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. 2024-00264

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:

<u>Introduction</u>

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. The Company attests that it is currently in good standing and is subject to the Commission's jurisdiction. A certified copy of Duke Energy Kentucky's certificate of good standing from the Kentucky Secretary of State and a certificate for the following assumed name: "Duke Energy" is on file with the Kentucky Secretary of State

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[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 (Apr. 11, 2013) (Order).

and on file with the Commission in Case No. 2022-00372.[2] In addition, the Company has attached, as Exhibit 1, a certified Certificate of Existence dated August 15, 2024. 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 the Commonwealth of Kentucky.

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 DSM 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, by August 15, annually, an application requesting any program expansion(s) and to include: (1) an Appendix A, setting forth the Cost Effectiveness Test Results of DSM programs,[3] (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, DSM rate, for both electric and natural gas customers, Appendix C.[4]

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[2] *In the Matter of the Electronic Application of Duke Energy Kentucky, Inc. (1) An Adjustment of Electric Rates; (2) Approval of New Tariffs; (3) Approval of Accounting Practices to Establish Regulatory Assets and Liabilities; and (4) All Other Required Approvals and Relief*, Case No. 2022-00372, Application (Dec. 1, 2022).

[3] The Company provides Cost Effectiveness Test Results for all of its programs in its November filings, with the most recent available results being available in Case No. 2023-00354, Application, Appendix B (Nov. 15, 2023). Appendix A to this Application contains the projected Cost Effectiveness Test Results for programs with proposed budget changes. Other programs' results remain unchanged.

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

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 Response (DR) programs, having offered such programs since the mid-90's. Its existing portfolio of DSM programs was approved by the Commission in Case No. 2023-00269, by Order dated November 20, 2023.[5] This current portfolio of programs are as follows:

- Program 1: Income Qualified 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: Non-Residential Smart $aver® Program
- Program 6: Power Manager® Program
- Program 7: PowerShare®
- Program 8: Income Qualified Neighborhood Energy Saver Program
- Program 9: Home Energy Report
- Program 10: Non-Residential Business Energy Saver Program
- Program 11: Non-Residential Pay for Performance[6]
- Program 12: Peak Time Rebate Pilot Program

5. Consistent with the Commission's previous Orders, the Company is proposing programmatic changes in this year's annual amendment filing, and budgetary

[5] *In the Matter of the Electronic Application of Annual Cost Recovery Filing for Demand Side Management by Duke Energy Kentucky, Inc.* Case No. 2023-00269, Order (Nov. 20, 2023).
[6] Marketed as Smart $aver® Performance.

management proposals to allocate funding more effectively among 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 DSM:

- This Application proposes to expand the scope and/or adjust program budgets to respond to market conditions and enhance the robustness of the following:
    - Residential Smart $aver®
    - Non-Residential Smart $aver®
    - Peak Time Rebate
    - Business Energy Saver
    - PowerShare®

6. The changes proposed to the Peak Time Rebate (PTR) program, in addition to enhancing the program, are proposed to comply with the Commission's orders in Case No. 2022-00251. In that proceeding, the Commission ordered the Company to make certain modifications to the PTR Program and authorized the Company to adjust the budget for any programmatic or research elements.[7] The Commission also ordered that Duke Energy Kentucky "seek to implement these requirements to the best of its ability in that application," and that a deadline for implementing the requirements would be set in the "final Order for the August 15, 2024 DSM filing."[8]

[7] *In the Matter of Electronic Application of Duke Energy Kentucky, Inc. to Amend its Demand Side Management Programs*, Case No. 2022-00251, Order, pp. 4-6, 7 (Feb. 21, 2024) (February Order).
[8] *Id.*, Order, pp. 2-3 (Apr. 1, 2024).

7. The Residential Collaborative[9] and the Commercial and Industrial Collaborative[10] (The Collaborative) have received the Company's proposed changes and had the opportunity to provide comments. A Collaborative meeting was held on July 22, 2024, reviewing the proposed changes requested within this application.

Amendments to Existing Programs

8. Duke Energy Kentucky is seeking approval to expand the scope of the Residential Smart $aver® program. Specifically, to add measures to the multi-family portion of the program.

The Residential Multifamily Program works with multifamily property managers and property management companies to help customers reduce energy usage through the reduction in the amount of energy used for heating and cooling each unit. Most measures are free to both the customer and property. Smart thermostats are also available to properties at a subsidized cost (which includes installation). This reduction in energy usage also leads to lower customer energy bills.

