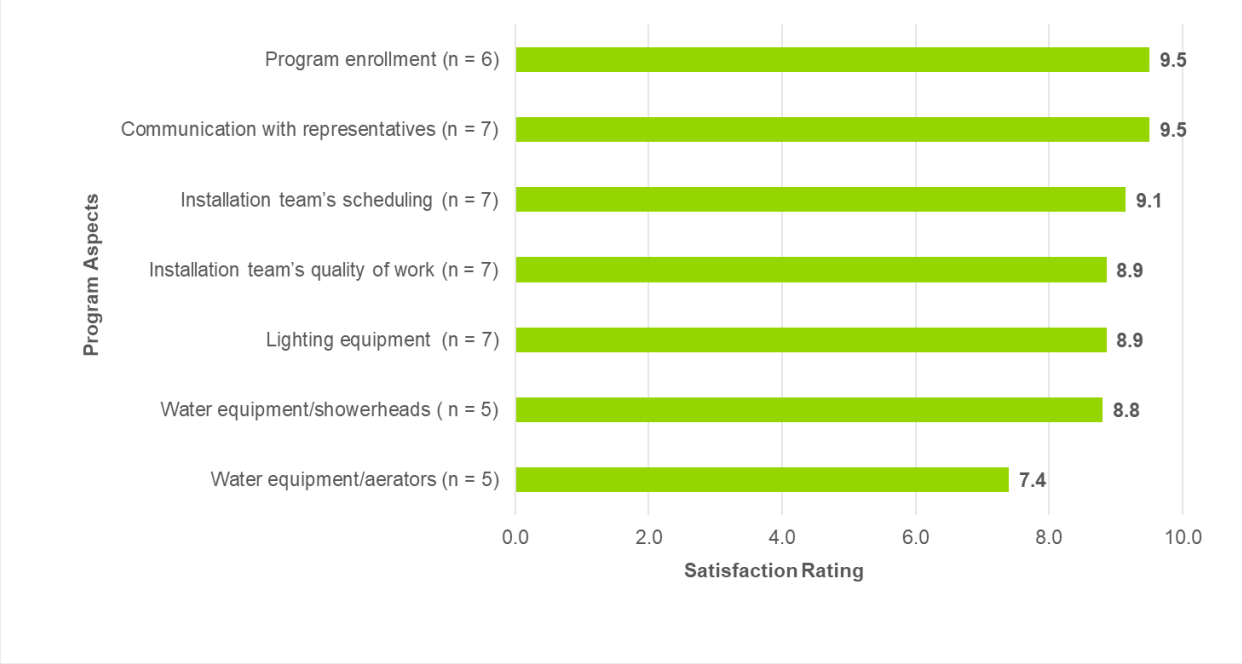
dissatisfied" and 10 meaning "very satisfied", the mean satisfaction rating for their overall experience with the program was 8.1 out of 10, which is the same satisfaction rating that tenants provided.

The property managers provided both positive and constructive remarks about the program. The constructive comments expressed slight dissatisfaction with the numerous requests for onsite verification audits.

- "There were multiple requests to come back and get into the units [to inspect measures]. [I] probably would not do it again."
- "The installation went very well. The people that did the installing did well. I did not like the follow-up audit. I was called on numerous times for a follow-up audit."
- "It seems like there are a lot of people wanting to come back to review. I have to keep bothering the tenants."
- "It went really well. There were a couple of things that he would have done differently. They did not replace all the bulbs, and [I] was told that was going to happen. Some people already had LEDs and did not get new ones."
- "I give it a 9 because the program has been great."

Overall, the property managers were also satisfied with specific program aspects, as shown in Figure 10. The program enrollment process and communication with program representatives received the highest average satisfaction ratings of 9.5 out of 10. The lowest satisfaction rating was water equipment with an average rating of 7.4 out of 10. Bathroom and kitchen faucet aerators were the primary source of dissatisfaction from one property manager. They provided a very low rating of 2.0 out of 10 for the equipment stating, "tenants did not like them. There was no water pressure at all. People bought their own."

Figure 10. Satisfaction with Program Aspects



Source: Navigant analysis, values subject to rounding. Don't know responses were excluded from analysis.

Property managers indicated they consider Duke Energy to be a resource for energy efficiency, rating Duke Energy on 8.1 out of 10. The property managers also indicated their decision to install the energy efficient equipment at the property was largely motivated by Duke Energy's program. The program influenced their decision to participate because it allowed them to install LEDs and water measures much faster than they would have otherwise. All respondents indicated they would not have installed the same energy efficiency products and the same quantity without Duke Energy's technical and financial assistance, showing the program is very beneficial for property managers. As a result, property managers very likely to recommend the program to others. The average likelihood score was 9.3 out of 10.

6.5.1.1 Participant Suggestions

Navigant also included a question in the property manager satisfaction survey that allowed respondents to offer suggestions for improving the program.

- Six out of seven property managers suggested that outdoor lighting or common area lighting be offered through the program, so they can continue to increase the energy efficiency of their property.

7. SUMMARY FORM

Multifamily Energy Efficiency Program

Completed EMV Fact Sheet

Description of program

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. 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. Typically, measures are installed directly by the implementation contractor rather than tenants or onsite maintenance staff.

The program consists of lighting and water measures.

- **Lighting measures:** Light Emitting Diode (LED) bulbs installed in permanent fixtures
- **Water measures:** Bathroom and kitchen faucet aerators, water-saving showerheads, hot water pipe wrap

Date:	December 26, 2019
Region:	Duke Energy Kentucky
Evaluation Period	7/1/17 – 7/31/19
Annual kWh Savings	761,840
Per Participant kWh Savings	679
Net-to-Gross Ratio	0.99

Evaluation Methods

The evaluation team used engineering analysis and onsite field inspections as the primary basis for estimating program impacts. Additionally, telephone surveys were conducted with tenants and multifamily housing units to assess customer satisfaction and spillover. Detailed interviews were conducted with property managers to assess their decision-making process, and ultimately to estimate a net-to-gross ratio.

Impact Evaluation Details

- **Field inspections were conducted at 36 housing units.** The evaluation team inspected program equipment at 36 housing units to assess measure quantities and characteristics to be compared with the program tracking database.
- **In-Service rates (ISRs) varied by equipment type.** The evaluation team found ISRs ranging from 93% for bathroom aerators to 100% for candelabra LED lamps.
- **Participants achieved an average of 679 kWh of energy savings per year (at the tenant household level).**

8. CONCLUSIONS AND RECOMMENDATIONS

Navigant developed a few recommendations for Duke Energy to consider. 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.

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. Duke Energy should consider improving the program materials distributed to tenants that describe the program measures and energy savings that might be achieved due to the installation of the new equipment. Communicating tips to save energy and water with the new equipment could increase customer satisfaction and continue to build the strong trust and rapport Duke Energy has established with their customer base.
3. Duke Energy should consider leaving a few cases of backup LED bulbs with property managers. Some tenants removed LEDs and burnout was the primary reason for the removal. Leaving additional LEDs with property managers could help increase the customer satisfaction rate for this measure.
4. Duke Energy should consider whether smart thermostats or other HVAC-related measures would be reasonable offerings for this program. About 43 percent of survey respondents who did not have a smart thermostat indicated they would like to get one. Also, three out of four property managers recommended adding exterior and common area lighting to the program, so they can continue to make their properties energy efficient.
5. Duke Energy should consider making modifications to the Multifamily Energy Efficiency Program Direct Installation Service Agreement to include information about EM&V activities that may occur in the months or years following program participation. Navigant experienced significant resistance from property managers while recruiting for onsite field verification and process evaluation interviews. Many property managers indicated they had already received multiple site visits during the implementation phase and subsequent QC inspections, and that it was a challenge to accommodate additional inspections and interviews for EM&V.

9. 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 22 provides the measure-level inputs that can be used by Duke Energy Analytics for estimates of future program savings.

Table 22. Gross Measure-Level Impacts

	Measure*	Unit Basis for Impacts	Annual Energy Savings Per Unit (kWh)	Annual Summer Coincident Demand Savings Per Unit (kW)	Annual Winter Coincident Demand Savings Per Unit (kW)
Evaluation Findings	A-Line LED	Per lamp	49.2	0.0040	0.0064
	Candelabra LED	Per lamp	30.9	0.0045	0.0056
	Globe LED	Per lamp	30.0	0.0044	0.0054
	Bathroom Faucet Aerator	Per aerator	34.3	0.0030	0.0030
	Kitchen Faucet Aerator	Per aerator	138.6	0.0091	0.0091
	Low Flow Showerhead	Per showerhead	307.2	0.0136	0.0136
	Water Heater Pipe Wrap	Per foot	17.5	0.0020	0.0020

Source: Navigant analysis, values subject to rounding

Multifamily DEK
DSMore table 26Dec

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 4 property managers. This section presents additional details of the interviews that were not presented in the body of the report, section 6.5. The responses to each question shown are paraphrased to maintain confidentiality and summarize the key points. The information below described the properties that participated in the program.

Table 23. How many housing units does your property have?

Respondent #	Response
1	28
2	Facility 1: 40, Facility 2: 24
3	71
4	12
5	266
6	93
7	114

Source: Navigant analysis

Table 24. Can you tell me the approximate percentage of housing units at your facility that have the following number of bedrooms?

Respondent #	Response
1	One-bedroom: 97%, two-bedroom: 3%
2	Facility 1: One-bedroom: 90%, two-bedroom: 10% Facility 2: One-bedroom: 100%
3	One-bedroom: 50%, two-bedroom: 50%
4	One-bedroom: 50%, two-bedroom: 50%
5	One-bedroom: 52%, two-bedroom: 48%
6	One-bedroom: 100%
7	One-bedroom:4%, two-bedroom: 95%, three-bedroom: 1%

Source: Navigant analysis

Table 25. Can you tell me the average number of occupants that live in a typical unit at your property?

Respondent #	Response
1	One-bedroom 1.5, two-bedroom 2
2	One-bedroom: 2, two-bedroom: 3
3	One-bedroom: 1, two-bedroom: 2
4	One-bedroom: 1, two bedrooms: 3
5	Don't Know
6	One-bedroom: 1
7	One-bedroom: 1.5, two-bedroom: 1-4, three-bedroom: 4

Source: Navigant analysis

Table 26. Can you tell me the low and high range for rent costs for a unit at your property?

Respondent #	Response
1	$500 - 700
2	Facility 1: $530 - 775 Facility 2: $515-749
3	$1084 - 1254
4	$425-750
5	$590-740
6	Don't Know
7	$775-1400

Source: Navigant analysis

Table 27. Is there anything you would suggest to improve Duke Energy's Multifamily Energy Efficiency Program?

Respondent #	Response
1	Offer it to multifamily where landlords pay
2	Common area lighting
3	Nothing
4	The amount of time they keep wanting to come back is bothersome. Less of that would be great. Bothersome to tenants and bothersome for him to walk auditor around.
5	Some of the LEDs have not lasted very long. Duke Energy left a box in case some went out and some did not go into an LED. They already went through a box of 1 dozen.
6	Offer an outside lighting rebate
7	Get rid of the diverters. The program was great. She is hoping the diverter would have greater water pressure. The person doing it was great with customer service.

Source: Navigant analysis

APPENDIX B. TENANT SURVEY GUIDE

DUKE ENERGY MULTIFAMILY ENERGY EFFICIENCY PROGRAM
TENANT SATISFACTION SURVEY

This survey guide will be administered to residents who have received energy efficient equipment through Duke Energy's Multifamily Energy Efficiency Program (MEEP). The goal of the tenant satisfaction survey includes informing, updating and improving MEEP the. Recruiting calls for tenant surveys will be made between 10:00am-8:30pm ET on weekdays, and 10:00am-5:00pm ET on Saturdays. No calls are to be made on Sundays.

Company: _____ Telephone: _____
Name: _____ Cell phone: _____
Title: _____ Fax: _____
City: _____ State: _____ Zip: _____
Interview date: _____ Time: _____

[PROGRAMMER: INSERTS FOR "MEASURE(S)": (add MEASURE_NAME_# to sample)
IF LED_LIGHT_BULBS_1 ≥ 1, [INSERT MEASURE(S)] = "LED LIGHT BULBS"
IF BATHROOM_FAUCET_AERATORS_2 ≥ 1, [INSERT MEASURE(S)] = "BATHROOM FAUCET AERATORS"
IF KITCHEN_FAUCET_AERATORS_3 ≥ 1, [INSERT MEASURE(S)] = "KITCHEN FAUCET AERATORS"
IF HOT_WATER_HEATER_PIPE_WRAP_4 ≥ 1, [INSERT MEASURE(S)] = "HOT WATER HEATER PIPE WRAP"
IF LOW_FLOW_SHOWERHEADS_5 ≥ 1, [INSERT MEASURE(S)] = "LOW FLOW SHOWERHEAD"

INTRO **[IF COMPLEX_NAME = 2 USE THIS INTRO.]** **(individual - add "2"to sample)**
Hello, my name is (YOUR NAME) calling from Bellomy Research. I'm calling on behalf of DUKE ENERGY about the energy saving equipment that your landlord or property manager installed in your home as a part of a Duke Energy efficiency program. These may have included light bulbs, aerators, pipe wrap or showerheads. Is this the **[INSERT CONTACT_NAME FROM SAMPLE]** residence? (IF NOT AVAILABLE, SCHEDULE A CALLBACK.)

INTRO 2 **[IF COMPLEX_NAME = 1 USE THIS INTRO.]** **(complex – add to "1"sample)**
Hello, my name is (YOUR NAME) calling from Bellomy Research. I'm calling on behalf of DUKE ENERGY about the energy saving equipment that your landlord or property manager installed in your home as a part of a Duke Energy efficiency program. These may have included light bulbs, aerators, pipe

wrap or showerheads. Do you reside at a property managed by **[INSERT CONTACT_NAME FROM SAMPLE]**? (IF NOT AVAILABLE, SCHEDULE A CALLBACK.)

SC1. Safety is always first at Duke Energy. Are you able to safely take this call right now?
1. Yes **[CONTINUE]**
2. No **[SCHEDULE A CALLBACK]**
99. Refused **[THANK AND TERMINATE]**

[FOR TERMINATIONS]: I thank you for your time.

[IF RESPONDENT ASKS HOW LONG, SAY: "APPROXIMATELY 10-12 MINUTES."]

S1. I am calling for your opinion on your experience with the Multifamily Energy Efficiency Program from Duke Energy. We will keep all of your responses confidential. For quality purposes, this call may be monitored and recorded. I just need to ask a few screening questions before we get started. Our records show that your household received new energy efficient lighting and/or water-saving equipment **[IF TERRITORY = DEO "THIS YEAR OR IN 2018", IF TERRITORY = DEK "IN 2017, 2018, OR THIS YEAR"]**. Your landlord or property manager organized your participation in this program, and a work crew or maintenance staff would have installed **[INSERT MEASURE(S)]** in your home.

Do you recall these **[INSERT MEASURE(S)]** being installed in your home?

1. Yes, respondent recalls the program **[CONTINUE TO PS1.]**
2. No **[THANK AND TERMINATE]**

98. Don't know **[ASK S3]**
99. Refused **[ASK S3]**

[FOR TERMINATIONS]: I have been asked to conduct interviews with people who are familiar with the energy efficient equipment installed as part of this Duke Energy Multifamily Energy Efficiency Program. Since you do not recall this process, these are all the questions I have at this time. Thank you for your time and have a nice day.

[IF S1 = 98 OR 99, CONTINUE to S3. OTHERWISE SKIP TO PS1.]

S3. Is there anyone available who might know? (IF NOT AVAILABLE, SCHEDULE A CALL BACK).

1. Yes **[REPEAT S1 WITH NEW RESPONDENT TO CONFIRM MEASURES INSTALLED.]**
2. No

99. Refused

[IF S3 = 2 OR 99, THANK AND TERMINATE]

[FOR TERMINATIONS]: I thank you for your time.

==========

NTG Survey: Res

Notes for Client:

- Scoring and multipliers are for FR (not NTGR).
- Text in brackets {} serve as a placeholder and will be concluded with the survey firm

==========

PARTICIPATION and SATISFACTION

PS1. The following survey pertains to the energy efficiency improvements you had completed in your home: **[INSERT MEASURE(S)]**.This survey contains questions relating to your overall satisfaction with the Multifamily Energy Efficiency Program as well as questions about your experience with the energy efficient equipment that were installed.

How did you first hear about Duke Energy's Multifamily Energy Efficiency Program? (DO NOT READ LIST. RECORD ALL MENTIONS.)

1. Through property manager
3. Duke Energy website
7. Participation in other Duke Energy Programs

9. Other (Please Specify)
98. Don't know
99. Refused

PS2 TURNED OFF

PS3. On a scale of 0 to 10, with 0 being "Not at all satisfied", and 10 being "Extremely satisfied", how satisfied are you with your **[INSERT MEASURE(S)]? [REPEAT FOR EACH MEASURE INSTALLED BY PARTICIPANT.]**

Not at all satisfied										Extremely satisfied	Dk	Ref
0	1	2	3	4	5	6	7	8	9	10	98	99

[IF PS3 < 5, ASK PS4]

PS4. Why do you say that? (RECORD VERBATIM.)

_____**[OPEN-END]**

[LOOP PS3/PS4 WILL BE ASKED MULTIPLE TIMES, BASED ON NUMBER OF MEASURES INSTALLED.]

PS5A. **[IF LED_LIGHT_BULBS_1 ≥ 1, ASK. OTHERWISE, SKIP TO PS7.]**
In your own words, can you tell me about your experience ~~so far~~ with the LED Light Bulbs? This can include your opinion on quality of lighting, brightness, color, or any other observations that you have? (RECORD VERBATIM.)

_____**[OPEN-END]**

PS10. On a scale of 0 to 10, where 0 is "Not at all likely" and 10 is "Very likely", how likely are you to purchase **[IF LED_LIGHT_BULBS_1 ≥ 1, display** "additional"**]** LEDs in the future?

Not at all likely										Very likely	Dk	Ref
0	1	2	3	4	5	6	7	8	9	10	98	99

[IF PS10 < 5, ASK PS10A]

PS10a. Why do you say that? (RECORD VERBATIM.)

_____**[OPEN-END]**

[IF PS10 > 5, ASK PS10B]

PS10b. What type(s) of LED would you most likely purchase? (READ LIST ONLY IF NECESSARY. RECORD ALL MENTIONS.)

1. A-lamps
2. Globe lamps
3. Candelabra lamps
4. Track lights
5. Can lights
6. Decorative lamps
7. Other (Please Specify)

8. Don't know

PS7. Have you noticed any savings on your electric bill since the installation of your new **[INSERT MEASURE(S)]**?
1. Yes
2. No
98. Don't know
99. Refused

PS8 TURNED OFF

PS9. We understand that the energy efficient items may have been installed by a contractor hired by Duke Energy. How would you rate your satisfaction with your installer's "quality of work" on a scale of 0 to 10, with 0 meaning "Not at all satisfied" and 10 meaning "Extremely satisfied"?

Not at all satisfied										Extremely satisfied	Dk	Ref
0	1	2	3	4	5	6	7	8	9	10	98	99

[IF PS9 < 5, ASK PS9A]

PS9a. What is the main reason for your satisfaction rating? (RECORD VERBATIM.)
_____**[OPEN-END]**

PS11. Using a scale from 0 to 10, with 0 being "Not at all satisfied" and 10 being "Extremely satisfied", how satisfied are you with the Duke Energy Multifamily Energy Efficiency Program?

Not at all satisfied										Extremely satisfied	Dk	Ref
0	1	2	3	4	5	6	7	8	9	10	98	99

[IF PS11 = 0-10, ASK PS11A]

PS11a. Why do you give it that rating? (RECORD VERBATIM.)
_____**[OPEN-END]**

PS12. Do you have any suggestions to improve the Multifamily Energy Efficiency Program?
1. Yes
2. No
98. Don't know
99. Refused

[IF PS12 = 1, ASK PS12A.]

PS12a. What are those suggestions? (RECORD VERBATIM. PROBE FOR CLARIFICATION.)
_____**[OPEN-END]**

PS13. How would you rate your overall satisfaction with Duke Energy on a scale of 0 to 10, with 0 meaning "Not at all satisfied" and 10 meaning "Extremely satisfied"?

Not at all satisfied										Extremely satisfied	Dk	Ref
0	1	2	3	4	5	6	7	8	9	10	98	99

[IF PS13 < 5, ASK PS13A.]

PS13a. Why do you say that? (RECORD VERBATIM.)

_____**[OPEN-END]**

M1, M2, M3, M4, M4A, M5 TURNED OFF

Measures

Now I'd like to ask you a few questions about your experience with the energy efficient equipment installed through the Duke Energy Multifamily Energy Efficiency Program.

M6. Have you removed any of the **[INSERT MEASURE(S)]** that were installed in your home through this Duke Energy program?

1. Yes
2. No
98. Don't know

[IF M6 = 2 OR 98, SKIP TO IS1. OTHERWISE CONTINUE.]

M6aa. As I read the following measures, please tell me which ones you removed. Did you remove…(READ LIST. RECORD ALL MENTIONS)? **[INSERT MEASURE(S)] ONLY INCLUDE MEASURE INSTALLED IN THE UNIT. FOR THIS INSERT, WE NEED TO READ THE 3 LED TYPES IN THE MEASURE INSERT (INCLUDE A-LAMPS, GLOBE LAMPS, CANDELABRAS, BUT NOT TOTAL LED)**

7. LED A-lamps
8. LED Globe lamps
9. LED Candelabras

~~1. LED light bulbs~~ **TURN OFF**

2. Bathroom faucet aerators
3. Kitchen faucet aerators
4. Hot water heater pipe wrap
5. Low flow showerhead
6. (DO NOT READ) None were removed

[IF M6AA = 6, SKIP TO IS1. OTHERWISE CONTINUE.]

M6ab. Please tell me the quantity of items you removed for each of the following. How many (READ LIST) did you remove? (INTERVIEWER: RECORD QUANTITY FOR EACH MEASURE. USE "98" FOR DON'T KNOW AND "99" FOR REFUSED.) **[INSERT MEASURE(S)] ONLY INCLUDE MEASURE INSTALLED IN THE UNIT. FOR THIS INSERT, WE NEED TO READ THE 3 LED TYPES IN THE MEASURE INSERT (INCLUDE A-LAMPS, GLOBE LAMPS, CANDELABRAS, BUT NOT TOTAL LED)**

Measure Description	Quantity Removed
[IF M6aa = 2, 3, 4, 5, 7, 8 OR 9 INSERT MEASURES BELOW.]	
M6ab_7. LED A-lamps	_____
M6ab_8 LED Globe lamps	_____
M6ab_9 LED Candelabras	_____
~~M6ab_1. LED light bulbs~~	_____ **TURN OFF**
M6ab_2. Bathroom faucet aerators	_____
M6ab_3. Kitchen faucet aerators	_____
M6ab_4. Hot water heater pipe wrap (in feet)	_____
M6ab_5. Low flow showerheads	_____

[IF M6AB_7,_8, OR _9 GT "0", CONTINUE. OTHERWISE, SKIP TO M7B.]

M7a. You told me you removed LED light bulbs. Why did you remove those items? (RECORD VERBATIM.)

_____ **[OPEN-END]**

M7aa. From which rooms did you remove LEDs? (DO NOT READ. RECORD ALL MENTIONS.)

1. Bathroom(s)
2. Bedroom(s)
3. Kitchen/Pantry
4. Living room/Family room/Den/Playroom
5. Home office
6. Laundry room
7. Exterior room (garage/patio/outdoor area)
8. Dining room
9. Hall
10. Other (Please Specify)

[IF M6AB_2 GT "0", CONTINUE. OTHERWISE, SKIP TO M7C.]

M7b. You also told me you removed bathroom faucet aerators. Why did you remove those items? (RECORD VERBATIM.)

_____ **[OPEN-END]**

M7bb. Did you remove an aerator from the master bathroom or another type of bathroom? (RECORD ONE ANSWER ONLY.)

1. Master bathroom
2. Another type of bathroom

[IF M6AB_3 GT "0", CONTINUE. OTHERWISE, SKIP TO M7D.]

M7c. You also told me you removed kitchen faucet aerators. Why did you remove those items? (RECORD VERBATIM.)

_____ **[OPEN-END]**

[IF M6AB_4 GT "0", CONTINUE. OTHERWISE, SKIP TO M7E.]

M7d. You also told me you removed hot water heater pipe wrap. Why did you remove those items? (RECORD VERBATIM.)

_____**[OPEN-END]**

[IF M6AB_5 GT "0", CONTINUE. OTHERWISE, SKIP TO IS1.]

M7e. You also told me you removed low flow showerheads. Why did you remove those items? (RECORD VERBATIM.)

_____**[OPEN-END]**

M7ee. Did you remove a showerhead from the master bathroom or another type of bathroom? (RECORD ONE ANSWER ONLY.)

1. Master bathroom
2. Another type of bathroom

M8, M8A, M9, M90, M9A, M10 TURNED OFF

Spillover (INSIDE SPILLOVER)

IS1. As a result of your experience with the program, did you purchase additional energy efficiency equipment for your home or adopt any energy efficient behavior for which you did not receive a rebate/discount from any other Duke Energy program

1. Yes **[CONTINUE]**
2. No
98. Don't know

[IF IS1 = 2 OR 98, SKIP TO PS14.]

IS2. Please tell me the types of additional energy efficient items and the quantity you had installed where you did not receive a program rebate.

	Measure Description	Quantity
IS2a.	1._____	2._____
IS2b.	3._____	4._____
IS2c.	5._____	6._____
IS2d.	7._____	8._____
IS2e.	9._____	10._____

IS3. Please briefly describe how the program has influenced your decisions to incorporate additional energy efficient items in your home that were not part of a program rebate. (RECORD VERBATIM.)

_____**[OPEN-END]**

IS4. On a scale of 0 to 10, where 0 is "Not at all important" and 10 is "Extremely important," how important was your participation in the program in your decision to install additional energy efficiency measures?

Not at all important										Extremely important	Dk	Ref
0	1	2	3	4	5	6	7	8	9	10	98	99

DEMOGRAPHICS AND ADDITIONAL FEEDBACK

PS14. Thank you for your time and patience; there are only a few more questions.

Do you consider Duke Energy as a trusted resource for energy efficiency information?

1. Yes
2. No
98. Don't know
99. Refused

[IF PS14 = 1 "YES", ASK PS14A.]

PS14a. Why do you consider Duke Energy to be a trusted resource? (RECORD VERBATIM.)

_____**[OPEN-END]**

[IF PS14 = 2 "NO", ASK PS14B.]

PS14b. Why do you not consider Duke Energy to be a trusted resource? (RECORD VERBATIM.)

_____**[OPEN-END]**

PS15. Can you list any other Duke Energy solutions or programs to help you save energy and money in your apartment? (DO NOT READ LIST. RECORD ALL MENTIONS.)

1. Equipment incentives through the Smart Saver Energy Home Rebate Program, including HVAC, Water Heater, Insulation, Ductwork, Pool & Drives, and Refrigeration
2. Outdoor Lighting Solutions
3. Duke Online Savings Store for lighting measures
4. Lighting discounts at local retail stores
5. Refrigeration and Appliance Replacement
6. Heating and Cooling system replacement
7. ~~Duke Free LED Program~~ **TURN OFF**
8. Other (Please Specify)
9. No **[EXCLUSIVE]**
98. Don't Know
99. Refused

PS16, PS16O, PS16A TURNED OFF

P15a. How many bedrooms does your home have?

1. 1
2. 2
3. 3
4. More than 3
98. Don't know
99. Refused

PS15b. How many people live in your home?

1. 1
2. 2
3. 3
4. More than 3
98. Don't know
99. Refused

PS17. A smart thermostat heats or cools your home through the use of automation. Do you currently have a smart thermostat at your home?

1. Yes
2. No
98. Don't know
99. Refused

[IF PS17 = 2, ASK PS17A.]

PS17a. Would you be interested in a smart thermostat?

1. Yes
2. No
98. Don't know
99. Refused

PS18. Do you currently own an electric vehicle?

1. Yes
2. No
98. Don't know
99. Refused

[IF PS18 = 2, ASK PS18A.]

PS18a. Would you consider purchasing an electric vehicle in the next 1 to 3 years?

1. Yes
2. No
98. Don't know
99. Refused

PS19. Does your housing property have charging stations for electric vehicles?

1. Yes
2. No
98. Don't know
99. Refused

PS20. Does your housing property have solar panels?

1. Yes
2. No

98. Don't know
99. Refused

[IF PS20 = 2, ASK PS20A.]

PS20a. Would you like to see your housing property have solar panels installed?

1. Yes
2. No
98. Don't know
99. Refused

CLOSING: This completes the survey. Your responses are very important to Duke Energy and will help as we design future energy efficiency programs. We appreciate your participation and thank you for your time. Have a good day.

APPENDIX C. PROPERTY MANAGER SURVEY GUIDE

This survey guide will be administered to property managers who participated in Duke Energy's Multifamily Energy Efficiency Program (MEEP). The goal of property manager surveys includes informing, updating and improving MEEP. This survey guide walks the interviewer through the phone calls, which are to be made between 10:00am-8:30pm ET on weekdays, and 10:00am-5:00pm ET on Saturdays. No calls are to be made on Sundays. Navigant interviewer will introduce himself/herself and inform the customer about the purpose of the interview.

Company: _____ Telephone: _____
Name: _____David Wolfe_____ Cell phone: _____
Title: _____ Fax: _____
City: _____ State: _____ Zip: _____
Interview date: _____ Time: ___12:00 MT____

S1. According to our records, your property participated in Duke Energy's Multifamily Energy Efficiency Program during **2019]** and received free installation of energy efficient **lighting and water equipment**. Is that correct?

1. Yes
2. No
98. Don't know
99. Refused

[If S1 = 2 or 99, TERMINATE. Otherwise, Continue]
[*FOR TERMINATIONS]:* This study is for people who participated in Duke Energy's Multifamily Energy Efficiency Program during **[If DEK: 2017, 2018 or 2019. If DEO: 2018 or 2019]**. Since you did not, these are all the questions I have at this time, and I thank you for your time.

S2. Are you the primary person who was involved in making the decision to receive the installation for the energy efficient **lighting and/or water efficiency equipment?**

1. Yes
2. No
98. Don't know
99. Refused

[If S2 = 1, Move to PS1. If S2 = 99, Terminate. Otherwise, Continue]
[*FOR TERMINATIONS]:* This study is for people who participated in Duke Energy's Multifamily Energy Efficiency Program during **[If DEK: 2017, 2018 or 2019. If DEO: 2018 or 2019]**. Since you did not, these are all the questions I have at this time, and I thank you for your time.

S2a. I understand that the decision to install the **lighting and water equipment** may have been driven by someone other than yourself. However, if you had some involvement in the decision process

to participate in the program, your input will be helpful. Are you somewhat familiar with the program participation and installation process?

1. Yes
2. No
98. Don't know
99. Refused

[If S2a = 1, proceed to PS1. If S2 = 2 or 98, proceed to S2b. If S2a= 99, Terminate]
[*FOR TERMINATIONS]:* This study is for people who participated in Duke Energy's Multifamily Energy Efficiency Program during **[If DEK: 2017, 2018 or 2019. If DEO: 2018 or 2019]**. Since you did not, these are all the questions I have at this time, and I thank you for your time.

S2b. Can you direct me to the person who was involved in the decision making?

1. Yes [Gather correct contact information before terminating]
2. No [Terminate]
98. Don't know [Terminate]
99. Refused [Reassure participant prior to Terminating]

[If S2b = 1, Gather correct contact information before ending. If S2 = 2, 98 or 99, Terminate]
[*FOR ENDING*]: Thank you for providing us this information and thank you for your time.
[*FOR TERMINATIONS]:* This study is for people who participated in Duke Energy's Multifamily Energy Efficiency Program during **[If DEK: 2017, 2018 or 2019. If DEO: 2018 or 2019]**. Since you did not, these are all the questions I have at this time, and I thank you for your time.

Survey Introduction

My questions are about the energy efficient **lighting and water equipment** installed at **[Insert Property]** through the Duke Energy Multifamily Energy Efficiency Program in **[If DEK: 2017, 2018 or 2019. If DEO: 2018 or 2019]**: I will ask about your satisfaction with the program as well as questions relating to your decision to participate in the program. Finally, I am also interested in hearing about any decisions to pursue efficiency projects at other properties your company manages.

Participation and Satisfaction

The first set of questions relate to your satisfaction with the program. Using a scale from 0 to 10, with 0 being "not at all satisfied" and 10 being "extremely satisfied", how would you rate your satisfaction with the following aspects of Duke Energy's Multifamily Energy Efficiency program? *(INTERVIEWER: USE "98" FOR DON'T KNOW. USE "99" FOR REFUSED.)*

Questions	Ratings and explanations												
PS1. Overall experience with the program	0	1	2	3	4	5	6	7	8	9	10	98 Don't Know	99 Refused

PS1a. What's the reason for your rating*? (RECORD VERBATIM)*													
PS2. Communication with program representatives	0	1	2	3	4	5	6	7	8	9	10	98 Don't Know	99 Refused
[If PS2 < 5, ASK] PS2a. What's the reason for your rating*? (RECORD VERBATIM)*													
PS3. Program enrollment process	0	1	2	3	4	5	6	7	8	9	10	98 Don't Know	99 Refused
[If PS3 < 5, ASK] PS3a. What's the reason for your rating*? (RECORD VERBATIM)*													
PS4. Tenant communications and program materials to help you communicate with tenants about the program	0	1	2	3	4	5	6	7	8	9	10	98 Don't Know	99 Refused
[If PS4 < 5, ASK] PS4a. What's the reason for your rating*? (RECORD VERBATIM)*													
PS5. The lighting equipment offered in the program	0	1	2	3	4	5	6	7	8	9	10	98 Don't Know	99 Refused
[If PS5 < 5, ASK] PS5a. What's the reason for your rating*? (RECORD VERBATIM)*													
PS6. The water-saving equipment offered in the program	0	1	2	3	4	5	6	7	8	9	10	98 Don't Know	99 Refused
[If PS6 < 5, ASK]PS6a. What's the reason for your rating*? (RECORD VERBATIM)*													
PS7. Installation team's scheduling and timely installation in tenant-units	0	1	2	3	4	5	6	7	8	9	10	98 Don't Know	99 Refused
[If PS7 < 5, ASK] PS7a. What's the reason for your rating*? (RECORD VERBATIM)*													
PS8. Installation team's quality of work	0	1	2	3	4	5	6	7	8	9	10	98 Don't Know	99 Refused
[If PS8 < 5, ASK] PS8a. What's the reason for your rating*? (RECORD VERBATIM)*													

PS9. **[If property received lighting equipment ask PS9, otherwise skip to PS10]**

On a scale of 0 to 10, with 0 being "not at all satisfied", and 10 being "extremely satisfied", how satisfied would you say *your tenants* are with the new **lighting equipment**? (USE "98" FOR DON'T KNOW. USE "99" FOR REFUSED.)

Not at all Important										Extremely Important	Don't Know	Refused
0	1	2	3	4	5	6	7	8	9	10	98	99

PS9a. What is the reason for your rating? *(RECORD VERBATIM)*

_____

PS9b. Can you tell me about any feedback that you have received from your tenants about their experience with the LED lights? [Probe to understand any improvements to aesthetics in the space, reduced energy bills, etc.) (RECORD VERBATIM)

PS10. **[If property only received lighting equipment skip to PS11]** On a scale of 0 to 10, with 0 being "not at all satisfied", and 10 being "extremely satisfied", how satisfied would you say your tenants are with the new **water equipment**? (USE "98" FOR DON'T KNOW. USE "99" FOR REFUSED.)

Not at all Important										Extremely Important	Don't Know	Refused
0	1	2	3	4	5	6	7	8	9	10	98	99

PS10a. What is the reason for your rating? *(RECORD VERBATIM)*

_____

PS10b. Can you tell me about any feedback that you have received from your tenants about their experience with the water equipment? [Probe to understand any improvements to aesthetics in the space, reduced energy bills, etc.) (RECORD VERBATIM)

PS11. When speaking to prospective tenants, do you highlight the energy efficient features of your units?

1. Yes
2. No
98. Don't know
99. Refused

PS12. Are there other energy efficiency options you think the program should include? Some examples might be outdoor lighting solutions, heating and cooling solutions, programmable or smart thermostats (i.e. nests), electric vehicle charging stations, etc.? (RECORD VERBATIM)

PS13. On a scale of 0 to 10, where 0 is "not at all likely" and 10 is "very likely", how likely are you to

recommend the Duke Energy Multifamily Energy Efficiency Program to other property managers? (USE "98" FOR DON'T KNOW. USE "99" FOR REFUSED.)

Not at all Important										Extremely Important	Don't Know	Refused
0	1	2	3	4	5	6	7	8	9	10	98	99

[If PS13 <5 Ask]

PS13a. Why do you say that? (RECORD VERBATIM)

_____

Awareness Questions

The next set of questions relate to your decision to participate in the program.

A1. What was the primary reason for your decision to participate in the program? [DO NOT READ LIST. RECORD ONLY ONE MENTION.]

1. To save money on utility bills; save money on electric bills
2. Because the equipment was free to me
3. To replace old equipment
4. To replace broken equipment
5. To get more efficient equipment or the latest technology
6. To reduce maintenance costs
7. Because the program was sponsored by Duke Energy
8. Previous experience with other Duke Energy programs
9. To help protect the environment
10. To save energy
11. To improve tenant satisfaction
12. To attract new tenants
13. Part of a broader remodeling or renovation
14. Recommended by contractors/trade allies
15. Recommended by family, friend, or neighbor
16. Existing equipment was due for its regularly-scheduled checkup
17. Duke Energy Advertising
18. Advertising other than Duke Energy
19. No other reasons
20. Other [SPECIFY] _____
98. Don't know
99. Refused

A2. Are there any other reasons you decided to install **lighting and water equipment**?
[DO NOT READ LIST. RECORD ALL MENTIONS]

1. To save money on utility bills; save money on electric bills
2. Because the equipment was free to me
3. To replace old equipment
4. To replace broken equipment
5. To get more efficient equipment or the latest technology
6. To reduce maintenance costs
7. Because the program was sponsored by Duke
8. Previous experience with other Duke programs
9. To help protect the environment
10. To save energy
11. To improve tenant satisfaction
12. To attract new tenants
13. Part of a broader remodeling or renovation
14. Recommended by contractors/trade allies
15. Recommended by family, friend, or neighbor
16. Existing equipment was due for its regularly-scheduled checkup
17. Duke Advertising
18. Advertising other than Duke.
19. Federal tax credit
20. No other reasons
21. Other [SPECIFY] _____

98. Don't know
99. Refused

A3. On a scale of 0 to 10 where 0 means "strongly disagree" and 10 means "strongly agree," please rate your agreement with the following statements:

A3a. I consider Duke Energy to be a decent resource for energy efficiency information.
1. Record response 0-10
98. Don't know
99. Refused

A3b. My decision to install energy efficient equipment at my property was largely motivated by Duke Energy's program.
1. Record response 0-10
98. Don't know
99. Refused

Prior Plans

[Ask if property received lighting equipment]

PP1. Prior to participating in the Duke Energy program, had you considered installing the energy efficient **lighting equipment** at the property?

1. Yes
2. No
98. Don't know
99. Refused

[Ask if property received water equipment]

PP2. Prior to participating in the Duke Energy program, had you considered installing the energy efficient **water equipment** at the property?

1. Yes
2. No
98. Don't know
99. Refused

[If PP1 OR PP2 = 1 or 98, ASK PP2A. Otherwise ASK L3]

PP2a. Please describe any plans you had to install the **lighting and water equipment** prior to participating in the Duke Energy program.
[Record PM Response verbatim]: _____

PP3. Thinking about before you decided to participate in the Duke Energy Multifamily Energy Efficiency program. On a scale of 0 to 10, where 0 means you "had not yet started to plan for equipment or installation" and 10 means you "had identified and selected specific equipment and the contractor to install it", please tell me how far along you were in your plans to install the equipment before participating in the program. (USE "98" FOR DON'T KNOW. USE "99" FOR REFUSED.)

Had not Yet planned for Equipment and Installation										Identified and selected specific equipment and the contractor to install it	Don't know	Refused
0	1	2	3	4	5	6	7	8	9	10	98	99

Own

O1. Please tell me in your own words how the program influenced your decision to install the

lighting and water equipment. (RECORD VERATIM)

_____

Likelihood

L1. Given everything you've just told me, what is the likelihood that you would have installed the same energy efficient **lighting and water equipment** without the Duke Energy program and its financial and technical assistance? Would you say you … [READ LIST]?

1. Definitely would NOT have installed the same **lighting and water equipment without the Duke Energy program**
2. MAY HAVE installed the same **lighting and water equipment**, even without the Duke Energy program
3. Definitely WOULD have installed the same **lighting and water equipment,** even without the Duke Energy program
98. (DO NOT READ) Don't know
99. Refused

[If L1 = 2, ASK L1A. Otherwise ASK L2]

L1a. You indicated you may have installed the same energy efficient **[INSERT MEASURES DENOTED ABOVE]**, even without the Duke Energy program. On a scale of 0 to 10 where 0 is "DEFINITELY WOULD NOT have installed" and 10 is "DEFINITELY WOULD have installed", can you tell me the likelihood that you would have installed the same **equipment** without the program?

Definitely Would Not										Definitely Would	Don't Know	Refused
0	1	2	3	4	5	6	7	8	9	10	98	99

L2. Thinking about the quantity of lighting and water equipment you installed through the program, what is the likelihood that you would have installed the same quantity of the same measures without the program's financial and technical assistance? Would you say you … [READ LIST]

1. Definitely would NOT have installed the same quantity of the same **lighting and water equipment** without the Duke Energy program
2. MAY HAVE installed the same quantity of the same energy efficient **lighting and water equipment**, even without the Duke Energy program
3. Definitely WOULD have installed the same quantity of the same energy efficient **lighting and water equipment**, even without the Duke Energy program
98. (DO NOT READ) Don't know
99. Refused

[If L2 = 2, ASK L2A. Otherwise ASK L3]

L2a. You indicated you may have installed the same quantity of the same lighting and water equipment even without the Duke Energy program. Using a scale of 0 to 10 where 0 is "DEFINITELY WOULD NOT have installed" and 10 is "DEFINITELY WOULD have installed", can you tell me the likelihood that you would have installed the same quantity of the same measures **without the program**?

Definitely Would Not										Definitely Would	Don't Know	Refused
0	1	2	3	4	5	6	7	8	9	10	98	99

L3. **[If L2 = 3, proceed to L3a. Otherwise, continue]**

Is there a chance you would have had at least some of the work done without the program?

1. Yes
2. No
98. Don't know

[If L3 = 2, ASK IS1. Otherwise, continue]

L3a. Could you estimate the percentage of the work that you might have had done without the program? _____%

L3b. On a scale of 0 to 10 where 0 is "DEFINITELY WOULD NOT have installed" and 10 is "DEFINITELY WOULD have installed", what is the likelihood you might have installed [INSERT L3A ANSWER] percent of the **lighting and water equipment** without the Duke Energy program? (USE "98" FOR DON'T KNOW. USE "99" FOR REFUSED.)

Not at all Important										Extremely Important	Don't Know	Refused
0	1	2	3	4	5	6	7	8	9	10	98	99

L3c. You mentioned you might have done some work without the program, please describe what you might have had done. (RECORD VERBATIM)

_____

L4. Without the program, about when would you have installed the **lighting and water equipment**? Would it have been… (READ LIST)?

1. At the same time as you did
2. Within 1 year of the time you did
3. Between 1 and 2 years within the time you did
4. Between 2 and 4 years within the time you did

5. Sometime after 4 years within the time you did
6. Would have never installed without the program

Spillover

Thank you for your time and patience, we are almost done and the next few questions pertain to how the program may have influenced you to perform other energy efficiency activities are your property.

IS1. Did your experience with the program in any way influence you to incorporate additional energy efficiency equipment where you did not receive a program rebate at your property?

1. Yes
2. No
98. Don't know
99. Refused

[IF IS1 = 2, SKIP TO IS2]

IS1a. Please tell me the types of additional energy efficient equipment and the quantity you had installed where you did not receive a program rebate. [INTERVIEWER: RECORD MEASURE DESCRIPTION AND QUANTITY FOR EACH. AFTER EACH QUANTITY, ASK: Any others?]

Measure Description	Quantity
1._____	_____
2._____	_____
3._____	_____
4._____	_____
5._____	_____
6._____	_____

100. IS1b. Please briefly describe how the program influenced your decisions to incorporate additional energy efficiency equipment at your property that were not part of a program rebate. (RECORD VERBATIM)

_____

101. IS1c. On a scale of 0 to 10, where 0 is "not at all important" and 10 is "extremely important," how important was your participation in the program in your decision to install the additional energy efficiency equipment? (USE "98" FOR DON'T KNOW. USE "99" FOR REFUSED.)