The program targets prospective properties throughout Duke Energy Kentucky territories through electronic mail, phone calls, direct mail, tradeshows/events and in-person property visits by Energy Advisors.

Duke Energy Kentucky is seeking approval to expand the scope of the Residential Multifamily Energy Efficiency Program as follows:

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[9] The Residential Collaborative members receiving the information: John Horne, Michael West, and Lawrence Cook (Office of the Kentucky Attorney General), Jock Pitts (People Working Cooperatively), Catrena Bowman-Thomas (Northern Kentucky Community Action Commission), Laura Pleiman (Boone County), Kenya Stump (Kentucky Energy and Environment Cabinet), and Tim Duff and Trisha Haemmerle (Duke Energy).

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

Duke Energy Kentucky is requesting an increase in offerings to the current approved program to service additional eligible customers. This increase would allow Duke Energy Kentucky to expand the measures offered to multifamily properties. The additional proposed measures are:

- Weatherization (Doors & Windows)
- Caulking (Doors & Windows)
- Filter Change + Furnace Filter Whistle
- DHW turndown
- T8 Tube Light (4 ft)

Expanding the program offerings will allow Duke Energy Kentucky to serve more programs and properties, maximize the energy savings impacts associated with the program, and generally enable customers and properties to become more energy efficient.

The Company is requesting an increase to the current approved budget to allow for the additional measures being requested. This increase and the adjusted cost effectiveness scores are included in Appendix B and Appendix A, respectively.

9. The Non-Residential Smart $aver® Incentive Program provides incentives to commercial and industrial consumers for installation of high efficiency equipment in applications involving new construction, retrofit, and replacement of failed equipment. Incentives are provided based on Duke Energy Kentucky's cost effectiveness modeling to assure cost effectiveness over the life of the measure.

Prescriptive Measures: The program promotes prescriptive incentives for the following technologies—lighting, HVAC, pumps, variable frequency drives, food services, and process equipment. The eligible measures, incentives, and requirements for both equipment and customer eligibility are listed in the applications posted on Duke Energy's website.

Standards continue to change, and new, more efficient technologies continue to emerge in the market. The Company expects to continue to add or alter measures to provide incentives for customers to take advantage of a broader suite of products. The Company undertakes an annual review of technologies and efficiency levels through internal sources and with the assistance of outside technical experts. The review includes the existing technology categories as well as other emerging areas for energy efficiency.

For 2024-2025, a total of 6 measure additions were identified for the Lighting technology category, 12 measures for the HVAC technology category, 1 measure for the Process technology category, 2 measures for the Foodservice technology category and 5 measures for the Pumps and Motors technology category. A list of all measures proposed to be added to the program are included in Appendix D.

The Company is not requesting a change in the current approved budget. The forecasted budget for July 2025 – June 2026 to accommodate the baseline increases will be reflected in the annual cost recovery filing for DSM filed in November.

Since there are no requests to increase the budget, the Cost Effectiveness Test Results have not changed from the current scores that were filed in Case No. 2023-00354.

10. The 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. On February 21, 2024, the Commission issued an Order finding that

certain modifications should be made to the PTR Pilot program (February Order). The February Order listed eleven modifications and authorized the Company to adjust the initial budget for any specific programmatic or research elements.[11] The eleven modifications can be summarized as follows:

a) The PTR program should remain as a pilot program for a minimum of two years from the date of entry of this Order.

b) The PTR program should remain as an opt-in program without a participation cap.

c) Duke Energy Kentucky should develop a process for assessing a participant's reliance on electricity, considering factors including but not limited to gas or electric heat, gas, or electric water heater, enabling technology like a smart thermostat or smart fridge, electric or gas vehicle, computers and other electronics, and other applicable home appliances.

d) Duke Energy Kentucky should offer participating customers a tiered incentive based on its electric reliance assessment model (*e.g.,* $0.60 kWh, $0.90 kWh, and $1.20 kWh).

e) Duke Energy Kentucky should expand its PTR marketing campaign to include initiatives such as direct mail, television advertisement, mass media outlets, website enrollment, etc.

f) Duke Energy Kentucky should provide customer education on cost-effective ways to save energy at the time of enrollment when a Peak

[11] February Order, Order, pp. 4-6, 7.