Not at all Important										Extremely Important	Don't Know	Refused
0	1	2	3	4	5	6	7	8	9	10	98	99

IS2. Aside from the primary property that participated in the program, did your experience with the program in any way influence you to incorporate additional energy efficiency equipment where you did not receive a program rebate at any other properties managed by your company?

1. Yes
2. No
98. Don't know

[IF IS2 = 2, SKIP TO P1]

102. IS2a. Please briefly describe how the program influenced your decisions to incorporate additional energy efficiency equipment at another property that were not part of a program rebate. (RECORD VERBATIM)

_____

Property Characteristics

The last few questions are about the size and occupancy characteristics of your property.

P1. How many housing units does your property have?

1. Record Verbatim
98. Don't know
99. Refused

P2. Can you tell me the approximate percentage of housing units at your facility that have the following number of bedrooms?

1. One-bedroom (record percentage of units):
2. Two-bedrooms (record percentage of units):
3. Three-bedrooms (record percentage of units):
4. More than three bedrooms (record percentage of units):
98. Don't know
99. Refused

P3. Can you tell me the average number of occupants that live in a typical unit at your property?

103. (RECORD VERBATIM AND PROBE FURTHER IF THEY HAVE OCCUPANCY BY NUMBER OF BEDROOMS)

1. One-bedroom (enter average number of occupants)
2. Two-bedrooms (enter average number of occupants)
3. Three-bedrooms (enter average number of occupants)
4. More than three bedrooms (enter average number of occupants)
98. Don't know
99. Refused

P4. Can you tell me the low and high range for rent costs for a unit at your property?

1. Record low and high range
98. Don't know
99. Refused

P5. Is there anything you would suggest to improve Duke Energy's Multifamily Energy Efficiency Program?

(RECORD VERBATIM)

_____

CLOSING:

This completes the survey. Your responses are very important to DUKE ENERGY and will help as we design future energy efficiency programs. We appreciate your participation and thank you for your time. Have a good day.

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Duke Energy Kentucky

Non-Residential Smart $aver® Prescriptive Program Impact Evaluation Report – Final

July 24, 2019

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1. Evaluation Summary

1.1 Program Summary

The Duke Energy Kentucky (DEK) Smart $aver® Program provides incentives for electric commercial and industrial customers to purchase and install high-efficiency lighting, HVAC systems, pumps and drives, and qualifying process, food service, and information technology equipment. The program also uses incentives to encourage maintenance of existing equipment in order to reduce energy usage. Incentives are available for new construction and retrofits and replacements. Prescriptive incentives under the program are limited to 75% or less of the customer cost.

The main delivery channel for the program is application-based. The program has two additional delivery channels:

1. The **Business Savings Store** on the Duke Energy website offers customers a limited number of qualified products for which they can receive an instant discount. The discounts offered in the store are consistent with incentive levels in the main delivery channel.
2. The **midstream channel** allows distributors to provide instant discounts on eligible lighting equipment to prequalified customers. The discounts offered through this channel are consistent with incentive levels in the main delivery channel. The midstream channel is offered through qualified distributors only.

The evaluation period for this program is January 1, 2016 to December 31, 2018.

1.2 Evaluation Objectives

This evaluation included assessment of impacts only. Both gross and net impact analyses leveraged results from the recently completed evaluation of the Duke Energy Ohio (DEO) Smart $aver® Prescriptive Program.[1] This evaluation did not include a process evaluation.

The evaluation addressed the following key objectives.

Gross Impact Evaluation

- Develop ex post deemed savings values, based on the recently completed DEO evaluation and information from the DEK program-tracking database.
- Develop ex post gross energy and peak demand savings (both summer and winter), by end-use.
- Develop gross realization rates, by end-use.

Net Impact Analysis

- Develop net energy and peak demand savings (both summer and winter), by end-use, based on DEK ex post gross savings and net-to-gross ratios (NTGRs) from the recently completed DEO evaluation.

[1] Opinion Dynamics Corporation. Duke Energy Ohio – Non-Residential Smart $aver® Prescriptive Program Evaluation Report. December 7, 2018.

1.3 Key Findings

Gross Impact Findings

During the evaluation period, DEK Smart $aver® Program customers generated 46.6 GWh of ex post gross energy savings, 8.1 MW of gross summer peak demand savings, and 4.2 MW of gross winter peak demand savings.

Our gross impact analysis found overall realization rates for energy, summer demand, and winter demand savings of 99%, 90%, and 141%, respectively. The program-level realization rates are closely aligned with the lighting realization rates because lighting makes up 93% of main channel ex ante gross energy savings. The desk reviews and on-site visits for the DEO evaluation found no discrepancies between tracked and installed measures. As a result, the realization rates are entirely driven by updates to per-unit savings values based on the deemed savings review.

Table 1-1 presents gross realization rates, by technology.[2]

Table 1-1. Overall Gross Impact Realization Rates

Technology	Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)
Lighting	99%	89%	145%
HVAC	100%	100%	100%
Food Service Products	100%	100%	102%
Pumps and Drives	108%	116%	114%
Process Equipment	100%	100%	100%
Information Technology	100%	N/A	N/A
Total	99%	90%	141%

Net Impact Findings

The net-to-gross analysis for the recently completed DEO evaluation yielded a program-level NTGR for main channel projects of 87.4%. The NTGRs for lighting and non-lighting measures were 87.9% and 81.8%, respectively. The estimated program-level FR was 18.3%, PSO was 0.04%, and TA SO was 5.6%.

Table 1-2 summarizes the NTGR results of the DEO evaluation.

[2] In addition to these gross realization rates, Duke Energy requires realization rates that it can apply to new measures, for planning purposes. Those realization rates can be found in Section 3.2.3.

Table 1-2. Summary of DEO Evaluation NTGR Results

Technology	FR	PSO	TA SO	NTGR*
Lighting	17.7%	0.04%	5.6%	87.9%
Non-Lighting	23.9%			81.8%
Total	18.3%	0.04%	5.6%	87.4%

* NTGR = 1 – FR + PSO + TA SO

We applied the DEO technology group-level NTGRs to DEK ex post gross savings to determine DEK ex post net savings. Table 1-3 summarizes ex post gross and net savings for the evaluation period.

Table 1-3. Summary of Ex Post Gross and Net Program Savings

Technology	Ex Post Gross			NTGR	Ex Post Net		
	Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)		Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)
Main Channel	32,739,912	5,627	3,195	0.87	28,648,110	4,910	2,792
Lighting	*30,390,723*	*5,004*	*2,896*	*0.88*	*26,726,741*	*4,401*	*2,547*
HVAC	*1,030,005*	*446*	*111*	*0.82*	*842,427*	*365*	*91*
Food Service Products	*553,627*	*58*	*63*	*0.82*	*452,804*	*47*	*51*
Pumps and Drives	*561,088*	*70*	*77*	*0.82*	*458,906*	*57*	*63*
Process Equipment	*204,470*	*49*	*49*	*0.82*	*167,233*	*40*	*40*
Midstream Channel	11,717,043	2,081	970	1.00	*11,717,043*	2,081	970
Online Store	2,139,742	434	75	1.00	*2,139,742*	434	75
Total	46,596,696	8,142	4,240		42,504,895	7,425	3,836

2. Program Description

This section describes key elements of program design and performance. The evaluation period addressed in this report is January 1, 2016 to December 31, 2018.

2.1 Program Design

The DEK Smart $aver® Program provides incentives for electric commercial and industrial customers to purchase and install high-efficiency lighting, HVAC systems, pumps and drives, and qualifying process, food service, and information technology equipment. The program also uses incentives to encourage maintenance of existing equipment in order to reduce energy usage. Incentives are available for new construction and retrofits and replacements. Prescriptive incentives under the program are limited to 75% or less of the customer cost.

The main delivery channel for the program is application-based. In addition, the Business Savings Store on the Duke Energy website offers customers a limited number of qualified products for which they can receive an instant discount. The discounts offered in the store are consistent with program incentive levels. The program also includes a midstream marketing channel that allows distributors to provide the same incentives directly to prequalified customers on applicable equipment and receive reimbursement for those incentives from Duke Energy.

2.2 Program Performance

Based on the program-tracking database, the program generated 46,845 MWh of ex ante gross energy savings. Approximately 71% of these savings were generated through the program's main channel; the midstream channel and the Business Savings Store accounted for 25% and 5% of these savings, respectively. Ex ante gross energy savings, by delivery channel and technology, are summarized in Table 2-1.

Table 2-1. Smart $aver® Prescriptive Program Projects and Ex Ante Gross Savings

Delivery Channel	Ex Ante Gross Savings	
	MWh	Percent
Main Channel	**33,169**	**71%**
Lighting	*30,861*	*93%*
HVAC	*1,030*	*3%*
Food Service Products	*554*	*2%*
Pumps and Drives	*520*	*2%*
Process Equipment	*204*	*1%*
Midstream Channel	**11,535**	**25%**
Lighting	*11,535*	*100%*
Online Store	**2,141**	**5%**
Lighting	*2,106*	*98%*
HVAC	*31*	*1%*
Food Service products	*3*	*<1%*
Information Technology	*0.2*	*<1%*
Total	**46,845**	

3. Impact Evaluation

The gross impact evaluation mainly leveraged results from the recently completed DEO evaluation. However, it included two evaluation activities specific to DEK: a program-tracking database review and a limited update to Duke Energy's ex ante (deemed) savings assumptions.

This section summarizes the gross impact methodology – including a general overview of the DEO methodology and DEK-specific activities – as well as gross impact results.

3.1 Methodology

The first step in the gross impact evaluation was to perform a database review. We received an extract from the DEK program-tracking database that contained the data needed in support of our evaluation. Our team of energy data scientists and engineers cleaned these data and created an evaluation dataset that reflects program activity during the evaluation period. Key data-cleaning activities included verification of installation dates, removal of duplicate and otherwise ineligible records (e.g., zero savings), and development of ex ante savings (by multiplying per-unit savings by measure quantities).

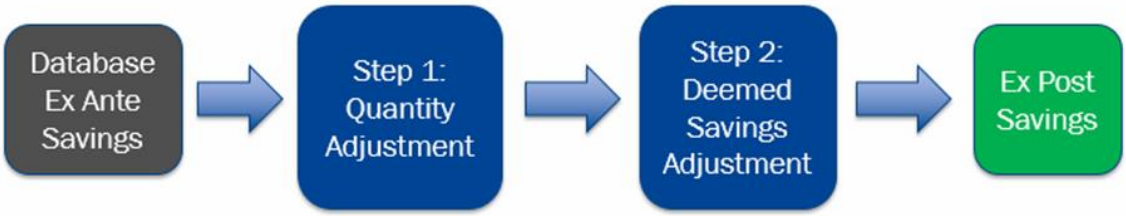
The database review resulted in a clean dataset that reflects the eligible population of program projects with complete data required to estimate savings. We used this dataset to develop technology- and program-level ex ante gross impacts.

Following the database review, the evaluation team used a combination of results from the DEO evaluation and a limited deemed savings update to estimate ex post (verified) gross impacts. The methodology consisted of a two-step process to adjust the ex ante savings from the program-tracking database:

- **Step 1: Quantity Adjustment:** We applied technology-specific quantity adjustments from the DEO evaluation to measure quantities in the program-tracking database.
- **Step 2: Deemed Savings Adjustment:** Based on a limited deemed savings update, we developed measure-specific per-unit savings adjustment factors, which we applied to the per-unit measure savings in the program-tracking database.

Figure 3-1 depicts this process.

Figure 3-1. Gross Impact Evaluation Approach



3.1.1 Quantity Adjustment

The quantity adjustments used for the DEK gross impact analysis were based on 90 desk reviews and 39 on-site verification visits, conducted for a sample of DEO main channel projects. Based on information from both

desk reviews and on-site visits, we developed technology-level quantity adjustment factors. While the desk reviews and on-site visits included only main channel projects, we applied the technology-level adjustment factors to all DEK program-incented measures, including those incented through the Business Savings Store and the midstream channel.

3.1.2 Deemed Savings Adjustment

The purpose of the deemed savings review was to make limited updates to per-unit savings assumptions for select measures incented through the DEK Smart $aver® Prescriptive Program. We leveraged the recently completed DEO evaluation to develop DEK deemed savings values, as follows:

- For 13 **lighting measures that were included in the DEO deemed savings review**, we developed ex post deemed savings values based on deemed savings review results from the DEO evaluation, but incorporated DEK-specific hours of use values from the DEK program database, as well as coincidence factors and waste heat factors, weighted by building type.
- For two **non-lighting measures that were included in the DEO deemed savings review**, ex post deemed savings values were set to equal ex post deemed savings values from the DEO evaluation.
- For **measures that were not part of the DEO deemed savings review**, ex post deemed savings values were set to equal DEK ex ante values provided by Duke Energy.

The full, measure-level deemed savings review is provided in Appendix A.

3.2 Gross Impact Results

Table 3-1 summarizes the DEK ex ante and ex post gross energy impacts (including savings from all three delivery channels) resulting from the two-step adjustment approach described above. The following subsections provide more detailed results from the quantity and deemed savings adjustment analyses, including realization rates.

Table 3-1. Overall Gross Impacts

Technology	Ex Ante Gross Savings			Ex Post Gross Savings		
	Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)	Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)
Lighting	44,502,508	8,413	2,711	44,213,463	7,518	3,939
HVAC	1,061,057	447	112	1,061,057	447	112
Food Service Products	556,419	58	62	556,419	58	63
Pumps and Drives	520,311	60	67	561,088	70	77
Process Equipment	204,470	49	49	204,470	49	49
Information Technology	200	-	-	200	-	-
Total	**46,844,963**	**9,027**	**3,001**	**46,596,696**	**8,142**	**4,240**

3.2.1 Quantity Adjustment

The DEO desk reviews and on-site visits did not find any discrepancies between the program-tracking data, project materials, and on-site measure quantities. Therefore, the quantity realization rates, shown in Table 3-2, were 100% for all technology types. We therefore applied no quantity adjustment to DEK ex ante savings.

Table 3-2. Quantity Adjustments

Technology	Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)
Lighting	100%	100%	100%
HVAC	100%	100%	100%
Food Service Products	100%	100%	100%
Pumps and Drives	100%	100%	100%
Process Equipment	100%	100%	100%
Information Technology	100%	N/A	N/A
Total	**100%**	**100%**	**100%**

3.2.2 Deemed Savings Adjustment

The deemed savings review resulted in modifications to the per-unit savings assumptions for the 13 lighting and 2 non-lighting measures included in this analysis. Table 3-3 summarizes the results of the deemed savings review, by technology.

Table 3-3. Deemed Savings Adjustments

Technology	Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)
Lighting	99%	89%	145%
HVAC[A]	100%	100%	100%
Food Service Products	100%	100%	102%
Pumps and Drives	108%	116%	114%
Process Equipment[A]	100%	100%	100%
Information Technology[A,B]	100%	N/A	N/A
Total	**99%**	**90%**	**141%**

[A] The deemed savings review did not include any HVAC, process, or information technology measures. Ex post savings for these technologies are set to equal ex ante savings, i.e., a realization rate of 100%.

[B] The information technology measures incented during the evaluation period did not have peak demand savings. As a result, a realization rate is not applicable.

3.2.3 Overall Gross Realization Rates

Based on the quantity and deemed savings adjustments, the overall program-level realization rates are 99% for energy savings, 90% for summer peak demand savings, and 141% for winter peak demand savings. These values are driven by adjustments to the deemed savings values. Table 3-4 summarizes the overall gross realization rates.

Table 3-4. Overall Gross Realization Rates

Technology	Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)
Lighting	99%	89%	145%
HVAC	100%	100%	100%
Food Service Products	100%	100%	102%
Pumps and Drives	108%	116%	114%
Process Equipment	100%	100%	100%
Information Technology	100%	N/A	N/A
Total	**99%**	**90%**	**141%**

In addition to the ex post gross impact results and realization rates developed above, Duke Energy requires realization rates that it can apply to new measures, for planning purposes. In most cases, the realization rates summarized in Table 3-4 can be used for that purpose, with two exceptions: The high winter demand realization rates for lighting and food service equipment resulted from assigning positive ex post savings to measures that had ex ante winter demand savings of zero. Applying these values to new measures with non-zero ex ante winter demand savings would overstate winter demand savings for those measures. As a result, we developed alternate winter demand realization rates for lighting and food service measures, which are based on only those incented measures that have non-zero ex ante winter demand savings. These rates can be applied to new lighting and food service measures, respectively, with non-zero ex ante winter demand savings.

Table 3-5 summarizes the overall gross realization rates when using the alternate winter peak demand realization rates described above. It should be noted that none of the other technology-level realization rates in Table 3-5 changed.

Table 3-5. Overall Gross Realization Rates – Alternate Rates for Planning Purposes

Technology	Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)
Lighting	99%	89%	81%
HVAC	100%	100%	100%
Food Service Products	100%	100%	100%
Pumps and Drives	108%	116%	114%
Process Equipment	100%	100%	100%
Information Technology	100%	N/A	N/A
Total	**99%**	**90%**	**83%**

4. Net Impact Analysis

4.1 Methodology

Our net impact analysis included application of a net-to-gross ratio (NTGR) to ex post gross savings. The NTGR includes consideration of free-ridership (FR), participant spillover (PSO), and trade ally spillover (TA SO), applicable to the main delivery channel. These concepts are defined as follows:

- Free-riders are program participants who would have completed the same energy efficiency upgrade without the program. FR scores represent the percentage of savings that would have been achieved in the absence of the program. FR scores can range from 0% (not a free-rider; the participant would not have completed the project without the program) to 100% (a full free-rider; the participant would have completed the project without the program). FR scores between 0% and 100% represent partial free-riders, i.e., participants who were to some degree influenced by the program to complete the energy efficiency upgrade.
- PSO refers to additional energy efficiency upgrades participants made at the time of or after their participation in the Smart $aver® Prescriptive Program that were influenced by the program but for which they did not receive a program incentive. PSO is estimated at the program level and expressed as a percentage of program savings.
- TA SO refers to non-incented energy efficiency upgrades made by customers who were influenced by a participating trade ally who was in turn influenced by the Smart $aver® Prescriptive Program. TA SO is estimated at the program level and is expressed as a percentage of program savings.

FR, PSO, and TA SO are all based on the recently completed DEO evaluation. The NTGR is calculated as follows:

$$NTGR = 1 - FR + PSO + TA\ SO$$

Because the DEO evaluation scope did not include NTGR research with participants in the midstream channel and the online store, we applied a default NTGR of 1.0 to projects delivered through these two channels.

4.2 Net Impact Results

The DEO evaluation estimated the program-level NTGR for the main delivery channel to be 87.4%. The NTGRs for lighting and non-lighting are 87.9% and 81.8%, respectively.

Table 4-1 presents the NTGRs by NTG component (i.e., FR, PSO, and TA SO) and by technology group (i.e., lighting and non-lighting).

Table 4-1. Summary of DEO Evaluation NTGR Results

Technology	FR	PSO	TA SO	NTGR
Lighting	17.7%	0.04%	5.6%	87.9%
Non-Lighting	23.9%			81.8%
Total	**18.3%**	**0.04%**	**5.6%**	**87.4%**

The DEK Smart $aver® Program realized net energy savings of nearly 43 GWh during the evaluation period. The main channel contributed approximately 29 GWh to this total while the midstream channel contributed nearly 12 GWh and the online store contributed just over 2 GWh. The largest share of net savings came from main channel lighting projects, which accounted for 63% of total program net savings.

Table 4-2 summarizes ex post net savings for the evaluation period.

Table 4-2. Summary of Net Program Savings

Technology	Ex Post Gross			NTGR	Ex Post Net		
	Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)		Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)
Main Channel	32,739,912	5,627	3,195	0.87	28,648,110	4,910	2,792
Lighting	*30,390,723*	*5,004*	*2,896*	*0.88*	*26,726,741*	*4,401*	*2,547*
HVAC	*1,030,005*	*446*	*111*	*0.82*	*842,427*	*365*	*91*
Food Service Products	*553,627*	*58*	*63*	*0.82*	*452,804*	*47*	*51*
Pumps and Drives	*561,088*	*70*	*77*	*0.82*	*458,906*	*57*	*63*
Process Equipment	*204,470*	*49*	*49*	*0.82*	*167,233*	*40*	*40*
Midstream Channel	11,717,043	2,081	970	1.00	*11,717,043*	2,081	970
Online Store	2,139,742	434	75	1.00	*2,139,742*	434	75
Total	46,596,696	8,142	4,240		42,504,895	7,425	3,836

5. Summary Form

Duke Energy Kentucky
Non-Residential Smart $aver® Prescriptive Program

Completed EM&V Fact Sheet

Program Description

The Duke Energy Kentucky Non-Residential Smart $aver® Prescriptive Program provides incentives to commercial and industrial customers for a range of measures, including lighting; HVAC systems; pumps and drives; process equipment; food service products; and information technology equipment. The program works with trade allies to promote the program and drive participation. The program also offers two alternative channels where customers can purchase a subset of products offered through the main channel at comparable incentive levels either online through the Business Savings Store or directly from distributors as part of the midstream channel.

Date	July 24, 2019
Region(s)	Duke Energy Kentucky
Evaluation Period	January 1, 2016– December 31, 2018
Annual kWh Savings (ex post net)	42,505 MWh
Coincident kW Impact (ex post net)	7.4 MW (Summer) 3.8 MW (Winter)
Measure Life	Not Evaluated
Net-to-Gross Ratio	87.4% overall; 87.9% lighting; 81.8% non-lighting (based on 2018 DEO evaluation)
Process Evaluation	No
Previous Evaluation(s)	Impact Evaluation of the Non-Residential Smart $aver® Prescriptive Program in Ohio and Kentucky; November 21, 2013

Evaluation Methodology

The evaluation team performed a limited gross and net impact analysis, leveraging results from a recently completed evaluation for the Duke Energy Ohio Non-Residential Smart $aver® Prescriptive Program.

For the gross impact analysis, we reviewed program-tracking data and developed a comprehensive database of program measures and ex ante savings. We updated per-unit "deemed" savings values for lighting measures included in the DEO deemed savings review with DEK-specific hours of use values from the DEK program database, as well as coincidence factors and waste heat factors, weighted by building type. For non-lighting measures included in the DEO deemed savings review, we applied DEO ex post savings values. Finally, we estimated ex post gross energy and demand savings, by technology, based on these per-unit deemed savings adjustments and quantity adjustments from the DEO evaluation.

The net impact evaluation developed ex post net energy and demand savings by applying net-to-gross ratios from the DEO evaluation to DEK ex post gross savings.

6. DSMore Table

The Excel spreadsheet containing measure-level inputs for Duke Energy Analytics is provided in a separate file. Per-measure savings values in the spreadsheet are based on the gross and net impact analyses reported above. The evaluation scope did not include updates to measure life assumptions.

[DSMore Table provided in a separate file]

Appendix A. Deemed Savings Review Memorandum

The Word document containing the deemed savings review memorandum is provided in a separate file.

[Deemed Savings Review Memorandum provided in a separate file]

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Reimagine tomorrow.

Opinion Dynamics

Save Energy and Water Kits 2018 – 2019 Evaluation Report

Submitted to Duke Energy Kentucky
by Nexant in partnership with Opinion Dynamics

April 6th, 2020

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1 Executive Summary

1.1 Program Summary

The Save Energy and Water Kit Program (SEWKP) is a Duke Energy program that provides free energy and water efficiency kits to pre-selected households in the Duke Energy Kentucky (DEK) jurisdiction. The kits include aerators for kitchen and bathroom sink faucets, showerheads, and water heater pipe wrap.

1.2 Evaluation Objectives and Results

This report presents the results and findings of evaluation activities for DEK SEWKP conducted by the evaluation team, collectively Nexant Inc. and our subcontracting partner, Opinion Dynamics, for the program year of July 2018 – June 2019.

1.2.1 Impact Evaluation

The evaluation team conducted the evaluation as detailed in this report to estimate energy and demand savings attributable to the DEK program. The evaluation was divided into two research areas - to determine gross savings and net savings (or impacts). Gross impacts are energy and demand savings estimated at a participant's home that are the direct result of the homeowner's installation of a measure included in the SEWKP kit. Net impacts reflect the degree to which the gross savings are a result of the program efforts and funds.

Table 1-1, Table 1-2, and Table 1-3 present the summarized findings of the impact evaluation for the DEK jurisdiction. All totals in Table 1-1, excluding the population, are weighted averages based on the 2018-2019 evaluation sample and represent expected savings from the average participant.

Table 1-1: Energy Savings per Kit

Kit Size	Population	Reported Energy (kWh)	Energy Realization Rate	Gross Verified Energy (kWh)
Small	734	672	61.7%	414
Medium	369	843	60.3%	508
Program Total	**1,103**	**729**	**61.1%**	**446**

Table 1-2: Demand Savings per Kit

Kit Size	Summer Demand (kW)			Winter Demand (kW)		
	Reported	Realization Rate	Gross Verified	Reported	Realization Rate	Gross Verified
Small	0.054	68.7%	0.037	0.077	64.2%	0.049
Medium	0.067	66.5%	0.045	0.075	80.2%	0.060
Program Total	**0.058**	**67.9%**	**0.040**	**0.076**	**69.4%**	**0.053**

Table 1-3: Program Level Savings

Measurement	Population	Reported	Realization Rate	Gross Verified
Energy (kWh)	1,103	804,315	61.1%	491,780
Summer Demand (kW)		64.2	67.9%	43.6
Winter Demand (kW)		83.9	69.4%	58.2

The portion of gross verified savings by measure type are presented in Figure 1-1. Per unit energy and demand savings by measure and program net to gross ratio details are presented in Table 1-4.

Figure 1-1: Portion of Program Verified Savings by Measure

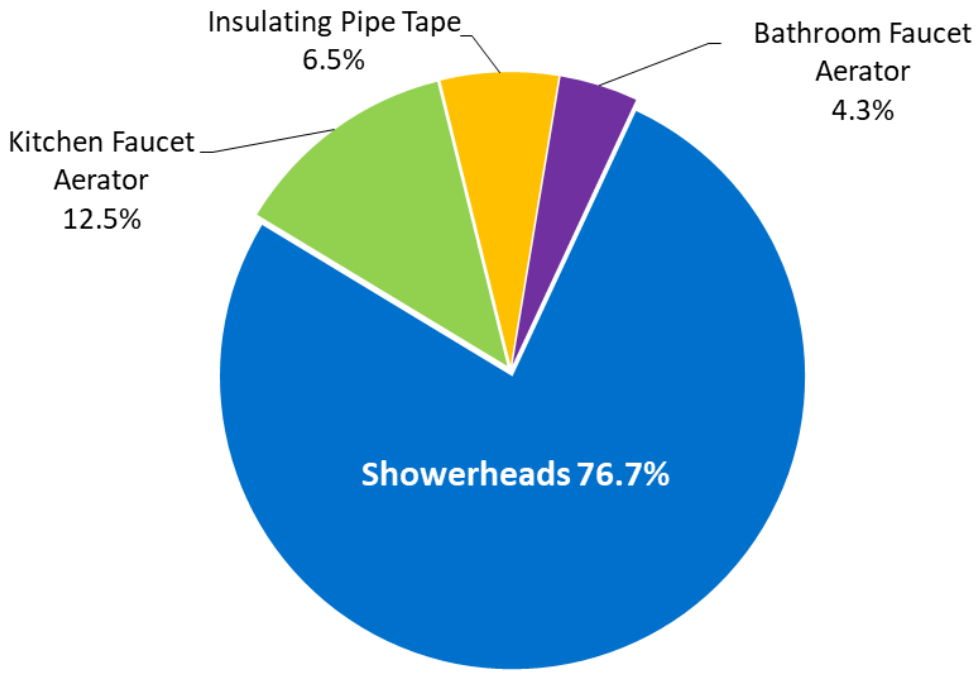


Table 1-4: DEK Verified Impacts by Measure

Measure	Energy Savings per unit (kWh)	Summer Demand Savings per unit (kW)	Winter Demand Savings per unit (kW)	Free Ridership	Spillover	Net to Gross Ratio
Low-flow Showerhead	256.3	0.0216	0.0297	12.0%	11.1%	99.1%
Low-flow Kitchen Aerator	55.7	0.0039	0.0051			
Low-flow Bathroom Aerator	9.6	0.0018	0.0024			
Pipe Wrap*	5.9	0.0007	0.0007			

* Savings for pipe tape is a per linear foot measurement

1.2.2 Process Evaluation

The process evaluation assessed opportunities for improving the program's design and delivery in the DEK service territory. It specifically documented participant experiences by investigating participating household responses to the kits and the extent to which the kits effectively motivate households to save energy.

The evaluation team reviewed program documents and conducted telephone and web surveys with households that received a kit (n=174). The team also conducted in-depth interviews with utility and implementation staff.

Program Successes

The 2018-2019 DEK SEWKP evaluation found successes in the following areas:

Most participants are satisfied with kit items and report high satisfaction with the program overall. Eighty-four percent of participants reported they were highly satisfied with the program overall, and less than 10% of participants reported dissatisfaction with each of the specific measures.

Kit instructions are perceived as highly helpful among SEWKP participants. Seventy-seven percent of participants said they read the instructional insert from their kit that offers detailed instructions on self-installing the measures, nearly three-quarters of whom said the instructions were highly helpful.

The program influenced household to install kit measures. Most participating households installed at least one measure from the kit and the vast majority of installed measures, once installed, remained installed. Participants were highly influenced by the program to install kit measures, as demonstrated by low free ridership rates. Further, 19% of respondents reported program-attributable spillover.

Program Challenges

The 2018-2019 DEK SEWKP evaluation found some challenges in the following areas:

Low water pressure is the primary contributor to dissatisfaction and uninstallation rates. Complaints of excessively low water pressure were the primary drivers of dissatisfaction with and uninstallation of water saving measures among a small minority of participants who were dissatisfied with or uninstalled items.

Fewer participants are installing at least one measure. Slightly less than three-quarters of participants installed at least one measure. This reflects a decrease in installation rates for all four measures and is a lower in-service rate than seen in previous SEWKP evaluation cycles across Duke Energy jurisdictions.

1.3 Evaluation Conclusions and Recommendations

The evaluation findings led to the following conclusions and recommendations for the program:

Conclusion 1: The program model is highly successful: it leverages low-cost measures to foster energy savings that would not have happened otherwise. Duke Energy's easy process for requesting and receiving a kit with free energy and water-saving items motivated over 1,100 customers to request and install energy saving measures in their home during the evaluation period. Most participants installed at least one measure from the kit, relatively few measures get uninstalled, and many participants reported installing additional energy saving items since receiving the kit. The majority of participants said they would not have installed any of the items on their own, as represented by low free ridership rates, and the program is reaching a diverse range of customers in terms of household characteristics and demographics.

> **Recommendation**: Continue using SEWKP to encourage Duke Energy customers to save energy and water.

Conclusion 2: The water-saving measures' low flow water pressure results in some minor dissatisfaction and uninstallation issues. Complaints of excessively low water pressure were the primary drivers of measure dissatisfaction and uninstallation. However, only a minority of participants were dissatisfied with or uninstalled water-saving items. The program has started offering showerhead upgradesfor on-line participants that allows them to choose their preferred showerhead style, but this was unavailable during the 2018-19 evaluation period

> **Recommendation**: Monitor how showerhead upgrades affect satisfaction and uninstallation rates going forward.

Conclusion 3: Fewer participants are installing at least one measure. Seventy-two percent of participants reported installing at least one item from the kit, which is lower than the in-service rates seen for this program in the past evaluation cycle

> **Recommendation**: Monitor installation rates in other jurisdictions in upcoming evaluations to determine if this downward trend is specific to Ohio and Kentucky,

leveraging reincorporated survey questions that ask why participants did not install measures.

2 Introduction and Program Description

2.1 Program Description

2.1.1 Overview

The Save Energy and Water Kit Program (SEWKP) is a Duke Energy program that provides free energy and water efficiency kits to pre-selected households in Duke Energy Kentucky (DEK) territory. The kits include low-flow aerators for kitchen and bathroom sink faucets, low-flow showerheads, and water heater pipe wrap.

2.1.2 Energy Efficiency Kit Measures

Table 2-1 lists the kit's contents included in the evaluation scope. There are two kit sizes, which dictate the number of showerheads and bathroom aerators the participant receives. In addition to the measures below, the kit includes plumbing tape, a rubber gasket opener to remove old aerators and showerheads, and an instructional insert that has detailed installation instructions. Duke Energy has additional installation instruction information available on their website.

Table 2-1: Kit Measures and Quantity

Measures	Small Kit	Medium Kit
Low-flow Showerhead (1.5 gpm)	1	2
Low-flow Bathroom Faucet Aerator (1.0 gpm)	2	2
Low-flow Kitchen Faucet Aerator (1.0 gpm)	1	1
Pipe Wrap (up to 10' of coverage)	1	1

2.2 Program Implementation

2.2.1 Participant Identification and Recruitment

Every month Duke Energy's internal analytics department identifies households to recruit into the program. They look through customer accounts for single family electric-only accounts that have not participated in SEWKP or any other programs with similar measures (specifically, the Energy Efficiency Education in Schools and Home Energy House Call programs). Pre-selected households are then assigned either a small or medium kit based on household square footage. Next, Duke Energy approaches these customers through either emails, if the pre-selected customer has an email address on file, or business reply cards (BRC). Simultaneously, Duke Energy sends the implementer – Energy Federation, Inc. (EFI) – a list of pre-selected accounts that received an offer to participate in the SEWKP that month. Email messages provide a link for the customer to join the program and households that receive the BRC simply detach the reply form and put it back in the mail (postage is pre-paid). Alternatively, customers may also call a

toll free number, provided on the email or BRC, to confirm eligibility and request their free kit. EFI then ships the appropriate kit (small or medium) to registered households.

2.2.2 Participation

For the defined evaluation period of July 1st, 2018 through June 30th 2019, the program recorded a total of 1,103 kit recipients in DEK. During survey recruitment of sampled customers, 0% of participants reported that their kit did not arrive in the mail.

2.3 Key Research Objectives

Over-arching project goals will follow the definition of impact evaluation established in the "Model Energy-Efficiency Program Impact Evaluation Guide – A Resource of the National Action Plan for Energy Efficiency," November 2007:

> *"Evaluation is the process of determining and documenting the results, benefits, and lessons learned from an energy-efficiency program. Evaluation results can be used in planning future programs and determining the value and potential of a portfolio of energy-efficiency programs in an integrated resource planning process. It can also be used in retrospectively determining the performance (and resulting payments, incentives, or penalties) of contractors and administrators responsible for implementing efficiency programs".*

Evaluation has two key objectives:

1) To document and measure the effects of a program and determine whether it met its goals with respect to being a reliable energy resource.
2) To help understand why those effects occurred and identify ways to improve the program.

2.3.1 Impact

As part of evaluation planning, the evaluation team outlined the following activities to assess the impacts of the DEK SEWKP:

- Quantify accurate and supportable energy (kWh) and demand (kW) savings for energy efficient measures implemented in participants' homes;
- Assess the rate of free riders from the participants' perspective and determine spillover effects;
- Benchmark verified measure-level energy impacts to applicable technical reference manual(s) and other Duke-similar programs in other jurisdictions.

2.3.2 Process

The process evaluation assessed opportunities for improving the design and delivery of the program in DEK service territory. It specifically documented participant experiences by

investigating participant responses to the energy efficiency kits and the extent to which the kits effectively motivate households to save energy and water.

The evaluation team assessed several elements of the program delivery and customer experience, including:

Motivation:

- What motivated participants to request and install the measures in the kit?
- In what ways, if any, did the program motivate participants to adopt new energy and water saving behaviors?

Program experience and satisfaction:

- How satisfied are participants with the overall program experience and kit items in terms of ease of use and measure quality?

Challenges and opportunities for improvement:

- Are there any inefficiencies or challenges with the delivery of the program?
- Are there any measures that have particularly low installation rates? If so, why?
- Are there any measures that have particularly high uninstallation rates? If so, why?

Participant household characteristics:

- What are demographic characteristics of those who received the kits?

2.4 Evaluation Overview

The evaluation team divided its approach into key tasks to meet the goals outlined:

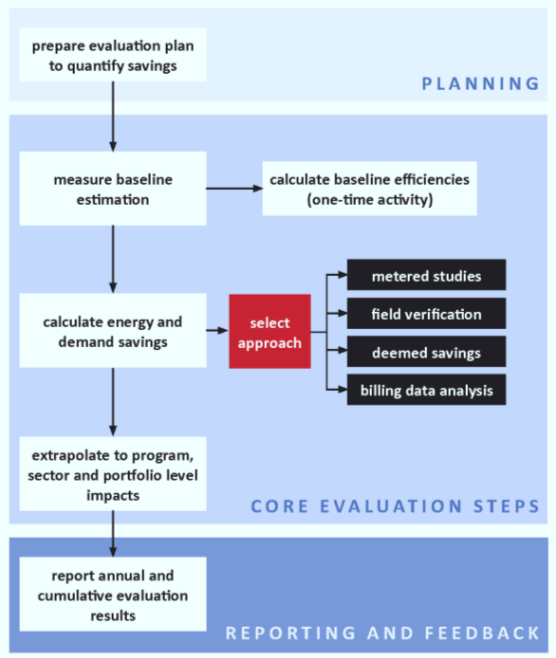
- **Task 1 –** Develop and manage evaluation work plan to describe the processes that will be followed to complete the evaluation tasks outlined in this project;
- **Task 2 –** Conduct a process review to determine how successfully the programs are being delivered to participants and to identify opportunities for improvement;
- **Task 3 –** Verify gross and net energy and peak demand savings resulting from SEWKP through verification activities of a sample of 2018-2019 program participants.

2.4.1 Impact Evaluation

The primary determinants of impact evaluation costs are the sample size and the level of rigor employed in collecting the data used in the impact analysis. The accuracy of the study findings is in turn dependent on these parameters. Techniques that we used to conduct our evaluation, measurement, and verification (EM&V) activities, and to meet the goals for this evaluation, included telephone and web-based surveys with program participants, best practice review, and interviews with implementation and program staff.

Figure 2-1 demonstrates the principal evaluation team steps organized through planning, core evaluation activities, and final reporting.

Figure 2-1: Impact Evaluation Process



The evaluation is generally comprised of the following steps, which are described in further detail throughout this report:

- **Participant Surveys:** The file review for all sampled and reviewed program participation concluded with a telephone and/or web-based survey with the participants. Table 2-2 below summarizes the number of surveys completed. The samples were drawn to meet a 90% confidence and 10% precision level based upon the expected and actual significance (or magnitude) of program participation, the level of certainty of savings, and the variety of measures.
- **Calculate Impacts:** Data collected via surveys enabled the evaluation team to calculate gross verified energy and demand savings for each measure.
- **Estimate Net Savings**: Net impacts are a reflection of the degree to which the gross savings are a result of the program efforts and incentives. The evaluation team estimated free-ridership and spillover based on self-report methods through surveys with program participants. The ratio of net verified savings to gross verified savings is the net-to-gross ratio as an adjustment factor to the reported savings.

2.4.2 Process Evaluation

Process evaluation examines and documents:

- Program operations
- Stakeholder satisfaction

- Opportunities to improve the efficiency and effectiveness of program delivery

To satisfy the evaluation, measurement, and verification (EM&V) objectives for this research effort, the evaluation team reviewed program documents and conducted telephone and web surveys with participating households who received a kit. The team also held in-depth interviews (IDI) with utility and implementation staff. Table 2-2 provides a summary of the activities the evaluation team conducted as part of the DEK SEWKP process and impact evaluation.

Table 2-2: DEK SEWKP Summary of Evaluation Activities

Target Group	2018 Population	Sample	Confidence /Precision	Method
Impact Activities				
DEK Participants	1,103	174	90/5.8	Telephone/Web Survey
Process Activities				
DEK Participants	1,103	174	90/5.8	Telephone/Web Survey
Duke Energy Program Staff	n/a	1	n/a	Telephone IDI
Implementer Staff: EFI	n/a	1	n/a	Telephone IDI

3 Impact Evaluation

3.1 Methodology

The evaluation team's impact analysis focused on the energy and demand savings attributable to the SEWKP for the period of July 2018 through June 2019. The evaluation was divided into two research areas: to determine gross savings and net savings (or impacts). Gross impacts are energy and demand savings estimated at a participant's home that are the direct result of the homeowner's installation of a measure included in the program-provided energy saving kit. Net impacts are a reflection of the degree to which the gross savings are a result of the program efforts and funds. The evaluation team verified energy and demand savings attributable to the program by conducting the following impact evaluation activities:

- Review of DEK participant database.
- Completion of telephone and web-based surveys to verify key inputs into savings calculations.
- Estimation of gross verified savings using primary data collected from participants.
- Comparison of the gross-verified savings to program-evaluated results to determine kit-level realization rates.
- Application of attribution survey data to estimate net-to-gross ratios and net-verified savings at the program level.

3.2 Database and Historical Evaluation Review

Duke Energy provided the evaluation team with a program database for the SEWKP participation within each jurisdiction. The program database provided participant contact information including account number, address, phone number, email address (if available), and whether or not the participant was willing to be contacted. Because Duke Energy was able to provide both phone numbers and email addresses, we were able to design a sampling approach that could take advantage of both phone and web-based surveying.

The evaluation team conducted a benchmarking review of the uncertainty of ex-ante savings estimates by comparing multiple technical reference manuals (TRMs) and SEWKP evaluations conducted in select Duke Energy jurisdictions. The details of the benchmarking review are referenced in Table 3-1. The listed savings values include the impact of in-service rates.

Table 3-1: Comparison of Ex-Ante SEWKP Savings to Peer Group Estimates

Measure	DEK 2018 ex-ante savings[1] (kWh)	Ohio 2010 TRM[2] (kWh)	Illinois 2019 TRM[3] (kWh)	Indiana 2015 TRM[4] (kWh)	Mid-Atlantic 2018 TRM[5] (kWh)	Pennsylvania 2016 TRM[6] (kWh)
Showerhead (1.5 gpm)	171.0	165.3	155.5	293.9	390.1	363.9
Bathroom Faucet Aerator (1.0 gpm)	96.0	20.2	13.5	15.9	26.2	56.4
Kitchen Faucet Aerator (1.0 gpm)	79.0	20.2	105.6	122.2	200.8	145.0
Pipe Wrap	46.0	18.6	19.3	18.6	9.4	20.9

[1] Provided by Duke Energy
[2] State of Ohio Energy Efficiency Technical Reference Manual. August, 2010
[3] Illinois Statewide Technical Reference Manual for Energy Efficiency, v7.0. September, 2018
[4] Indiana Technical Reference Manual, v2.1. July, 2015
[5] Mid-Atlantic Technical Reference Manual v8. May, 2018
[6] Pennsylvania Public Utility Commission Technical Reference Manual. June, 2016

While Table 3-1 does illustrate variation in deemed savings among each source for each given measure, much of this variation reflects different in-service rate and water heat fuel type assumptions. Also of note is that the Ohio and Mid-Atlantic TRMs do not differentiate parameter assumptions between bathroom and kitchen faucet aerators. For this reason, the evaluation team ultimately used assumptions outlined by the Indiana and Pennsylvania TRMs to capture different usage patterns between each aerator location. All other parameters not mined from the participant survey generally relied on either the Ohio or Indiana TRM assumptions.

3.3 Sampling Plan and Achievement

To provide representative results and meet program evaluation goals, a sampling plan was created to guide all evaluation activity. A random sample was created to target 90/10 confidence and precision at the program level assuming a coefficient of variation (C_v) equal to 0.5.

3.3.1 DEK Sample

After reviewing the program database, we identified a population of 1,103 participants within our defined evaluation period. Based on this population, the evaluation team established sub-sample frames for phone and web-based survey administration. Customers who were flagged as “do not contact” in the participation database were excluded from the sample frame. As illustrated in Table 3-2 below, we completed a total of 174 surveys among Kentucky program participants between October 14th and 28th, 2019. This sample size resulted in a precision of ±5.8% at a 90% confidence interval.

Table 3-2: DEK Impact Sampling

Survey Mode	Sample Frame	Sampled Participants	Achieved Precision at 90% Confidence
Phone	313	43	90/5.8
Web-based	685	131	
Total	**998**[1]	**174**	

3.4 Description of Analysis

3.4.1 Telephone and web-based surveys

The evaluation team performed telephone and web-based surveys to gain key pieces of information used in the savings calculations. Results of the completed surveys were used to inform our program-wide assumptions as detailed in Table 3-3.