Time Event (PTE) is initiated and include an easily accessible PTR link on its website to highlight these energy saving opportunities.

g) Eligibility criteria should remain the same, in that customers cannot be enrolled in another DR program and have a past due balance on their account.

h) The amount of PTEs that Duke Kentucky utilizes for the PTR program should remain the same.

i) Duke Energy Kentucky should allow its customers to decide how to receive event communications at the time of registering for the program. Communication options should include, but not limited to, text, email or automated calling system.

j) Duke Energy Kentucky should file an Evaluation, Measurement and Verification (EM&V) report with the Commission once the two-year pilot program is completed.

k) After every 1,000 additional customers Duke Energy Kentucky enrolls in the updated PTR Pilot program, Duke Energy Kentucky should be allowed to earn a 5-basis point incentive to its PTR Pilot program DSM return on equity (ROE) for the duration of the PTR Pilot program period. Duke Energy Kentucky should provide the Commission, during its annual filing, with the number of customers currently enrolled in the PTR program and the current PTR program ROE incentive that the Company is calculating with its recovery mechanism.[12]

[12] *Id.*, pp. 4-6.

On March 12, 2024, the Company filed a motion, pursuant to KRS 278.400, requesting a rehearing of the February Order, seeking clarification regarding enhancements (c), (d), and (e) above, as well as the overall timing and process for compliance with the February Order.[13] On April 1, 2024, the Commission found that the Company's motion for rehearing be granted, and that the deadline for implementation of the PTR requirements will be set in the final Order for the August 15, 2024 DSM filing.[14] The Company was ordered to seek to implement the outlined requirements to the best of its ability in this Application, and its requests for clarification of the issues set forth in its motion will be addressed by the Commission in this proceeding.[15]

With regard to requirements (a), (b), (g), (h) and (j), in the February Order, the Company proposes to implement these as stated in the February Order, with no additional elaboration or clarification needed. With regard to items (c), (d), (e), (f), (i), and (k), the Company proposes to implement these requirements as elaborated below, as part of the modifications to the program and in adherence to the Commission's order:

Pertaining to item (c), that Duke Kentucky should develop a process for assessing a participant's reliance on electricity, the Company proposes that the initial customer enrollment process will ask the customer a series of questions which will help better ascertain the customer's reliance on electricity and extent to which they are able to affect their electricity demand. Such questions may include whether their home has gas or electric heat, gas or electric water heater, gas, or electric vehicle, or if they have certain technology such as a smart thermostat or smart appliance. The Company will seek to find the correct

[13] *Id.*, Application for Rehearing (Mar. 12, 2024).
[14] *Id.*, Order, p. 3 (Apr. 1, 2024).
[15] *Id.*

balance of information gathering so as not to dissuade enrollment with an overly lengthy or burdensome survey.

Pertaining to item (d), that Duke Energy Kentucky should offer participating customers a tiered incentive (e.g., \$0.60 kWh, \$0.90 kWh, and \$1.20 kWh) based on its electric reliance assessment model, the Company proposes to offer three incentive tiers. Initially, the tiers will be based on the customer's percentage of energy reduction during a given peak event, comparative to a calculated baseline for the customer. The base incentive tier would be a credit of \$1.00/kWh reduced, based on the Company's research. In Case 2022-00251, Appendix E (Peak Time Credit Pilot Evaluation), results from the program's customer survey indicated that 49% of non-participants said that they did not join the program because they felt the incentive to reduce electric usage (\$0.60/kWh) was too low. Additionally, a benchmarking review conducted by ESource indicated that many other utilities who conduct PTR-type programs offer credits in the range of \$1.00/kWh to \$1.50/kWh, although no instances of a tiered-credit incentive structure were found. The proposed second tier of credit incentive would be \$1.25/kWh and the highest tier would be \$1.50/kWh, with each successive incentive tier awarded to customers who exhibit an increased percentage reduction in usage during an event compared to their estimated baseline usage. When the Company has gathered a sufficient amount of information for its electric reliance assessment model, the Company will modify the tiers to consider information from the model. Although the Company believes that offering incentive credits at these levels may make cost effectiveness challenging to achieve, the Company also believes that they have a likelihood of increasing participation in the program.