Table 3-3: Participant Data Collected and Used for Analysis

Measure	Data Collected	Assumption
Showerhead Bathroom Faucet Aerator Kitchen Faucet Aerator	Units Installed	In-Service Rate
	Units Later Removed	
	Hot Water Fuel Type	% Electric DHW
	Frequency of Showers	Hot Water Consumption
	Duration of Showers	
Pipe Wrap	Pipe Wrap Used	In-Service Rate
	Pipe Wrap Removed	
	Hot Water Fuel Type	% Electric DHW
	Length of Insulated Pipe	Pipe Length

3.4.2 In-Service Rate

The in-service rate (ISR) represents the ratio of equipment installed and operable to the total pieces of equipment distributed and eligible for installation. For example, if 15 telephone surveys were completed for customers receiving 1 bathroom aerator each, and five customers reported to still have the aerator installed and operable, the ISR for this measure would be five out of 15 or 33%. In some instances equipment was installed, but may have been removed later due to homeowner preferences. In these cases the equipment is no longer operable and therefore contributes negatively to the ISR. In-service rates for each measure from all eligible survey respondents are detailed in Table 3-4.

[1] Differences in program participation and sample frame are due participants with “do not contact” designations

Table 3-4: DEK SEWKP In-Service Rates

Measure	Distributed	Installed	Removed	ISR
Showerhead	233	96	10	37%
Bathroom Faucet Aerator	348	92	8	24%
Kitchen Faucet Aerator	174	56	9	27%
Pipe Wrap*	174	51	0	29%

*Quantity of pipe tape packages

In-service rates for all measures are lower than reported values for past evaluations of the SEWKP in other service territories, but they're also aligned with ISRs from the 2018-19 SEWKP evaluation in the Duke Energy Ohio service territory. The cause of this drop is unknown at the moment, but may be due to introduction of email recruitment that lessens the effort needed to participate in the program and results in participants who are less committed to installing the equipment, program saturation within the targeted population that is now reaching into homes that are less motivated to completed installs, or market wide shifts in energy and water efficiency within the DEK service territory. The latter of these options will be tested as evaluations are completed for other Duke Energy service territories, but those results are unavailable at this time.

3.4.3 Kit Measure Savings

The next section of the evaluation report provides a summary of the algorithms used to estimate energy and demand savings for each of the kit items. Input parameters were provided by program participant responses in the surveys. For more technical inputs the evaluation applied secondary data sources such as the Ohio or Indiana TRMs. Where the Ohio 2010 TRM made appropriate distinctions, the evaluation team used Ohio parameter assumptions due to its geographic relevance to the DEK territory. However, where the Ohio TRM lacked granularity, the evaluation team elected to use the Indiana TRM as the secondary data source for savings inputs. Specifically the Indiana TRM provided more comprehensive savings algorithms along with the most applicable secondary source for differentiating between kitchen and bathroom water use.

Demand savings coincident factors (CF) for the summer and winter seasons were estimated to align with peak demand periods for Duke Energy Kentucky[2] using the study on residential domestic hot water use referenced by the Ohio TRM[3]. This method takes into account the average hot water use by fixture type (showerhead, faucet aerator) during the peak period along with the probability of the evaluation daily hours of use occurring at the same time.

[2] Summer Demand Peak: July, 4pm to 5pm and Winter Demand Peak: January, 7pm to 8pm

[3] Aquacraft, DeOreo and Mayer, *The End Uses of Hot Water in Single Family Homes from Flow Trace Analysis*

3.4.3.1 Faucet Aerators

The Save Energy and Water Kit contained one kitchen faucet aerator and multiple bathroom faucet aerators. Participants receiving a kit were provided two bathroom faucet aerators. The equations below outline the algorithms utilized to estimate savings accrued by the faucet aerator measures with parameters defined in Table 3-5.

Equation 3-1: Faucet Aerator Energy Savings

$$\Delta kWh = ISR \times ELEC \times \left[\frac{\Delta GPM \times MPD \times PH \times DR \times 8.3\frac{BTU}{gal \cdot °F} \times \Delta T \times 365\frac{days}{year}}{FH \times 3{,}412\frac{BTU}{kWh} \times RE}\right]$$

Equation 3-2: Faucet Aerator Demand Savings

$$\Delta kW = \frac{ISR \times ELEC \times \Delta GPM \times 60 \times DR \times 8.3\frac{BTU}{gal \cdot °F} \times CF \times \Delta T}{3{,}412\frac{BTU}{kWh} \times RE}$$

Table 3-5: Inputs for Faucet Aerator Measures Savings Calculations

Input	Units	Aerator Savings Input		Source
		Kitchen	Bathroom	
ISR	n/a	27%	24%	Participant survey responses
ELEC	n/a	90%		Participant survey responses
ΔGPM	gpm	1.2		Baseline, federal code minimum Retrofit, product specification sheet
MPD	minutes/day	4.5	1.6	Indiana TRM v2.1
PH	people in home	2.7	2.5	Participant survey responses
DR	n/a	50%	70%	Indiana TRM v2.1
ΔT	°F	35.2	28.2	$Temp_{in}$, Ohio 2010 TRM $Temp_{out}$, Indiana TRM v2.1
FH	Units	1.0	1.9	Participant survey responses
RE	N/A	98%		Ohio 2010 TRM
CF, summer	n/a	0.0051	0.0023	Ohio 2010 TRM, adjusted
CF, winter	n/a	0.0067	0.0031	Ohio 2010 TRM, adjusted

Outside of the Ohio TRM the evaluation team determined that Indiana TRM (v2.1) provided the most applicable secondary by differentiating between kitchen and bathroom water use and providing more comprehensive algorithms. Where the Ohio 2010 TRM made appropriate distinctions, the evaluation team used the Ohio parameter assumptions due to its geographic relevance to the DEK territory. However, where the Ohio TRM lacked granularity, the evaluation team elected to use the Indiana TRM as the secondary data source for estimating savings.

3.4.3.2 Showerheads

The Save Energy and Water Kit contained multiple low-flow showerheads with the quantity depending on the size of the kit received. Participants receiving a small kit received one showerhead; those qualifying for a medium kit received two showerheads. The equations below outline the algorithms utilized to estimate savings accrued by the faucet aerator measures with parameters defined in Table 3-6.

Equation 3-3: Showerhead Energy Savings

$$\Delta kWh = ISR \times ELEC \times \left[\frac{\Delta GPM \times MS \times SPD \times PH \times 8.3\frac{BTU}{gal \cdot °F} \times \Delta T \times 365\frac{days}{year}}{SH \times 3{,}412\frac{BTU}{kWh} \times RE}\right]$$

Equation 3-4: Showerhead Demand Savings

$$\Delta kW = \frac{ISR \times ELEC \times \Delta GPM \times 60 \times 8.3\frac{BTU}{gal \cdot °F} \times CF \times \Delta T}{3{,}412\frac{BTU}{kWh} \times RE}$$

Table 3-6: Inputs for Showerhead Savings Calculations

Input	Units	Showerhead Savings Input	Source
ISR	n/a	37%	Participant survey responses
ELEC	n/a	90%	Participant survey responses
ΔGPM	gpm	1.0	Baseline, federal code minimum Retrofit, product specification sheet
MS	minutes/shower	9.5	Participant survey responses
SPD	showers/person/day	1.1	Participant survey responses
PH	people in home	2.6	Participant survey responses
ΔT	°F	43.2	$Temp_{in}$, Ohio 2010 TRM $Temp_{out}$, Indiana TRM v2.1
SH	showers/home	1.33	Participant survey responses
RE	n/a	98%	Ohio 2010 TRM
CF, summer	n/a	0.0101	Ohio 2010 TRM, adjusted
CF, winter	n/a	0.0139	Ohio 2010 TRM, adjusted

3.4.3.3 Insulating Pipe Wrap

All participants received a 15 foot roll of pipe wrap insulation with their kit. To estimate the impacts resulting from the installation pipe wrap measure, the evaluation team used the algorithms presented below.

Equation 3-5: Insulating Pipe Wrap Energy Savings

$$\Delta kWh = ISR \times ELEC \times \frac{\left(\frac{1}{R_{ex}} - \frac{1}{R_{new}}\right) \times L \times C \times \Delta T \times 8{,}760}{\eta DHW \times 3{,}413}$$

Equation 3-6: Insulating Pipe Wrap Demand Savings

$$\Delta kW = \frac{\Delta kWh}{8{,}760}$$

Table 3-7: Inputs for Insulating Pipe Wrap Savings Calculations

Input	Units	Pipe Wrap Savings Input	Source
ISR	n/a	30%	Participant survey responses
ELEC	n/a	90%	Participant survey responses
R_{ex}	n/a	1.00	Ohio 2010 TRM
R_{new}	n/a	3.00	Product specification sheet
L	linear feet	4.9	Survey Responses*
C	feet	0.20	Indiana TRM (Average of 1/2" and 3/4" pipe)
ΔT	°F	65	Ohio 2010 TRM
ηDHW	n/a	98%	Ohio 2010 TRM

*Participant-provided estimated lengths of hot water pipe covered by the pipe tape was used to estimate verified savings.

Through a combination of participant survey responses as well as TRM and other deemed values, we estimated the parameter inputs presented above in Table 3-7.

3.5 Targeted and Achieved Confidence and Precision

We developed the SEWKP evaluation plan with the goal of achieving a target of 10% relative precision at the 90% confidence interval across both jurisdictions at the program level. Due to a high response rate from the web-based surveys, the evaluation team was able to surpass this target and achieve a high level of statistical precision. The final DEK sample yielded a relative precision of +/- 5.8% at the 90% confidence level (Table 3-8).

Table 3-8: Targeted and Achieved Confidence and Precision

Program	Targeted Confidence/Precision	Achieved Confidence/Precision
DEK SEWKP	90/10.0	90/5.8

3.6 Results

Measure-level and kit-level energy savings values for the DEK jurisdiction are detailed in Figure 3-1 and Table 3-9.

Figure 3-1: Gross Verified Energy Savings

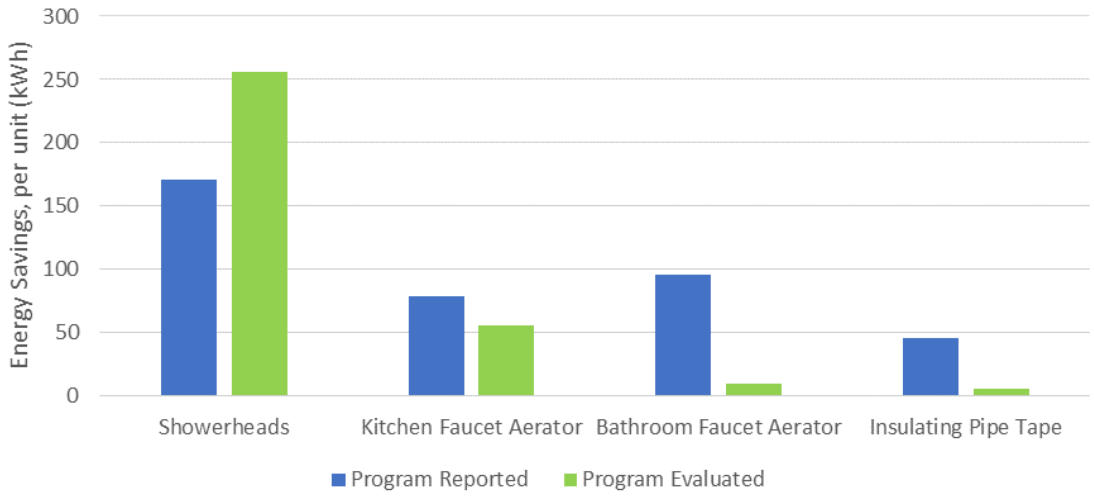


Table 3-9: Measure-Level Reported and Verified Gross Energy Savings

Measure	Reported Energy Savings, per unit (kWh)	Realization Rate	Verified Energy Savings, per unit (kWh)
Low-flow Showerhead	171.0	149.9%	256.3
Low-flow Kitchen Aerator	79.0	70.5%	55.7
Low-flow Bathroom Aerator	96.0	10.0%	9.6
Pipe Wrap*	46.0	12.9%	5.9

* Savings for pipe wrap is a per linear foot measurement

Measure-level and kit-level demand savings are detailed in Table 3-10.

Table 3-10: DEK Measure-Level Reported and Verified Demand Gross Savings

Measure	Summer Demand, per unit (kW)			Winter Demand, per unit (kW)		
	Reported	Realization Rate	Gross Verified	Reported	Realization Rate	Gross Verified
Low-flow Showerhead	0.0137	157.9%	0.0216	0.0195	152.4%	0.0297
Low-flow Kitchen Aerator	0.0063	61.4%	0.0039	0.0090	56.8%	0.0051
Low-flow Bathroom Aerator	0.0076	23.6%	0.0018	0.0108	21.8%	0.0024
Pipe Wrap*	0.0037	18.3%	0.0007	0.0053	12.8%	0.0007

* Savings for pipe wrap is a per linear foot measurement

The impact evaluation for the 2018-2019 program resulted in a program energy realization rate of 61.1% and a demand realization rate of 67.9% (summer) and 69.4% (winter) as presented in Table 3-11 and Table 3-12.

Table 3-11: Energy Savings per Kit

Kit Size	Population	Reported Energy (kWh)	Energy Realization Rate	Gross Verified Energy (kWh)
Small	734	672.0	61.7%	414
Medium	369	843.0	60.3%	508
Program Total	**1,103**	**729.2**	**61.1%**	**446**

Table 3-12: Demand Savings per Kit

Kit Size	Summer Demand (kW)			Winter Demand (kW)		
	Reported	Realization Rate	Gross Verified	Reported	Realization Rate	Gross Verified
Small	0.054	68.7%	0.037	0.077	64.2%	0.049
Medium	0.067	66.5%	0.045	0.075	80.2%	0.060
Program Total	**0.058**	**67.9%**	**0.040**	**0.076**	**69.4%**	**0.053**

Table 3-13 presents the reported and verified energy and demand savings for the 2018-2019 program year.

Table 3-13: Program Level Savings

Measurement	Population	Reported	Realization Rate	Gross Verified
Energy (kWh)	1,103	804,315	61.1%	491,780
Summer Demand (kW)		64.2	67.9%	43.6
Winter Demand (kW)		83.9	69.4%	58.2

4 Net-to-Gross Methodology and Results

The evaluation team used participant survey data to calculate a net-to-gross (NTG) ratio for SEWKP. NTG reflects the effects of free ridership (FR) and spillover (SO) on gross savings. Free ridership refers to the portion of energy savings that participants would have achieved in the absence of the program through their own initiatives and expenditures (U.S. DOE, 2014).[4] Spillover refers to the program-induced adoption of additional energy-saving measures by participants who did not receive financial incentives or technical assistance for the additional measures installed (U.S. DOE, 2014). The evaluation team used the following formula to calculate the NTG ratio:

$$NTG = 1 - FR + SO$$

4.1 Free Ridership

Free ridership estimates how much the program influenced participants to install the energy-saving items included in the energy efficiency kit. Free ridership ranges from 0 to 1, 0 being no free ridership and 1 being total free ridership.

The evaluation team used participant survey data to estimate free ridership. The survey used several questions to identify items that a given participant installed and did not later uninstall: respondents were only asked free ridership questions about items that remained installed by the date of the survey.

The evaluation team's methodology for calculating free ridership consists of two components, free ridership change (FRC) and free ridership influence (FRI), both of which range from 0 to .5 in value.

$$FR = FRC + FRI$$

4.1.1 Free Ridership Change

FRC reflects what participants reported they would have done if the program had not provided the items in the kit. For each respondent, the survey assessed FRC for each measure that the respondent installed and did not later uninstall.

Specifically, the survey asked respondents which, if any, of the currently installed items they would have purchased and installed on their own within the next year if Duke Energy had not provided them. For respondents who installed more than one of a given measure (bathroom

[4] The U.S. Department of Energy (DOE) (2014). *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Chapter 23: Estimating Net Savings: Common Practices.* Retrieved August 29, 2016 from http://energy.gov/sites/prod/files/2015/02/f19/UMPChapter23-estimating-net-savings_0.pdf.

aerators or showerheads) that indicated they would have installed either of the multi-count measures on their own, we asked them a follow up question that determined how many of the number installed through the program that they would have installed on their own.

For each measure, the evaluation team assigned one of the FRC values shown in the Table 4-1, based on the respondents' responses. FRC values range from 0.0 to 0.5.

Table 4-1: Free Ridership Change Values

What Respondent Would Have Done Absent the Program*	FRC Value
Would ***not*** have purchased and installed the item within the next year	0.00
Would have purchased and installed the item within the next year	$\frac{\text{Count respondent said would install on their own}}{\text{Count respondent installed through program}}$

*Survey response to: If you had not received the free efficiency items in the kit, would you have purchased and installed any of these same items within the next year?

4.1.2 Free Ridership Influence

FRI assesses how much influence the program had on a participant's decision to install (and keep installed) the items in the kit. The survey asked respondents to rate how much influence four program-related factors had on their respective decisions to install the measures, using a scale from 0 ("not at all influential") to 10 ("extremely influential"). The program-related factors included:

- The fact that the items were free
- The fact that the items were mailed to their home
- Information provided by Duke Energy about how the items would save energy and water
- Other information or advertisements from Duke Energy, including its website

Asking respondents to separately rate the influence of each of the four above items had on the decision to install each measure would have been overly burdensome. Therefore, while the survey assessed FRC for each measure type, it assessed collective FRI for all measures.

FRI is based on the highest-rated item in the FRI battery. The evaluation team assigned the following FRI scores, based on that rating (Table 4-2).

Table 4-2: Free Ridership Influence Values

Highest Influence Rating	FRI Value
0	0.50
1	0.45
2	0.40
3	0.35

Highest Influence Rating	FRI Value
4	0.30
5	0.25
6	0.20
7	0.15
8	0.10
9	0.05
10	0.00

4.1.3 Total Free Ridership

The evaluation team calculated total free ridership by measure by calculating

- First, measure-specific FR scores for each respondent by summing each respondent's measure-specific FRC score with their FRI score.
- Second, a measure-specific average FR score across all respondents, weighted by the number of units installed by each respondent.

The evaluation team then estimated overall program-level free ridership by calculating a savings-weighted mean of the measure-specific FR scores. Table 4-3 presents the measure-specific and overall FR estimates.

Table 4-3: Measure-Specific Free Ridership Scores

End-use	Measure-Specific Free Ridership
Showerhead	0.137
Kitchen Faucet Aerator	0.063
Bathroom Faucet Aerator	0.055
Pipe Wrap	0.077
Overall	**0.120**

4.2 Spillover

Spillover estimates energy savings from additional energy improvements made by participants who are influenced by the program to do so and is used to adjust gross savings. The evaluation team used participant survey data to estimate spillover. The survey asked respondents to indicate what energy-saving measures they had implemented since participating in the program. The evaluation team then asked participants to rate the influence the program had on their decision to purchase these additional energy-saving measures on a scale of 0 to 10, where 0 means "not at all influential" and 10 means "extremely influential."

The evaluation team converted the ratings to a percentage representing the program-attributable percentage of the measure savings, from 0% to 100%. The team then applied the program-attributable percentage to the savings associated with each reported spillover measure

to calculate the participant measure spillover (PMSO) for that measure. We defined the per-unit energy savings for the reported spillover measures based on ENERGY STAR® calculators, gross verified savings from DEO Smart $aver Program Evaluations, and algorithms and parameter assumptions listed in the 2010 Ohio TRM and the Illinois TRM v7.0.

Since Duke Energy offered program incentives for a variety of energy-saving measures throughout the evaluation period, we compared the list of customers reporting measures as spillover against participation records for other Duke Energy programs that offered the measure. To avoid double-counting savings for measures already claimed by another Duke Energy offering, we excluded savings from measures that appeared in another program's tracking data from our estimation of spillover savings.

Participant measure spillover is calculated as follows:

$$PMSO = Deemed\ Measure\ Savings * Program\ Attributable\ Percentage$$

The evaluation team summed all PMSO savings (Table 4-4).

Table 4-4: DEK Sample PMSO, by Measure by Category

Measure Category	Total kWh for Category	Percent Share of kWh
HVAC	2,900	34%
Appliance	2,079	24%
LEDs	2,058	24%
Insulation	558	6%
Duct Sealing	476	6%
CFLs	224	3%
Water Heater	176	2%
Windows	170	2%
Total	**8,641**	**100%**

The evaluation team then calculated gross program savings associated with sampled participants by summing the products of each measure's average per household savings and the total sample size (Table 4-5).

Table 4-5: DEK Sample Gross Program Savings (n=143)

Measure	Average per Household Savings (kWh)	Verified Sample Savings (kWh)
Showerhead	342.0	59,851
Kitchen Faucet Aerator	55.7	9,752
Bathroom Faucet Aerator	19.2	3,365
Insulating Pipe Tape	28.9	5,057

Measure	Average per Household Savings (kWh)	Verified Sample Savings (kWh)
Total	**445.9**	**78,025**

The evaluation team then divided the summed jurisdictional PMSO values by the sample's gross program savings to calculate an estimated spillover percentage for the program:

$$Program\ SO = \frac{\sum PMSO}{\sum Sample\ Gross\ Program\ Savings}$$

$$DEO\ SO = \frac{8{,}614}{78{,}025}$$

These calculations produced a spillover estimate of 11.1% for the DEK program.

4.3 Net-to-Gross

Inserting the FR and SO estimates into the NTG formula (NTG = 1 – FR + SO) produces an NTG value of 1.01 for the program (Table 4-6). The evaluation team applied this NTG ratio to program-wide verified gross savings to calculate SEWKP kit net savings for the jurisdiction (Table 4-7).

Table 4-6: Net-to-Gross Results

Jurisdiction	Free Ridership	Spillover	NTG
DEK	0.120	0.111	0.991

Table 4-7: Program Level Savings

Measurement	Population	Gross Verified	Net-to-Gross Ratio	Net Verified
Energy (kWh)	1,103	491,780	99.1%	487,190
Summer Demand (kW)		43.6		43.2
Winter Demand (kW)		58.2		57.7

5 Process Evaluation

5.1 Summary of Data Collection Activities

The process evaluation is based on interviews and surveys with program staff, implementer staff, and households who received a kit during the program evaluation year (Table 5-1).

Table 5-1: Summary of Process Evaluation Data Collection Activities

Target Group	Method	Sample Size	Population	Confidence / Precision
Duke Energy program staff	Phone in-depth interview	1	N/A	N/A
Implementation staff: EFI	Phone in-depth interview	1	N/A	N/A
DEK participants	Mixed mode (web/phone) survey	174	1,103	90/±5.8

Comparisons with census data confirm that the DEK sample is fairly representative of income for the region, although higher income residents were slightly underrepresented and middle income residents were slightly overrepresented. Additionally, the sample demonstrated slightly greater educational attainment than that of the region.[5]

5.2 Process Evaluation Findings

Installation Rates

Nearly three-quarters (72%) of kit recipients installed at least one measure, each installing an average of two measures, and 5% of respondents reported initially installing at least one of each measure type. Half of kit recipients (50%) initially installed at least one of the showerheads, with roughly two-fifths (42%) reporting they installed at least one of the bathroom faucet aerators. A smaller portion reported installing kitchen faucet aerators (33%) or pipe wrap (30%). Of the respondents who received a medium-sized kit, about one-fifth (17%) installed both showerheads.[6] Regardless of kit size, participants installed an average of one bathroom aerator and one showerhead.

Of the respondents who installed at least one item from the kit, 17% said they later uninstalled at least one of the measures, and 4% uninstalled everything that they had initially installed. In total, 9% of all initially installed measures were uninstalled at the time of the survey. Kitchen faucet aerators and showerheads had the highest uninstallation rates, with over one-tenth of respondents who installed them later uninstalling them (16% for kitchen faucet aerators and 11% for showerheads). Respondents who uninstalled these water-saving measures most often

[5] Region comparisons come from 2017 American Community Survey (Census) 5-year period estimates data for Boone, Campbell, and Kenton Counties served by DEK in Kentucky.

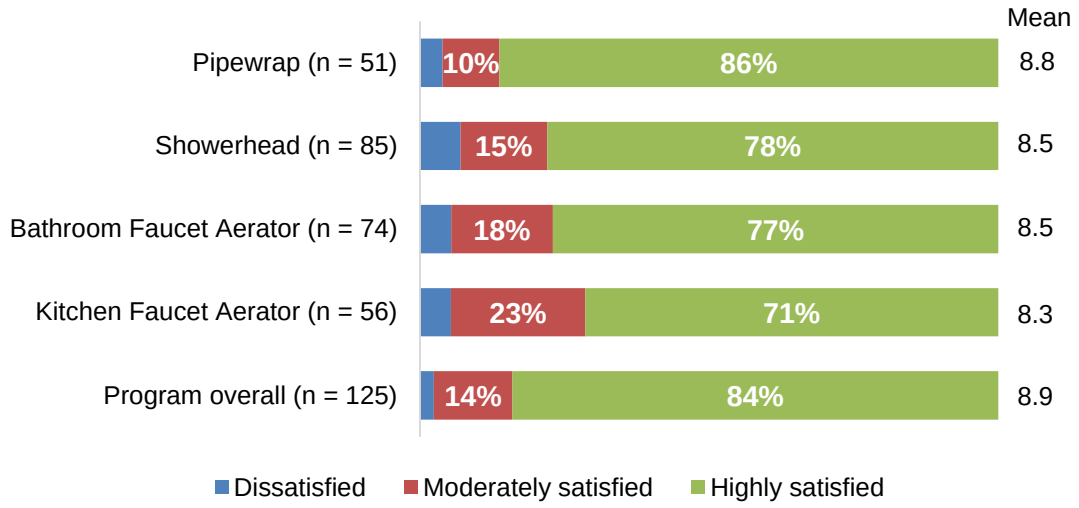
[6] Forty-nine percent of medium kit recipients installed at least one of the two showerheads, 33% of whom installed both.

indicated they did so because they did not like how they worked, later elaborating that the water pressure provided was insufficient for their preferences.

Measure Satisfaction

Nearly all kit recipients reported moderate to high satisfaction with the items they installed from their kit (Table 5-1). We asked respondents to rate their satisfaction with all measures they installed, including those they later uninstalled to best gauge the experience of all participants. Respondents were most satisfied with the pipe wrap and kitchen faucet aerator.

Figure 5-1: Kit Recipient Satisfaction with Measures They Had Installed*



* Respondents rated their satisfaction with the measures on a scale ranging from 0 (“very dissatisfied”) to 10 (“very satisfied”). Dissatisfied indicates 0-4 ratings, moderately satisfied indicates 5-7 ratings, and highly satisfied indicates 8-10 ratings.

Kit Instructional Materials

In addition to energy-saving measures, the Save Energy and Water Kit includes a detailed instruction insert booklet that provides information on how to install the provided measures. Most respondents (77%) said they read the booklet, and among those who did, three-quarters (75%) found it highly helpful.[7] Duke Energy also offers a customer care hotline that participants can call for additional assistance, but only 1% of respondents took advantage of the service.

Additional Energy Saving Actions

Some respondents (41%) reported purchasing and installing additional energy efficiency measures since receiving their kit (Table 5-2). Participants most commonly reported installing LEDs (29%) or buying energy efficient appliances (15%). The majority of respondents (79%) who installed additional measures said DEK SEWKP at least partially influenced their decision to purchase and install additional energy-saving measures.

[7] We asked respondents to rate the helpfulness of the instruction booklet on a scale from 0 (“not at all helpful”) to 10 (“very helpful”). One-hundred and one of the 135 (or 75%) respondents who reported reading the booklet gave a rating of 8 or higher.

Table 5-2: Additional Energy Saving Measures Purchased by DEK Participants (Multiple Responses Allowed; n=174)

	Percent of Respondents Reporting Purchases After Receiving the Kit	Percent Reporting at Least Some DEK Program Influence on Purchase
At least one measure	41%	31%
LEDs	29%	23%
Efficient appliances	15%	10%
Efficient heating or cooling equipment	11%	7%
Air sealing	8%	7%
Efficient water heater	7%	5%
Insulation	5%	3%
Efficient windows	5%	3%
CFLs	5%	4%
Installed storm doors	3%	3%
Duct sealing	1%	1%
Other*	1%	1%

*Other measures included an awning and furnace air filters, each of which represented <1% of respondents

6 Conclusions and Recommendations

The evaluation findings led to the following conclusions and recommendations for the program:

Conclusion 1: The program model is highly successful: it leverages low-cost measures to foster energy savings that would not have happened otherwise. Duke Energy's easy process for requesting and receiving a kit with free energy and water-saving items motivated over 1,100 customers to request and install energy saving measures in their home during the evaluation period. Most participants installed at least one measure from the kit, relatively few measures get uninstalled, and many participants reported installing additional energy saving items since receiving the kit. The majority of participants said they would not have installed any of the items on their own, as represented by low free ridership rates, and the program is reaching a diverse range of customers in terms of household characteristics and demographics.

> **Recommendation**: Continue using SEWKP to encourage Duke Energy customers to save energy and water.

Conclusion 2: The water-saving measures' low flow water pressure results in some minor dissatisfaction and uninstallation issues. Complaints of excessively low water pressure were the primary drivers of measure dissatisfaction and uninstallation. However, only a minority of participants were dissatisfied with or uninstalled water-saving items.

> **Recommendation**: Monitor how showerhead upgrades affect satisfaction and uninstallation rates going forward.

Conclusion 3: Fewer participants are installing at least one measure. Seventy-two percent of participants reported installing at least one item from the kit, which is lower than the in-service rates seen for this program in the past evaluation cycle.

> **Recommendation**: Monitor installation rates in other jurisdictions in upcoming evaluations to determine if this downward trend is specific to Ohio and Kentucky, leveraging reincorporated survey questions that ask why participants did not install measures.

Appendix A Summary Form

Save Energy and Water Kit Program

Completed EMV Fact Sheet

Description of program

The Duke Energy Save Energy and Water Kit Program (SEWKP) is an energy efficiency program that offers energy-efficient water fixtures and water pipe insulation to residential customers. The program is designed to reach customers who have not adopted energy-efficient water devices. The kits are provided to residents through a Direct Mail Campaign, allowing eligible customers to request to have the items shipped directly to their homes, free of charge.

Date	December 17, 2019
Region(s)	Kentucky
Evaluation Period	July 1, 2018 – June 30, 2019
Annual Gross MWh Savings	491.8
Per Kit Gross kWh Savings	445.9
Annual Gross MW Savings	Summer: 0.044 Winter: 0.058
Net-to-Gross Ratio	0.991
Process Evaluation	Yes
Previous Evaluation(s)	none

Evaluation Methodology

Impact Evaluation Activities

- Telephone/web surveys (n=174) and analysis of 4 unique measures

Impact Evaluation Findings

- Realization rates: 61.1% for energy; 67.9% for summer demand impacts; and 69.4% for winter demand
- Net-to-gross ratio: 99.1%

Process Evaluation Activities

- Telephone/web surveys with SEWKP participants (n=174) and analysis of 4 unique measures
- 1 interview with program staff
- 1 interview with implementation staff

Process Evaluation Findings

- The SEWKP influences participants to install kit measures and adopt new behaviors.
- Participants are generally satisfied with kit items and report high satisfaction with overall program.
- Low water pressure is the primary contributor to dissatisfaction among a small subset of participants.

Appendix B Measure Impact Results

Table B-1: Per Unit Verified Impacts by Measure – Key Measure Parameters

Measure Category	Gross Energy Savings (kWh)	Gross Summer Demand (kW)	Gross Winter Demand (kW)	Realization Rate (Energy)	Free Ridership	Spillover	Net to Gross Ratio	M&V Factor (Energy) (RR x NTG)	Measure Life
Low-flow Showerhead (1.5 gpm)	256.3	0.0216	0.0297	149.9%	13.7%	11.1%	97.4%	146.0%	10
Kitchen Faucet Aerator (1.0 gpm)	55.7	0.0039	0.0051	70.5%	6.3%		104.7%	73.9%	10
Bathroom Faucet Aerator (1.0 gpm)	9.6	0.0018	0.0024	10.0%	5.5%		105.6%	10.6%	10
Insulating Pipe Tape*	5.9	0.0007	0.0007	12.6%	7.7%		103.4%	13.0%	13

* Per linear foot

Appendix C Program Performance Metrics

This appendix provides key program performance metrics, or PPIs. See Chapter 5 for the underlying results and more detailed findings.

Figure C-1: DEK Program Experience PPIs

	Participants	
	%	n
Program experience & satisfaction PPIs		
Overall satisfaction with program	84%	125
Usefulness of kit instructions	75%	135
Satisfaction with kit measures		
Showerhead	78%	85
Kitchen faucet aerator	71%	56
Bathroom faucet aerator	77%	74
Pipe wrap	86%	51
Program influence on behavior PPIs		
Installed at least one kit measure	72%	175
Most common measure installed: *showerhead*	50%	175
Respondents reporting program attributable spillover	19%	175
Challenges and opportunities for improvement PPIs		
Measure with lowest installation rate: *pipewrap*	30%	175
Measure with highest uninstallation rate: *kitchen faucet aerator*	16%	58
Measure with highest dissatisfaction: *showerhead*	7%	85

Figure C-2: DEK Participant Demographics PPIs

Ownership Status	
Own	93%
Rent	5%
Refused / Don't know	2%

Household Size	
One to two	58%
Three	15%
Four	13%
Five +	11%
Refused / Don't know	3%

Education	
High school or less	18%
Some college	23%
Bachelor's degree	29%
Graduate degree	18%
Refused / Don't know	7%

Income	
<$30k	10%
$30k to <$60k	24%
$60k to <$75k	9%
$75k to <$100k	12%
$100k+	15%
Refused / Don't know	30%

Age	
18 to 34	12%
35 to 44	19%
45 to 64	31%
65 and older	21%
Refused / Don't know	17%

Figure C-3: DEK Participant Household Characteristics PPIs

Housing Type	
Detached	74%
Attached	12%
Mobile	5%
Apartment or condo	8%
Duplex or triplex	1%

Water Heater Fuel Type	
Electric	90%
Natural Gas	5%
Other	5%

Home Size		
Area (ft^2)	Small Kit	Medium Kit
Less than 1,000	15%	2%
1,000-1,499	34%	28%
1,500-1,999	25%	32%
2,000-2,999	19%	35%
3,000+	7%	4%

Number of Showers		
Count	Small Kit	Medium Kit
1	30%	18%
2	55%	72%
3	16%	8%
4+	0%	2%

Number of Kitchen Faucets		
Count	Small Kit	Medium Kit
1	93%	93%
2	6%	7%
3+	1%	0%

Number of Bathroom Faucets		
Count	Small Kit	Medium Kit
1-2	54%	35%
3-4	41%	58%
5+	5%	7%

Appendix D Instruments

D.1 Program Staff In-Depth Interview Guide

Introduction

Today, we'll be discussing your role in the SEWKP or water kit program. We would like to learn about your experiences in administering this program.

Your comments are confidential. If I ask you about areas you don't know about, please feel free to tell me that and we will move on. Also, if you want to refer me to specific documents to answer any of my questions, that's great – I'm happy to look things up if I know where to get the information.

I would like to record this interview for my note-taking purposes. Do I have your permission?

Roles & Responsibilities

Q1. Has your position at Duke Energy or your role in the water kit program changed at all since we spoke last year?

Program Delivery

Next, I'd like to learn more about how this program was delivered since your involvement. If the program implementation is different in 2019, please let me know.

Q2. Historically, the program used BRC mailers in the kit program. But recently you added some online components – which you told me about last year. Have these changes been rolled out to all jurisdictions? Have there been any changes since we last spoke?

Q3. Has Duke launched the upgrade store, where customers could upgrade to a higher-end item?

Q4. How popular or common are the upgrade requests?

Q5. How has the online channel been going? How successful is the online channel? How many kits come online vs. BRC?

Q6. Have you changed your BRC at all in the last year?

Q7. After the last time we spoke, you sent me a story board for a new video featuring a piggy bank character. I don't see that video online – was it ever made?

Q8. Are there any other changes to program delivery that have recently happened or are in the works?

Q9. EFI is still the implementer, right? Can you describe EFI's role? Any challenges with EFI lately? [IF NEEDED: what is EFI's role with the online component?]

Q10. Can you confirm the kit contents? Small with 1 showerhead, 2 bathroom aerators, 1 kitchen aerator, and one set of pipe wrap; and large with the same contents except two showerheads instead of one?

Q11. Have any kit items changed since we last spoke other than the kitchen aerator?

Q12. Are there any other program delivery components that are unique to a specific jurisdiction?

Evaluation

Q13. Is there anything else about the program that we have not discussed that you feel should be mentioned? Is there anything else you'd like to learn from the program evaluation?

Q14. We are about to start surveying participants. Are there any questions or topics you'd like us to add before we start surveying?

Q15. One thing we need to do each year is make sure any LEDs that survey respondents said they installed on their own weren't from any Duke programs. I know of the following ways to get free/discounted LEDs from Duke (and some of these may be out of date):

1. Online savings store
2. Home energy house calls
3. School kits
4. Buy down brick-and-mortar locator – was that discontinued?
5. Any others I'm missing?
6. And do these all apply to all jurisdictions?

Those are all of my questions. Thank you very much for your time.

D.2 Implementer Staff In-Depth Interview Guide

Introduction

[*Note: Interviewer will schedule calls ahead of time via email.*]

I would like to record this interview for my note-taking purposes. Do I have your permission?

Roles & Responsibilities

Q1. Can you describe your role in the SEWKP or water kit program?

Q2. How long have you been in this role?

Program Delivery

Q3. Can you describe your program processes? (From receipt of kit forms to sending kits)

Q4. [IF NOT DISCUSSED] Historically, the program used BRC mailers in the kit program. But recently Duke added some online components – can you tell me about this process?

Q5. I know the kitchen aerator was changed a year ago or so. Does the new one have three flow settings? What are they and what are they labeled as?

Q6. Have there been any other measure changes in the last year or so?

Q7. Are there any other changes to program delivery that have recently happened or are in the works?

Q8. Do these changes apply to all jurisdictions?

Q9. Are there any other program delivery components that are unique to a specific jurisdiction?

Q10. Are there any other issues unique to Kentucky that we should know about?

Q11. Are there any other issues unique to Carolinas that we should know about?

Q12. Are there any other issues unique to Progress that we should know about?

Q13. Are there any other issues unique to Ohio that we should know about?

Q14. What is the biggest challenge in implementing the water kit program?

Q15. If you could change one thing, what would it be?

Evaluation

Q16. Is there anything else about the program that we have not discussed that you feel should be mentioned?

Q17. We are about to start surveying participants. Are there any questions or topics you'd like us to add before we start surveying?

Q18. Is there anything else you'd like to learn from the program evaluation?

Those are all of my questions. Thank you very much for your time.

D.3 Participant Survey

Introduction/ Screening

[READ IF MODE=PHONE]

Q1. Hi, I'm _____, calling on behalf of Duke Energy. We are calling about the Save Energy and Water Kit you got from Duke Energy.
This kit included faucet aerators, one or two showerheads, and pipe wrap that can help you save water and energy in your home. Do you recall receiving this kit?

1. Yes
2. No [If no: Can I speak with someone who may know something about this kit?]
98. Don't know [If DK: Can I speak with someone who may know something about this kit?]

[INTERVIEWER INSTRUCTIONS: *If no adults are able to speak about the kit, thank and terminate*.]

Q2. [DISPLAY IF MODE=WEB]
We are conducting surveys about the Save Energy and Water Kit you got from Duke Energy. This kit included faucet aerators, one or two showerheads, and pipe wrap that can help you save water and energy in your home.
Do you recall receiving this kit?

1. Yes
2. No [TERMINATE]
98. Don't know [TERMINATE]

Motivation and Collateral

Q4. Did you read the included instructions on how to install the items that came in the kit?

1. Yes
2. No
98. Don't remember

[ASK IF Q4 = 1]

Q5. On a scale from 0 to 10, where 0 is not at all helpful and 10 is very helpful, how helpful were the instructions on how to install the items that came in the kit?

0. Not at all helpful
1.
2.
3.
4.
5.
6.
7.
8.

9.
10. Very helpful
98. Don't know

[ASK IF Q5<7]
Q6. What might have made the instructions more helpful?
[RECORD VERBATIM ANSWER]

Assessing Measure Installation

[DISPLAY IF KIT_SIZE=SMALL]
We'd like to ask you about the energy and water saving items included in your kit. The kit contained a showerhead, faucet aerators for the bathroom and kitchen, and pipe wrap.

[DISPLAY IF KIT_SIZE=MEDIUM]
We'd like to ask you about the energy and water saving items included in your kit. The kit contained two showerheads, faucet aerators for the bathroom and kitchen, and pipe wrap.

Q10. Have you or anyone else installed any of those items in your home, even if they were taken out later? [SINGLE RESPONSE]
[*Interviewer: Throughout interview, remind respondent as needed to report whether someone else in the home installed or uninstalled any items.*]
1. Yes
2. No [→ Q24a]
98. Don't know [→ TERMINATE]

[ASK IF Q10 = 1]
Q11. Which of the items did you install, even if they were taken out later?
[MULTIPLE RESPONSE]
[*Interviewer: Record each response, then prompt with the list items.*]

Item
a. Showerhead
b. Kitchen faucet aerator
c. Bathroom faucet aerator
d. Pipe wrap
e. I don't remember which items were installed [→ TERMINATE]

[ASK IF Q11A = 1 AND KIT_SIZE=MEDIUM]
Q12. Your kit contained two showerheads. Did you install one or both of the showerheads in the kit, even if one or both were taken out later?
[SINGLE RESPONSE]
1. I installed both
2. I only installed one showerhead
98. Don't know

[ASK IF Q11C = 1]
Q13. How many of the bathroom faucet aerators from the kit did you install in your home, even if one or more were taken out later?
[SINGLE RESPONSE]
1. One
2. Two
3. Three [*DISPLAY IF KIT_SIZE=MEDIUM*]
4. Four [*DISPLAY IF KIT_SIZE=MEDIUM*]
98. Don't know

[ASK IF Q11D = 1]
Q14. Did you install all of the pipe insulation that was included with the kit?
[SINGLE RESPONSE]
1. Yes
2. No
98. Don't know

[ASK IF Q14 IS DISPLAYED]
Q15. About how many feet of the pipe extruding from your water heater did you wrap with the insulation **that came in the kit**? Please go over to your water heater if you need to check. [SINGLE RESPONSE]
1. About three feet or less
2. About five feet
3. About ten feet
4. About fifteen feet or more
98. Don't know

[ASK IF ANY PART OF Q11 = 1]
Q16. Overall, how satisfied are you with the item[s] you installed?
[DISPLAY IF MODE=PHONE] Please use a 0 to 10 scale, where 0 is very dissatisfied and 10 is very satisfied. How satisfied are you with...

DISPLAY IF	Item	Rating
Q11a = 1	a. Showerhead	0-10 with DK
Q11b = 1	b. Kitchen faucet aerator	0-10 with DK
Q11c = 1	c. Bathroom faucet aerator	0-10 with DK
Q11d = 1	d. Pipe wrap	0-10 with DK

[ASK IF ANY ITEMS IN Q16<7]
Q16a. Can you please explain any dissatisfaction you had with [DISPLAY ALL ITEMS IN Q16 THAT ARE <7]?
[OPEN END: RECORD VERBATIM]

Q17. Overall, how satisfied are you with Duke Energy's Save Energy and Water Kit Program? [DISPLAY IF MODE=PHONE] [IF NEEDED: Please use that same 0 to 10 scale, where 0 is very dissatisfied and 10 is very satisfied.]