Pertaining to item (e), that Duke Energy Kentucky should expand its PTR marketing campaign to include initiatives such as direct mail, television advertisement, mass media outlets, website enrollment, etc., the Company will expand its marketing efforts to include additional marketing channels beyond email. Email, direct mail, web enrollment, call center promotion, etc. will be leveraged to promote participation in the program. The Company does not propose to use television advertisement and mass media, as these are cost prohibitive and also less targeted to eligible customers. As is standard practice, the Company will continually evaluate the performance of the various marketing channels and adjust where needed in order maximize efficiency and effectiveness. If the Company discontinues any of the channels listed above as proposed to be used, it will inform the Commission in its next filing after the discontinuance.

Pertaining to item (f), that Duke Energy Kentucky should provide customer education on cost-effective ways to save energy and include an easily accessible PTR link on its website to highlight these energy saving opportunities, the Company will develop a program landing page site which will contain information on energy saving opportunities during peak events and provide the link to customers.

Pertaining to item (i), that Duke Energy Kentucky should allow its customers to decide how to receive event communications at the time of registering for the program, the Company at enrollment will capture the customer's preferred method of communication. The available methods will include: text message, automated calling, and email.

Pertaining to item (k), this item is not yet applicable, apart from providing the number of customers currently enrolled, because the Company has not yet implemented the updated program. The program currently has 592 enrolled customers. However, the Company does not currently have any capital cost recovery components in its DSM portfolio or any rate base associated with any of the programs. The Company currently calculates its Rider DSM revenue requirement using "projected . . . program costs, lost revenues, and shared savings . . . . along with under-recoveries and over-recoveries from the prior period."[16] The shared savings portion is "10% of the total savings net of the costs of measures, incentives to customers, marketing, impact evaluation, and administration," and "[t]he savings are estimated by multiplying the program spending times the UCT value and then subtracting the program costs."[17] Thus, item (k) would not add anything to the Company's Rider DSM recovery. Duke Energy Kentucky believes this provision was included in the February Order in order to provide positive financial incentive to encourage an expanded PTR program.[18] Given that the PTR pilot is not cost effective and is appropriately not included in the Company's shared savings incentive calculation, the Company defers to the Commission's judgment on whether a different positive financial should be provided, that would impact the Company's recovery upon increased enrollment in the PTR program, given the way that the Company's revenue requirement is currently calculated.

Due to the expected increased costs to expand and modify the program (*e.g.*, technology development costs, marketing costs, incentive costs) the Company estimates a program cost budget of $429,200 for the fiscal year, which is an increase from the budget of $215,998 in the most recent filing.[19]

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[16] *See In the Matter of the Electronic Application of Duke Energy Kentucky, Inc. to Amend its Demand Side Management Programs*, Case No. 2023-00269, Order, p. 8 (Nov. 20, 2023).
[17] *See In the Matter of the Annual Cost Recovery Filing for Demand Side Management by Duke Energy Kentucky, Inc.*, Case No. 2012-00495, Application, pp. 32-33 (November 15, 2012). This application was approved. *Id.*, Order, p. 15 (Apr. 11, 2013) (approving application).
[18] February Order, p. 6.
[19] *In the Matter of the Annual Cost Recovery Filing for Demand Side Management by Duke Energy Kentucky, Inc.*, Case No. 2023-00354, Application, Appendix C, p. 2 (Nov. 15, 2023).

This increase and the adjusted cost effectiveness scores are included in Appendix B and Appendix A, respectively.

11. The Business Energy Saver (BES) program is requesting additional budget due to anticipated increased participation in the SmartPath component of the program. SmartPath is meant to build upon the traditional Business Energy Saver option by minimizing financial barriers to customer participation by allowing customers to finance and implement energy efficiency upgrades at little to no upfront costs. The program is implemented by a qualified Trade Ally network who complete energy assessments, develops proposals, and implements the turnkey projects on the program's behalf. SmartPath offers customers financing through a partnership with the National Energy Improvement Fund (NEIF). All financing is between the customer and NEIF and is offered by the Trade Allies.

SmartPath was launched as an offering within the Duke Energy Kentucky service territory last year, however; due to the new product nature of the program, participation has been low. The Company is beginning to see an increasing amount of customer and Trade Ally interest in SmartPath which is expected to drive participation in excess of the amount that was budgeted for BES in the 2024-2025 fiscal year. The increased budget and impacts will allow the Business Energy Saver program to accommodate the SmartPath growth for the remainder of the fiscal year.

This increase and the adjusted cost effectiveness scores are included in Appendix B and Appendix A, respectively.