0.	0. Very dissatisfied
1.	1.
2.	2
3.	3
4.	4
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Very satisfied
98.	Don't Know

[ASK IF ANY PART OF Q11 = 1]

Q18. Have you (or anyone in your home) uninstalled any of the items from the kit that you had previously installed? [SINGLE RESPONSE]

1. Yes
2. No
98. Don't know

[ASK IF Q18 = 1]

Q19. Which of the items did you uninstall?
[*Interviewer: Record the response, then prompt with the list items.*]
[MULTIPLE RESPONSE]

1. [DISPLAY IF Q11a = 1] Showerhead[s]
2. [DISPLAY IF Q11b = 1] Kitchen faucet aerator
3. [DISPLAY IF Q11c = 1] Bathroom faucet aerator[s]
4. [DISPLAY IF Q11d = 1] Pipe wrap
98. Don't know [*EXCLUSIVE ANSWER*]

[ASK IF Q19.1 = 1 AND Q12 = 1]

Q20. Did you uninstall one or both of the showerheads you had previously installed? [SINGLE RESPONSE]

1. I uninstalled both
2. I only uninstalled one of the showerheads
98. Don't know

[ASK IF Q19.3 = 1 AND Q13 = 2-4]

Q21. How many bathroom faucet aerators did you uninstall? [SINGLE RESPONSE]

1. One [*DISPLAY IF Q13 = 1-4*]
2. Two [*DISPLAY IF Q13 = 2-4*]

3. Three [*DISPLAY IF Q13 = 3-4*]
4. Four [*DISPLAY IF Q13 = 4*]
98. Don't know

[CALCULATE SHOWERHEAD:
IF Q12 = 1, THEN SHOWERHEAD = 2;
IF Q12 = 2 OR (Q11_1 = 1 AND KIT_SIZE = SMALL), THEN SHOWERHEAD = 1;
ELSE SHOWERHEAD = 0]

[CALCULATE KITCHEN:
IF Q11_2 = 1, THEN KITCHEN = 1, ELSE KITCHEN=0]

[CALCULATE BATH:
IF Q13 = 2, THEN BATH = 2;
IF Q13 = 1, THEN BATH = 1;
ELSE BATH = 0]

[CALCULATE PIPEWRAP:
IF Q11_4 = 1, THEN PIPEWRAP = 1, ELSE PIPEWRAP=0]

[CALCULATE SHOWERHEAD_I:
IF SHOWERHEAD = 1 AND Q19_1 = 1, THEN SHOWERHEAD_I = 0;
IF Q19_1 = 1 AND (Q20 = 1 OR Q20 = 98), THEN SHOWERHEAD_I = 0;
IF Q19_1 = 1 AND Q20 = 2, THEN SHOWERHEAD_I = 1;
ELSE SHOWERHEAD_I = SHOWERHEAD]

[CALCULATE KITCHEN_I:
IF Q19_2 = 1, THEN KITCHEN_I = 0;
ELSE KITCHEN_I = KITCHEN]

[CALCULATE BATH_I:
IF BATH = 1 AND Q19_3 = 1, THEN BATH_I = 0;
IF Q19_3 = 1 AND (Q21 = 2 OR Q21 = 98), THEN BATH_I = 0;
IF Q19_3 = 1 AND Q21 = 1, THEN BATH_I = 1;
ELSE BATH_I = BATH]

[CALCULATE PIPEWRAP_I:
IF Q19_4 = 1, THEN PIPEWRAP_I = 0;
ELSE PIPEWRAP_I = PIPEWRAP]

CALCULATE TOTAL_I:
[SHOWERHEAD_I + BATH_I + KITCHEN_I + PIPEWRAP_I]

[ASK IF ANY OF Q19.1-4 IS SELECTED]
Q22. Why were those items uninstalled?
[READ IF MODE=PHONE] Let's start with…
[*Interviewer: Read each item*]
[MULTIPLE RESPONSE]

DISPLAY ONLY THOSE 1-6 ITEMS THAT WERE SELECTED IN Q19	Item	Reason
	a. Showerhead	1. It was broken 2. I didn't like how it worked 3. I didn't like how it looked, or 96. Some other reason (specify: _____) 98. Don't know
	b. Kitchen faucet aerator	Repeat reason options
	c. Bathroom faucet aerator	Repeat reason options
	d. Pipe wrap	Repeat reason options

Q24a. Customers that need additional assistance with their items can call a toll-free customer care hotline. Did you call the customer care hotline to seek assistance in installing any of your items?
1. Yes
2. No
98. Don't know

[ASK IF Q24a = 1]
Q24b. Did you call the customer care hotline to seek assistance in installing your kitchen faucet aerator?
1. Yes
2. No
98. Don't know

[ASK IF Q24b = 1]
Q24c. Did the customer care hotline offer to send you an adapter for the kitchen faucet aerator?
1. Yes
2. No
98. Don't know

[ASK IF Q24a = 1]
Q24d. Did you call the customer care hotline to seek assistance in installing your bathroom faucet aerator?
1. Yes
2. No
98. Don't know

[ASK IF Q24d = 1]
Q24e. Did the customer care hotline offer to send you an adapter for the bathroom faucet aerator?

1. Yes
2. No
98. Don't know

[ASK IF Q11a = 1 AND AT LEAST ONE SHOWERHEAD STILL INSTALLED]
Q29. On average, what is the typical shower length in your household?

1. One minute or less
2. Two to four minutes
3. Five to eight minutes
4. Nine to twelve minutes
5. Thirteen to fifteen minutes
6. Sixteen to twenty minutes
7. Twenty-one to thirty minutes
8. More than thirty minutes
98. Don't know

[ASK IF AT LEAST ONE SHOWERHEAD STILL INSTALLED]
Q30. [DISPLAY IF TWO SHOWERHEADS STILL INSTALLED: Thinking of the efficient showerhead you installed that gets the most usage…]
[DISPLAY IF ONE SHOWERHEAD STILL INSTALLED: Thinking of the efficient showerhead currently installed in your home…]
On average, how many showers per day are taken in this shower?

1. Less than one
2. One
3. Two
4. Three
5. Four
6. Five
7. Six
8. Seven
9. Eight or more
98. Don't know

[ASK IF TWO SHOWERHEADS STILL INSTALLED]
Q31. Thinking of the other efficient showerhead you installed…
On average, how many showers per day are taken in this shower?
1. Less than one
2. One
3. Two
4. Three
5. Four
6. Five
7. Six
8. Seven
9. Eight or more
98. Don't know
Q32. [This question was moved to demographics section – but not renumbered for programming purposes]

NTG

[IF TOTAL_I = 0, SKIP TO Q40]
Q33. If you had not received the free efficiency items in the kit, would you have purchased and installed any of these same items within the next year?
1. Yes
2. No
98. Don't know

[ASK IF Q33 = 1]
Q34. What items would you have purchased and installed within the next year?
[MULTIPLE RESPONSES]
Q34_1. [IF SHOWERHEAD_I > 0] Energy-efficient showerhead[s]
Q34_2. [IF KITCHEN_I > 0] Energy-efficient kitchen faucet aerator
Q34_3. [IF BATH_I > 0] Energy-efficient bathroom faucet aerator[s]
Q34_4. [IF PIPEWRAP_I > 0] Pipe wrap
Q34_7. Don't know [EXCLUSIVE ANSWER]

[ASK IF Q34_1 = 1 AND SHOWERHEAD_I = 2]
Q35. If you had not received them in your free kit, how many energy-efficient showerheads would you have purchased and installed within the next year?
1. One
2. Two
98. Don't know

[ASK Q34.3=1 AND IF MORE THAN ONE BATHROOM AERATOR IS STILL INSTALLED]
Q36. If you had not received them in your free kit, how many energy-efficient bathroom aerators would you have purchased and installed within the next year?

1. One
2. Two
98. Don't know

Q37. Now, thinking about the energy and water savings items that were provided in the kit - using a scale from 0 to 10, where 0 means "not at all influential" and 10 means "extremely influential," how influential were the following factors on your decision to install the items from the kit? How influential was…

[*Interviewer: If respondent says, "Not applicable - I didn't get/use that," then follow up with: "So would you say it was "not at all influential?" and probe to code.*]

[MATRIX QUESTION: SCALE]

Elements	Responses
The fact that the items were free	0-10 scale with DK
The fact that the items were mailed to your house	0-10 scale with DK
Information provided by Duke Energy about how the items would save energy and water	0-10 scale with DK
Other information or advertisements from Duke Energy, including its website	0-10 scale with DK

Q40. Since receiving your kit from Duke Energy, have you purchased and installed any other products or made any improvements to your home to help save energy?

1. Yes
2. No
98. Don't know

[ASK IF Q40 = 1]

Q41. What products have you purchased and installed to help save energy in your home? [*Do not read list. After each response, ask, "Anything else?"*] [MULTIPLE RESPONSE]

Q41_4. Bought energy efficient appliances
Q41_5. Moved into an ENERGY STAR home
Q41_6. Bought efficient heating or cooling equipment
Q41_7. Bought efficient windows
Q41_8. Added insulation
Q41_9. Sealed air leaks in windows, walls, or doors
Q41_10. Sealed or insulated ducts
Q41_11. Bought LEDs
Q41_12. Bought CFLs
Q41_13. Installed an energy efficient water heater
Q41_14. None – no other actions taken [EXCLUSIVE ANSWER]
Q41_15. Other, please specify: _____
Q41_16. Don't know [EXCLUSIVE ANSWER]

[ASK IF Q41_5 = 1]

Q42. Is Duke Energy still your gas or electricity utility?

1. Yes

2. No
98. Don't know

[ASK IF ANY ITEM IN Q41 WAS SELECTED]

Q46. On a scale of 0 to 10, where 0 means "not at all influential" and 10 means "extremely influential", how much influence did the Duke Energy Save Energy and Water Kit Program have on your decision to…

[MATRIX QUESTION: SCALE]

[LOGIC] ITEM	Response
[IF **ERROR! REFERENCE SOURCE NOT FOUND.**_4 IS SELECTED] Q46_4 uy energy efficient appliances	0-10 scale with DK
[IF **ERROR! REFERENCE SOURCE NOT FOUND.**_5 IS SELECTED] Q46_5 ove into an ENERGY STAR home	0-10 scale with DK
[IF **ERROR! REFERENCE SOURCE NOT FOUND.**_6 IS SELECTED] Q46_6 uy efficient heating or cooling equipment	0-10 scale with DK
[IF **ERROR! REFERENCE SOURCE NOT FOUND.**_7 IS SELECTED] Q46_7 uy efficient windows	0-10 scale with DK
[IF **ERROR! REFERENCE SOURCE NOT FOUND.**_8 IS SELECTED] Q46_8 dd insulation	0-10 scale with DK
[IF **ERROR! REFERENCE SOURCE NOT FOUND.**_9 IS SELECTED] Q46_9 eal air leaks in windows, walls, or doors	0-10 scale with DK
[IF **ERROR! REFERENCE SOURCE NOT FOUND.**_10 IS SELECTED] Q46_10 eal or insulate ducts	0-10 scale with DK
[IF **ERROR! REFERENCE SOURCE NOT FOUND.**_11 IS SELECTED] Q46_11 uy LEDs	0-10 scale with DK
[IF **ERROR! REFERENCE SOURCE NOT FOUND.**_12 IS SELECTED] Q46_12 uy CFLs	0-10 scale with DK
[IF **ERROR! REFERENCE SOURCE NOT FOUND.**_13 IS SELECTED] Q46_13 nstall an energy efficient water heater	0-10 scale with DK
[IF **ERROR! REFERENCE SOURCE NOT FOUND.**_15 IS SELECTED] Q46_15 **ERROR! REFERENCE SOURCE NOT FOUND. open ended response]**	0-10 scale with DK

[ASK IF Q41_1 IS SELECTED AND Q46_1 <> 0]

Q47. What kinds of appliance(s) did you buy?
[*Do not read list*] [MULTIPLE RESPONSE]

Q47_4 Refrigerator
Q47_5 Stand-alone Freezer
Q47_6 Dishwasher
Q47_7 Clothes washer
Q47_8 Clothes dryer
Q47_9 Oven
Q47_10 Microwave
Q47_11 Other, please specify: _____
Q47_12 Don't know

[ASK IF Q47 = 4, 5, 6, 7, 8, 10, OR 11]
Q48. Was the [INSERT Q47 RESPONSE] an ENERGY STAR or high-efficiency model?
1. Yes
2. No
98. Don't know
99. Refused
[REPEAT THIS QUESTION FOR EACH ITEM MENTIONED IN Q47]

[ASK IF Q47 = 8]
Q49. Does the new clothes dryer use natural gas?
1. Yes - it uses natural gas
2. No – does not use natural gas
98. Don’t know
99. Refused

[ASK IF Q41 = 6 AND Q46_6 > 0]
Q50. What type of heating or cooling equipment did you buy?
[*Do not read list*] [MULTIPLE RESPONSE]
Q50_4 Central air conditioner
Q50_5 Window/room air conditioner unit
Q50_6 Wall air conditioner unit
Q50_7 Air source heat pump
Q50_8 Geothermal heat pump
Q50_9 Boiler
Q50_10 Furnace
Q50_11 Wifi
Q50_12 Other, please specify: _____
Q50_13 Don't know

[ASK IF Q50 = 9 OR 10]
Q51. Does the new [INSERT Q50 RESPONSE] use natural gas?
1. Yes – it uses natural gas
2. No – does not use natural gas
98. Don’t know
99. Refused

[ASK IF Q50= 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, OR 12]
Q52. Was the [INSERT Q50 RESPONSE] an ENERGY STAR or high-efficiency model?
[SINGLE RESPONSE]
1. Yes
2. No
98. Don't know
99. Refused

[REPEAT THIS QUESTION FOR EACH ITEM MENTIONED IN Q50, EXCLUDING WIFI THERMOSTAT]

[ASK IF Q41 = 7 AND Q46_7 > 0]

Q53. Do you know how many windows you installed??

1. Yes (please specify how many you installed) [NUMERIC OPEN END]
2. No

[ASK IF Q41=8 AND Q46_8 > 0]

Q54. Please let us know what spaces you added insulation to. Also, let us know the proportion of each space you added insulation to (for example, if you added insulation that covered your entire attic space, you would type in 100%).

	Check here for each space you added insulation to	Use these boxes to type in the approximate proportion of each space you added insulation to
1. Attic		[NUMERIC 0-100] %
2. Walls		[NUMERIC 0-100] %
3. Below the floor		[NUMERIC 0-100] %

[ASK IF Q41= 11 AND Q46_11 > 0]

Q55. Do you know how many LEDs you installed at your property?

1. Yes (please specify how many you installed) [NUMERIC OPEN END]
2. No

[ASK IF Q41 = 12 AND Q46_12 > 0]

Q56. Do you know how many CFLs you installed at your property?

1. Yes (please specify how many you installed) [NUMERIC OPEN END]
2. No

[ASK IF Q41 = 13 AND Q46_13 > 0]

Q57. Does the new water heater use natural gas?

1. Yes – it uses natural gas
2. No – does not use natural gas
98. Don't know

[ASK IF Q41 = 13 AND Q46_13 > 0]

Q58. Which of the following water heaters did you purchase?

1. A traditional water heater with a large tank that holds the hot water
2. A tankless water heater that provides hot water on demand
3. A solar water heater
4. Other, please specify: _____
98. Don't know

[ASK IF Q41= 13 AND Q46_13 > 0]

Q59. Is the new water heater an ENERGY STAR model?
[SINGLE RESPONSE]

1. Yes
2. No
98. Don't know

Demographics

Lastly, we have some basic demographic questions for you. Please be assured that your responses are confidential and are for statistical purposes only.

Q60. Which of the following types of housing units would you say best describes your home? It is...?

1. Single-family detached house
2. Single-family attached home (such as a townhouse or condo)
3. Duplex, triplex or four-plex
4. Apartment or condominium with 5 units or more
5. Manufactured or mobile home
6. Other _____
98. Don't know
99. Prefer not to say

Q61. How many showers are in your home? Please include both stand-up showers and bathtubs with showerheads.

1. One
2. Two
3. Three
4. Four
5. Five or more
98. Don't know

Q62. How many bathroom sink faucets are in your home? (Keep in mind that some bathrooms may have multiple bathroom sink faucets in them)

1. One
2. Two
3. Three
4. Four
5. Five
6. Six
7. Seven
8. Eight or more
98. Don't know

Q63. How many kitchen faucets are in your home?

1. One

2. Two
3. Three
4. Four or more
98. Don't know

Q63a. [ASK IF [Q63=2,3,4] You mentioned that you have more than one kitchen faucet. Where is/are your other kitchen faucet(s) located in your home?
[OPEN-ENDED: RECORD VERBATIM RESPONSE]

Q32. What fuel type does your water heater use?
1. Electric
2. Natural Gas
3. Other, please specify: [OPEN-ENDED RESPONSE]
4. Don't know

Q64. How many square feet of living space are there in your residence, including bathrooms, foyers and hallways (exclude garages, unfinished basements, and unheated porches)?
1. Less than 500 square feet
2. 500 to under 1,000 square feet
3. 1,000 to under 1,500 square feet
4. 1,500 to under 2,000 square feet
5. 2,000 to under 2,500 square feet
6. 2,500 to under 3,000 square feet
7. Greater than 3,000 square feet
98. Don't know
99. Prefer not to say

Q65. Do you or members of your household own your home, or do you rent it?
1. Own / buying
2. Rent / lease
3. Occupy rent-free
98. Don't know
99. Prefer not to say

Q66. Including yourself, how many people currently live in your home year-round?
1. I live by myself
2. Two people
3. Three people
4. Four people
5. Five people
6. Six people
7. Seven people
8. Eight or more people
98. Don't know

99. Prefer not to say

Q67. What was your total annual household income for 2019, before taxes?

1. Under $20,000
2. 20 to under $30,000
3. 30 to under $40,000
4. 40 to under $50,000
5. 50 to under $60,000
6. 60 to under $75,000
7. 75 to under $100,000
8. 100 to under $150,000
9. 150 to under $200,000
10. $200,000 or more
98. Don't know
99. Prefer not to say

Q68. What is the highest level of education achieved among those living in your household?

1. Less than high school
2. Some high school
3. High school graduate or equivalent (such as GED)
4. Trade or technical school
5. Some college (including Associate degree)
6. College degree (Bachelor's degree)
7. Some graduate school
8. Graduate degree, professional degree
9. Doctorate
98. Don't know
99. Prefer not to say

Q69. Finally, what is your year of birth?

[Scroll box with years 1900-2010, and Prefer not to say]

Appendix E DEK Participant Survey Results

This section reports the results from each question in the DEK participant survey. Since the results reported in this appendix represent the "raw" data (that is, none of the open-ended responses have been coded and none of the scale questions have been binned), some values may be different from those reported in the Process Evaluation Findings chapter (particularly: percentages in tables with "Other" categories and scale response questions). Only respondents who completed the survey are included in the following results.

Q1. [Read if mode = phone] Hi, I'm _____, calling on behalf of Duke Energy. We are calling about the Save Energy and Water Kit you got from Duke Energy.

This kit included faucet aerators, one or two showerheads, and pipe wrap that can help you save water and energy in your home. Do you recall receiving this kit?

Response Option	Percent (n=39)
Yes	100%
No	0%
Don't know	0%

Q2. [Display if mode = web] We are conducting surveys about the Save Energy and Water Kit you got from Duke Energy. This kit included faucet aerators, one or two showerheads, and pipe wrap that can help you save water and energy in your home.

Do you recall receiving this kit?

Response Option	Percent (n=136)
Yes	100%
No	0
Don't know	0

Q4. Did you read the included instructions on how to install the items that came in the kit?

Response Option	Percent (n=174)
Yes	77%
No	15%
Don't remember	7%

Q5. [Ask if Q4 = YES] On a scale from 0 to 10, where 0 is not at all helpful and 10 is very helpful, how helpful were the instructions on how to install the items that came in the kit?

Response Option	Percent (n=135)
Not at all helpful	0%
1	0%
2	1%
3	0%
4	1%
5	6%
6	4%
7	7%
8	23%
9	10%
10 - Very helpful	42%
Don't Know	7%

Q6. [Ask if Q5<7] What might have made the instructions more helpful?

Verbatim Response	Count (n=15)
we already knew how	1
The instructions were fine, I just didn't need them. I can change an aerator or shower head without instructions	1
Pictures	1
picssss	1
Nothing really. I already knew how to install the showerhead.	1
Nothing I can think opf	1
More visuals	1
More photos	1
More examples or photos included.	1
More details	1
Less steps.	1
It's that I have a hard time with written directions and find them complicated	1
I need some one to install them.	1
I don't think tou could have made them more helpful	1
easier terminology	1

Q10. Have you or anyone else installed any of those items in your home, even if they were taken out later?

Response Option	Percent (n=174)
Yes	72%
No	28%
Don't Know	0%

Q11. [Ask if Q10 = YES] Which of the items did you install, even if they were taken out later?

Response Option	Percent (n=174)*
Showerhead	50%
Kitchen faucet aerator	33%
Bathroom faucet aerator	42%
Pipe wrap	30%
I don't remember	0%

* Multiple responses were allowed for this question

Q12. [Ask if Q11 = SHOWERHEAD AND KIT_SIZE= MEDIUM] Your kit contained two showerheads. Did you install one or both of the showerheads in the kit, even if one or both were taken out later?

Response Option	Percent (n=30)
I installed both	33%
I only installed one showerhead	63%
Don't know	3%

Q13. [Ask if Q11 = BATHROOM FAUCET AERATOR] How many of the bathroom faucet aerators from the kit did you install in your home, even if one or more were taken out later?

Response Option	Percent (n=74)
One	59%
Two	34%
Don't know	7%

Q14. [Ask if Q11 = PIPEWRAP] Did you install all of the pipe insulation that was included with the kit?

Response Option	Percent (n=52)
Yes	67%
No	25%
Don't know	8%

Q15. [Ask if Q14 is displayed] About how many feet of the pipe extruding from your water heater did you wrap with the insulation **that came in the kit**? Please go over to your water heater if you need to check.

Response Option	Percent (n=52)
About three feet or less	38%
About four to five feet	36%
About six feet or more	10%
Don't know	15%

Q16. [Ask if any part of Q11 = YES] Overall, how satisfied are you with the item[s] you installed?

Showerhead

Response Option	Percent (n=87)
0 - Very dissatisfied	1%
1	0%
2	1%
3	3%
4	1%
5	1%
6	2%
7	12%
8	15%
9	16%
10 - Very satisfied	45%
Don’t know	2%

Kitchen Faucet Aerator

Response Option	Percent (n=58)
0 – Very dissatisfied	1%
1	0%
2	0%
3	0%
4	4%
5	10%
6	3%
7	9%
8	14%
9	10%

Response Option	Percent (n=58)
10 - Very satisfied	46%
Don't know	3%

Bathroom Faucet Aerator

Response Option	Percent (n=74)
0 – Very dissatisfied	0%
1	0%
2	1%
3	1%
4	3%
5	7%
6	4%
7	7%
8	12%
9	15%
10 - Very satisfied	50%
Don't know	0%

Pipe Wrap

Response Option	Percent (n=52)
0 – Very dissatisfied	2%
1	2%
2	0%
3	0%
4	0%
5	4%
6	4%
7	2%
8	10%
9	20%
10 - Very satisfied	57%
Don't know	2%

Q16a. Can you please explain any dissatisfaction you had with [DISPLAY ALL ITEMS IN Q16 THAT ARE <7]?

Showerhead

Verbatim Response	Count (n=9)
We use a removable shower head wand more than a stationary head. Besides that it was a good head. Good pressure	1
too small	1
The water pressure expelled from the shower head was too low for my liking.	1
the flow was too light	1
Not enough flow for ys	1
It seemed cheap and leaked no matter what i tried	1
It leaked	1
It doesn't have as much pressure as the old one but I realize it is to save water.	1
I like my rain shower head better	1

Kitchen Faucet Aerator

Verbatim Response	Count (n=11)
Water pressure was very low with these	1
Wasn't as much pressure	1
Slow running water	1
Reduced water flow.	1
Not being used to an aerator, it made the water pressure much lower therefore not being useful for a kitchen faucet as that is typically used to rinse plates and bowls which needs a higher pressure. Easy to install.	1
It will spray water everywhere and it gets in the way when cleaning large items	1
It was to slow not enough pressure, we live in the country and the pressure is already slow as it is.	1
it made the faucet head too low and made doing dishes and filling up pitchers tough. Also the switching from spray to stream needed more force then should be necessary.	1
It hangs lower than what I'm used to.	1
Didn't like the pressure	1
Didn't fit my faucet used parts from it	1

Bathroom Faucet Aerator

Verbatim Response	Count (n=13)
Water pressure very low	1
water flow too low	1
There wasn't enough water pressure	1
slow running water	1
Reduced water flow	1
None other than water pressure being significantly reduced.	1
None	1
It reduces the flow of water too much.	1
Hangs too low into the sink	1
Didn't work for very long.	1
Decreasing water flow to the extent the aerator did made it more difficult to keep the sink clean.	1
chrome discolored	1
After I installed this aerator the faucet would sometimes leak out of it.	1

Pipe wrap

Verbatim Response	Count (n=6)
The adhesive isn't sticky enough.	3
None, just needed more	1
None	1
I did not use for the pipe. I cut it and stuck on door side to fill the space in between a door and the frame. The pipe wrap doesn't seem to be a good quality product.	1
Didn't seem to be practical.	1
Did little to no insulating had to use tape to secure ends	1

Q17. Overall, how satisfied are you with Duke Energy's Save Energy and Water Kit Program?

Response Options	Percent (n=126)
0 - Very dissatisfied	0%
1	0%
2	1%
3	2%
4	0%
5	3%
6	3%
7	7%

8	14%
9	16%
10 - Very satisfied	53%
Don't know	1%

Q18. [Ask if any part of Q11 = YES] Have you (or anyone in your home) uninstalled any of the items from the kit that you had previously installed?

Response Option	Percent (n=126)
Yes	17%
No	82%
Don't know	1%

Q19. [Ask if Q18 = YES] Which of the items did you uninstall?

Response Option	Count (n= 21)*
Showerhead	10
Kitchen faucet aerator	9
Bathroom faucet aerator	7
Pipe wrap	0
Don't know	0

* Multiple responses were allowed for this question

Q20. [Ask if Q19 = SHOWERHEAD and Q12 = INSTALLED BOTH] Did you uninstall one or both of the showerheads you had previously installed?

Response Option	Percent (n=2)
I only uninstalled one of the showerheads	100%
Don't know	0%

Q21. [Ask if Q19 = BATHROOM FAUCET AERATOR and Q13 = 2-4] How many bathroom faucet aerators did you uninstall?

Response Option	Percent (n=2)
One	50%
Two	50%
Don't know	0%

Q22. [Ask if any item of Q19 is selected] Why were those items uninstalled?

Showerhead

Response Option	Percent (n=10)*
It was broken	10%

Didn't like how it worked	50%
Didn't like how it looked	0%
Other	50%
Don’t know	0%

* Multiple responses were allowed for this question

Verbatim Other Responses	Count (n=5)
I reinstalled my hand held sprayer. I found I needed it.	1
I'm remodeling that bathroom.	1
It leaked	1
Not enough flow for us	1
Remodeled bathroom	1

Kitchen faucet aerator

Response Options	Percent (n=9)*
It was broken	0%
Didn't like how it worked	56%
Didn't like how it looked	11%
Other	44%
Don’t know	0%

* Multiple responses were allowed for this question

Verbatim Other Response	Count (n=4)
Bought new faucet and it had an aerator in it.	1
Bought new kitchen faucet	1
It didn't fit right, so we took it out.	1
Too slow, not enough pressure.	1

Bathroom faucet aerator

Response Options	Percent (n=7)*
It was broken	0%
Didn't like how it worked	43%
Didn't like how it looked	29%
Other	43%
Don’t know	0%

* Multiple responses were allowed for this question

Verbatim Other Responses	Count (n=3)
Got clogged	1
I bought a completely new faucet	1
Remodeling bathroom and have torn out all sinks and showers.	1

Pipe wrap

Response Options	Percent (n=0)*
It was broken	0%
Didn't like how it worked	0%
Didn't like how it looked	0%
Other	0%
Don't know	0%

* Multiple responses were allowed for this question

Q24a. Customers that need additional assistance with their items can call a toll-free customer care hotline. Did you call the customer care hotline to seek assistance in installing any of your items?

Response Option	Percent (n=174)
Yes	1%
No	98%
Don't know	1%

Q24b. [ASK IF Q24a = YES] Did you call the customer care hotline to seek assistance in installing your kitchen faucet aerator?

Response Option	Percent (n=1)
Yes	0%
No	100%
Don't know	0%

Q24c. [ASK IF Q24b = YES] Did the customer care hotline offer to send you an adapter for the kitchen faucet aerator?

Response Option	Percent (n=0)
Yes	0%
No	0%
Don't know	0%

Q24d. [ASK IF Q24a = YES] Did you call the customer care hotline to seek assistance in installing your bathroom faucet aerator?

Response Option	Percent (n=1)
Yes	0%
No	100%
Don't know	0%

Q24e. [ASK IF Q24d = YES] Did the customer care hotline offer to send you an adapter for the bathroom faucet aerator?

Response Option	Percent (n=0)
Yes	0%
No	0%
Don't know	0%

Q29. [Ask if Q11 = SHOWERHEAD and at least one showerhead is still installed] On average, what is the typical shower length in your household?

Response Option	Percent (n=78)
One minute or less	0%
Two to four minutes	5%
Five to eight minutes	35%
Nine to twelve minutes	33%
Thirteen to fifteen minutes	17%
Sixteen to twenty minutes	8%
Twenty-one to thirty minutes	0%
More than thirty minutes	0%
Don't know	3%

Q30. [DISPLAY IF TWO SHOWERHEADS STILL INSTALLED: Thinking of the efficient showerhead you installed that gets the most usage…]

[DISPLAY IF ONE SHOWERHEAD STILL INSTALLED: Thinking of the efficient showerhead currently installed in your home…]

On average, how many showers per day are taken in this shower?

Response Option	Percent (n=78)
Less than one	14%
One	32%
Two	28%
Three	14%

Four	8%
Six	3%
Seven	0%
Eight or more	0%
Don't know	0%

Q31. [Ask if two showerheads still installed] Thinking of the other efficient showerhead you installed…

On average, how many showers per day are taken in this shower?

Response Option	Percent (n=8)
Less than one	38%
One	25%
Two	25%
Three	12%
Four	0%
Five	0%
Six	0%
Seven	0%
Eight or more	0%
Don't know	0%

Q32. What fuel type does your water heater use?

Response Option	Percent (n=174)
Electric	89%
Natural gas	5%
Other (please specify in the box below)	5%
Don't know	2%

Verbatim Other Response	Count (n=8)
Propane	6
Oil	1
Propaine	1

Q33. [IF CALCTOTAL1 = 0, SKIP TO Q40] If you had not received the free efficiency items in the kit, would you have purchased and installed any of these same items within the next year?

Response Option	Percent (n=121)
Yes	25%
No	56%
Don't know	19%

Q34. [Ask if Q33 = YES] What items would you have purchased and installed within the next year?

Response Option	Count (n=30)*
Showerhead	21
Kitchen faucet aerator	5
Bathroom faucet aerator	6
Pipe wrap	6
Don't know	1

*Multiple responses were allowed for this question

Q35. [Ask if Q34 = SHOWERHEAD and two showerheads are still installed] If you had not received them in your free kit, how many energy-efficient showerheads would you have purchased and installed within the next year?

Response Option	Percent (n=2)
One	50%
Two	50%
Don't know	0%

Q36. [Ask if Q34 = BATHROOM FAUCET AERATOR and if more than one bathroom aerator is still installed] If you had not received them in your free kit, how many energy-efficient bathroom aerators would you have purchased and installed within the next year?

Response Option	Percent (n=2)
One	0%
Two	100%
Don't know	0%

Q37. [If Q33 was displayed] Now, thinking about the energy and water-savings items that were provided in the kit - using a scale from 0 to 10, where 0 means “not at all influential” and 10 means “extremely influential,” how influential were the following factors on your decision to install the items from the kit? How influential was…

The fact that the items were free

Response Option	Percent (n=121)
Not at all influential	3%
1	0%
2	0%
3	0%
4	0%
5	2%
6	2%
7	6%
8	12%
9	8%
10 - Extremely influential	66%
Don't know	0%

The fact that the items were mailed to your home

Response Option	Percent (n=121)
0- Not at all influential	1%
1	0%
2	0%
3	0%
4	0%
5	0%
6	2%
7	6%
8	12%
9	10%
10 - Extremely influential	70%
Don't know	0%

Information provided by Duke Energy about how the items would save energy and water

Response Option	Percent (n=121)
0- Not at all influential	5%
1	0%
2	0%
3	1%
4	0%
5	4%

6	6%
7	7%
8	15%
9	9%
10 - Extremely influential	53%
Don't know	0%

Other information or advertisements from Duke Energy, including its website

Response Option	Percent (n=121)
0- Not at all influential	16%
1	1%
2	1%
3	1%
4	3%
5	12%
6	3%
7	8%
8	10%
9	8%
10 - Extremely influential	31%
Don't know	6%

Q40. Since receiving your kit from Duke Energy, have you purchased and installed any other **products** or made any improvements to your home to help save energy?

Response Option	Percent (n=174)
Yes	41%
No	57%
Don't know	3%

Q41. [If Q40 = YES] What **products** have you purchased and installed to help save energy in your home?

Response Option	Percent (n=174)*
Bought energy efficient appliances	15%
Moved into an ENERGY STAR home	0%
Bought efficient heating or cooling equipment	11%
Bought efficient windows	5%
Added insulation	5%
Sealed air leaks in windows, walls, or doors	8%
Sealed or insulated ducts	1%

Response Option	Percent (n=174)*
Bought LEDs	29%
Bought CFLs	5%
Installed an energy efficient water heater	7%
None – no other actions taken	0%
Other	3%
Don't know	1%

* Multiple responses were allowed for this question

Verbatim Other Responses	Count (n=6)
Light bulbs but I don't know what kind. They came in the mail.	1
Installed energy efficient vstorm doors	1
Installed an awning to shield from heat and cold. Cut my energy bill by 30%+	1
Bought new storm door	1
air filters that fit our furnace!, others didn't fit very well.	1
A storm door	1

Q42. [If Q41 = MOVED INTO AN ENERGY STAR HOME] Is Duke Energy still your gas or electricity utility?

Response Option	Count (n=0)
Yes	0%
No	0%
Don’t know	0%

Q46. [Ask if any item in Q41 was selected] On a scale of 0 to 10, where 0 means “not at all influential” and 10 means “extremely influential”, how much influence did the Duke Energy Save Energy and Water Kit Program have on your decision to…

Response Option	0	1	2	3	4	5	6	7	8	9	10	Don’t know	n
Buy energy efficient appliances	31%	0%	8%	0%	8%	0%	0%	4%	8%	15%	27%	3%	26
Move into an ENERGY STAR home	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0
Buy efficient heating or cooling equipment	35%	0%	0%	0%	5%	5%	0%	5%	20%	5%	20%	5%	20
Buy efficient windows	33%	0%	0%	0%	11%	11%	0%	11%	11%	0%	22%	0%	9
Add insulation	22%	0%	0%	11%	0%	11%	0%	22%	11%	0%	11%	11%	9
Seal air leaks	14%	0%	0%	0%	7%	0%	14%	14%	0%	0%	50%	0%	14
Seal ducts	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	2
Buy LEDs	16%	0%	0%	4%	4%	4%	6%	10%	8%	6%	39%	2%	49
Buy CFLs	0%	0%	12%	0%	12%	12%	12%	12%	0%	0%	25%	12%	8
Install an energy efficient water heater	8%	8%	8%	0%	8%	8%	0%	17%	8%	0%	17%	17%	12
Other	0%	0%	17%	0%	17%	0%	17%	0%	0%	33%	0%	17%	6

Q47. [Ask if Q41 = BOUGHT ENERGY EFFICIENT APPLIANCES and Q46_BUY ENERGY EFFICIENT APPLIANCES <> 0] What kinds of appliance(s) did you buy?

Response Option	Percent (n=18)*
Refrigerator	61%
Stand-alone freezer	17%
Dishwasher	33%
Clothes washer	44%
Clothes dryer	39%
Oven	17%
Microwave	22%
Other	11%
Don't know	0%
Refused	0%

* Multiple responses were allowed for this question

Verbatim Other Responses	Count (n = 2)
Water heater	1
HVAC System	1

Q48. [Ask if Q47 <> DON'T KNOW] Was the [INSERT Q47 RESPONSE] an ENERGY STAR or high-efficiency model?

Response Option	Microwave	Refrigerator	Stand-alone Freezer	Dishwasher	Clothes washer	Clothes dryer	Other
Yes	3	9	3	5	6	5	2
No	0	0	0	0	0	0	0
Don't know	1	2	0	1	2	2	0
Total	4	11	3	6	8	7	2

Q49. [Ask if Q47 = CLOTHES DRYER] Does the new clothes dryer use natural gas?

Response Option	Percent (n=7)
Yes	0%
No	100%
Don't know	0%
Refused	0%

Q50. [Ask if Q41 = BOUGHT EFFICIENT HEATING OR COOLING EQUIPMENT and Q46_BUY EFFICIENT HEATING OR COOLING EQUIPMENT > 0] What type of heating or cooling equipment did you buy?

Response Option	Percent (n=13)*
Central air conditioner	62%
Window/room air conditioner unit	0%
Wall air conditioner unit	8%
Air source heat pump	15%
Geothermal heat pump	0%
Boiler	0%
Furnace	54%
Wifi thermostat	15%
Other	8%
Don't know	0%
Refused	0%

* Multiple responses were allowed for this question

Verbatim Other Responses	Count (n = 1)
Furnace filter	1

Q51. [Ask if Q50 = BOILER OR FURNACE] Does the new [INSERT Q50 RESPONSE] use natural gas?

Response Option	Percent (n=7)
Yes - it uses natural gas	43%
No – does not use natural gas	57%
Don’t know	0%

Q52. [Ask if Q50 <> WIFI-ENABLED THERMOSTAT, DON’T KNOW, OR REFUSED] Was the [INSERT Q50 RESPONSE] an ENERGY STAR or high-efficiency model?

Response Option	Other	Central air conditioner	Window / room air conditioner unit	Wall air conditioner unit	Air source heat pump	Geothermal heat pump	Boiler	Furnace
Yes	1	6	0	1	2	0	0	0
No	0	2	0	0	0	0	0	0
Don't know	0	0	0	0	0	0	0	0
Total	1	8	0	1	2	0	0	0

Q53. [Ask if Q41= BOUGHT EFFICIENT WINDOWS and Q46_BUY EFFICIENT WINDOWS >0] Do you know how many windows you installed?

Response Option	Percent (n=6)
Yes [please specify how many you installed in the box below]	100%
No	0%

Verbatim Responses	Percent (n=6)
6	2
10	1
13	2
Sic	1

Q54. [Ask if Q41 = ADDED INSULATION and Q46_ADD INSULATION > 0] Please let us know what spaces you added insulation to. Also, let us know the proportion of each space you added insulation to (for example, if you added insulation that covered your entire attic space, you would type in 100%).

Response Option	Percent (n=7)*
Attic	57%
Walls	57%
Below the floor	29%

* Multiple responses were allowed for this question

Attic

Verbatim Response	Count (n=4)
About 16” deep entire attic	1
45×60	1
100%	2

Walls

Verbatim Response	Count (n=4)
Put on walls	1
100%	1
10×12 room and 10×10 room	1
??	1

Below the floor

Verbatim Response	Count (n=2)
On water pipes	1
??	1

Q55. [Ask if Q41 = BOUGHT LEDS and Q46_BUY LEDS > 0] Do you know how many LEDs you installed at your property?

Response Option	Percent (n=41)
Yes	76%
No	24%

[Please specify how many you installed in the box below:]

Verbatim Response	Count (n=31)
10	5
10?	1
15	3
18	1
2	1
20	2
26	1
30	1
30+	1
35	1
4	2
5	2
5 or 6	1
6	1
6 to 10	1
7	2
8	2
About 30	1
All lights	1
approx. 8	1

Q56. [Ask if Q41 = BOUGHT CFLS and Q46_BUY CFLS > 0] Do you know how many CFLs you installed at your property?

Response Option	Percent (n=8)
Yes	63%

No	37%

[Please specify how many you installed in the box below:]

Verbatim Response	Count (n=5)
9	1
7	1
6	1
5	1
3	1

Q57. [Ask if Q41 = INSTALLED AN ENERGY EFFICIENT WATER HEATER and Q46_INSTALL AN ENERGY EFFICIENT WATER HEATER > 0] Does the new water heater use natural gas?

Response Option	Percent (n=11)
Yes	18%
No	82%
Don't know	0%

Q58. [Ask if Q41 = INSTALLED AN ENERGY EFFICIENT WATER HEATER and Q46_INSTALL AN ENERGY EFFICIENT WATER HEATER > 0] Which of the following water heaters did you purchase?

Response Option	Percent (n=11)
A traditional water heater with a large tank that holds the hot water	73%
A tankless water heater that provides hot water on demand	0%
A solar water heater	0%
Other	18%
Don’t know	9%

Verbatim Other Responses	Count (n=2)
Propane	1
Hybrid electric heat pump	1

Q59. [Ask if Q41 = INSTALLED AN ENERGY EFFICIENT WATER HEATER and Q46_INSTALL AN ENERGY EFFICIENT WATER HEATER > 0] Is the new water heater an ENERGY STAR model?

Response Option	Percent (n=11)
Yes	91%
No	9%
Don't know	0%

Q60. Which of the following types of housing units would you say best describes your home? It is . . .?

Response Option	Percent (n=174)
Single-family detached house	74%
Single-family attached home (such as a townhouse or condo)	12%
Duplex, triplex or four-plex	1%
Apartment or condo with 5 units or more	8%
Manufactured or mobile home	5%
Other	1%
Prefer not to say	0%
Don't know	0%

Verbatim Other Response	Count (n=1)
Brick single family home.	1

Q61. How many showers are in your home? Please include both stand-up showers and bathtubs with showerheads.

Response Option	Percent (n=174)
One	26%
Two	61%
Three	13%
Four	1%
Five or more	0%
Don’t know	0%

Q62. How many bathroom sink faucets are in your home? (Keep in mind that some bathrooms may have multiple bathroom sink faucets in them)

Response Option	Percent (n=174)
One	13%
Two	35%
Three	28%
Four	19%
Five	4%

Six	2%
Seven	0%
Eight or more	0%
Don't know	0%

Q63. How many kitchen faucets are in your home?

Response Option	Percent (n=174)
One	93%
Two	6%
Three	0%
Four or more	1%
Don't know	0%

Q63A. [IF Q63 > 1] You mentioned that you have more than one kitchen faucet. Where is/are your other kitchen faucet(s) located in your home?

Verbatim Other Response	Count (n=12)
Upstairs and downstairs	1
Laundry room.	1
Kitchenette	1
It's on the bar or counter top of the kitchen.	1
in the garage	1
in my second kitchen, we have a kitchen both upstairs and down stairs	1
family room in basement	1
Basement kitchen	1
Basement	2
Badement	1
5	1

Q64. How many square feet of living space are there in your residence, including bathrooms, foyers and hallways (exclude garages, unfinished basements, and unheated porches)?

Response Option	Percent (n=174)
Less than 500 square feet	0%
500 to under 1,000 square feet	9%
1,000 to under 1,500 square feet	25%
1,500 to under 2,000 square feet	22%
2,000 to under 2,500 square feet	13%
2,500 to under 3,000 square feet	6%
Greater than 3,000 square feet	5%

Prefer not to say	1%
Don't know	20%

Q65. Do you or members of your household own your home, or do you rent it?

Response Option	Percent (n=174)
Own / buying	93%
Rent / lease	5%
Occupy rent-free	0%
Prefer not to say	2%
Don't know	1%

Q66. Including yourself, how many people currently live in your home year-round?

Response Option	Percent (n=174)
I live by myself	23%
Two people	34%
Three people	15%
Four people	13%
Five people	7%
Six people	2%
Seven people	1%
Eight or more people	1%
Prefer not to say	3%
Don't know	0%

Q67. What was your total annual household income for 2018, before taxes?

Response Option	Percent (n=174)
Under $20,000	3%
$20,000 to under $30,000	7%
$30,000 to under $40,000	7%
$40,000 to under $50,000	4%
$50,000 to under $60,000	13%
$60,000 to under $75,000	9%
$75,000 to under $100,000	12%
$100,000 to under $150,000	9%
$150,000 to under $200,000	5%
$200,000 or more	1%
Prefer not to say	25%
Don't know	5%

Q68. What is the highest level of education achieved among those living in your household?

Response Option	Percent (n=174)
Less than high school	1%
Some high school	2%
High school graduate or equivalent (such as GED)	15%
Trade or technical school	5%
Some college (including Associate degree)	23%
College degree (Bachelor's degree)	29%
Some graduate school	1%
Graduate degree, professional degree	14%
Doctorate	4%
Prefer not to say	7%
Don't know	0%

Q69. Finally, what is your year of birth?

Verbatim Response	Count (n=174)
1933	1
1934	1
1937	2
1938	1
1939	1
1941	1
1942	1
1944	1
1945	2
1946	1
1947	2
1948	3
1949	5
1950	4
1951	5
1952	3
1953	2
1954	1
1955	2
1956	5
1957	2
1958	4

1959	3
1960	4
1961	4
1962	2
1963	3
1964	3
1965	2
1966	4
1967	4
1969	2
1970	1
1971	4
1972	3
1973	1
1974	1
1975	2
1976	4
1977	1
1978	3
1979	4
1980	1
1981	7
1982	5
1983	6
1984	1
1985	3
1987	1
1988	4
1989	4
1990	5
1991	1
1993	2
1994	1
Prefer not to say	29