12. The PowerShare® program is requesting additional budget of $77,000 to conduct an EM&V evaluation during the 2024 – 2025 fiscal year. This evaluation is

required to evaluate two events associated with Winter Storm Elliott.

This increase and the adjusted cost effectiveness scores are included in Appendix B and Appendix A, respectively.

13. Pursuant to KRS 278.285(1)(b) and the Commission's Order, Appendix A includes the Cost Effectiveness Test Results for all programs with proposed budget changes.

14. 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).

15. 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.

16. Pursuant to KRS 278.285(1)(c) and the Commission's Order in Case No. 2012-00495, the Company is filing an evaluation schedule and program evaluations within this application. The following evaluations are included in Appendices E – H Appendix E: Evaluation, Measurement, and Verification Schedule; Appendix F: Residential Smart $aver® - HVAC; Appendix G: Residential Smart $aver® - Multifamily; Appendix H: Residential Smart $aver® - Save Energy and Water Kit.

17. 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/ Larisa M. Vaysman

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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 in paper medium; that the electronic filing was transmitted to the Commission on August 15, 2024; that there are currently no parties that the Commission has excused from participation by electronic means in this proceeding; and that submitting the original filing to the Commission in paper medium is no longer required as it has been granted a permanent deviation.[20]

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*/s/ Larisa M. Vaysman*________________
Counsel for Duke Energy Kentucky, Inc.

[20] *In the Matter of Electronic Emergency Docket Related to the Novel Coronavirus COVID-19,* Case No. 2020-00085, Order (July 22, 2021).

Commonwealth of Kentucky
Michael G. Adams, Secretary of State

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Certificate of Existence

Authentication number: 317480
Visit https://web.sos.ky.gov/ftshow/certvalidate.aspx to authenticate this certificate.

I, Michael G. Adams, Secretary of State of the Commonwealth of Kentucky, do hereby certify that according to the records in the Office of the Secretary of State,

DUKE ENERGY KENTUCKY, INC.

DUKE ENERGY KENTUCKY, INC. is a corporation duly incorporated and existing under KRS Chapter 14A and KRS Chapter 271B, whose date of incorporation is March 20, 1901 and whose period of duration is perpetual.

I further certify that all fees and penalties owed to the Secretary of State have been paid; that Articles of Dissolution have not been filed; and that the most recent annual report required by KRS 14A.6-010 has been delivered to the Secretary of State.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my Official Seal at Frankfort, Kentucky, this 15th day of August, 2024, in the 233rd year of the Commonwealth.

Michael G. Adams

Michael G. Adams
Secretary of State
Commonwealth of Kentucky
317480/0052929

APPENDICES A – H

Appendix A

Cost Effectiveness Test Results - 2024-25 Forecast

as amended 8/15/24 for modified programs

Program Name	UCT	TRC	RIM	PCT
Residential Programs				
Residential Smart $aver®	1.38	1.20	0.54	5.13
Peak Time Rebate Pilot Program	0.15	0.15	0.15	n /a
Non-Residential Programs				
Business Energy Saver	2.61	1.72	0.75	3.51
PowerShare®	2.07	5.21	2.07	n /a

Kentucky DSM Rider
Comparison of Revenue Requirement to Rider Recovery

Residential Programs	(1) Projected Program Costs 7/2022 to 6/2023 (A)	(2) Projected Lost Revenues 7/2022 to 6/2023 (A)	(3) Projected Shared Savings 7/2022 to 6/2023 (A)	(4) Program Expenditures 7/2022 to 6/2023 (B)	(5) Program Expenditures (C) Gas	(6) Program Expenditures (C) Electric	(7) Lost Revenues 7/2022 to 6/2023 (B)	(8) Shared Savings 7/2022 to 6/2023 (B)	(9) 2022 Reconciliation Gas (D)	(10) 2022 Reconciliation Electric (D)	(11) Rider Collection (E) Gas	(12) Rider Collection (E) Electric	(13) (Over)/Under Collection Gas (F)	(14) (Over)/Under Collection Electric (G)
Low Income Neighborhood	$ 503,214	$ 27,702	$ (20,137)	$ 571,412	$ -	$ 571,412	$ 15,054	$ (25,325)						
Low Income Services	$ 698,215	$ 26,554	$ (26,796)	$ 409,592	$ 176,657	$ 232,935	$ 21,830	$ (12,282)						
My Home Energy Report	$ 78,224	$ 83,976	$ 6,620	$ 31,477	$ -	$ 31,477	$ 102,409	$ 11,746						
Residential Energy Assessments	$ 284,858	$ 69,660	$ 9,820	$ 187,280	$ -	$ 187,280	$ 68,392	$ 9,964						
Residential Smart $aver®	$ 1,192,589	$ 240,313	$ 1,918	$ 787,360	$ -	$ 787,360	$ 243,477	$ 17,372						
Power Manager®	$ 855,519	$ -	$ 116,813	$ 835,517	$ -	$ 835,517	$ -	$ 108,866						
Peak Time Rebate Pilot Program	$ 216,257	$ -	$ -	$ 242,753	$ -	$ 242,753	$ -							
Revenues collected											$627,444	$8,942,349		
Total	$ 3,828,877	$ 448,205	$ 88,239	$ 3,065,391	$ 176,657	$ 2,888,733	$ 451,162	$ 110,342	$ (448,108)	$ 2,052,765	$ 627,444	$ 8,942,349	$ (898,895)	$ (3,439,347)

(A) Amounts identified in report filed in Case No. 2021-00313
(B) Actual program expenditures, lost revenues (for this period and from prior period DSM measure installations), and shared savings for the period July 1, 2022 through June 30, 2023
(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. 2022-00398
(E) Revenues collected through the DSM Rider between July 1, 2022 and June 30, 2023
(F) Column (5) + Column (9) - Column(11)
(G) Column (6) + Column (7) + Column (8) + Column (10) - Column(12)

Commercial Programs	(1) Projected Program Costs 7/2022 to 6/2023 (A)	(2) Projected Lost Revenues 7/2022 to 6/2023 (A)	(3) Projected Shared Savings 7/2022 to 6/2023 (A)	(4) Program Expenditures 7/2022 to 6/2023 (B)	(5) Lost Revenues 7/2022 to 6/2023 (B)	(6) Shared Savings 7/2022 to 6/2023 (B)	(7) 2022 Reconciliation (C)	(8) Rider Collection (D)	(9) (Over)/Under Collection (E)
Small Business Energy Saver	$ 771,723	$ 273,455	$ 70,371	$ 496,251	$ 348,401	$ 36,599			
Smart $aver® Non-Residential	$ 1,218,433	$ 527,401	$ 261,716	$ 503,612	$ 339,126	$ 111,846			
Total	$ 1,990,156	$ 800,855	$ 332,086	$ 999,862	$ 687,527	$ 148,445	$ 227,701	$ (688,651)	$ 2,752,187
PowerShare®	$ 851,383	$ -	$ 67,100	$ 885,512	$ -	$ 84,761	$ (136,731)	$ 372,902	$ 460,639
Total All Programs	$ 6,670,417	$ 1,249,060	$ 487,425	$ 4,950,765	$ 1,138,689	$ 343,548			

(A) Amounts identified in report filed in Case No. 2021-00313
(B) Actual program expenditures, lost revenues (for this period and from prior period DSM measure installations), and shared savings for the period July 1, 2022 through June 30, 2023
(C) Recovery allowed in accordance with the Commission's Order in Case No. 2022-00398
(D) Revenues collected through the DSM Rider between July 1, 2022 and June 30, 2023
(E) Column (4) + Column (5) + Column (6) + Column (7) - Column(8)

Kentucky DSM Rider

2024-2025 Projected Program Costs, Lost Revenues, and Shared Savings
as Amended 8.15.24

Residential Program Summary (A)

	Costs	Lost Revenues	Shared Savings	Total	Allocation of Costs (B) Electric	Gas	Electric Costs	Budget (Costs, Lost Revenues, & Shared Savings) Electric	Gas Costs
Income Qualified Neighborhood	$ 534,292	$ 31,541	$ (20,759)	$ 545,074	100.0%	0.0%	$ 534,292	$ 545,074	$ -
Income Qualified Services	$ 748,255	$ 12,001	$ (40,116)	$ 720,139	56.7%	43.3%	$ 424,087	$ 395,971	$ 324,168
My Home Energy Report	$ 442,331	$ 741,075	$ 65,215	$ 1,248,622	100.0%	0.0%	$ 442,331	$ 1,248,622	$ -
Residential Energy Assessments	$ 322,137	$ 50,042	$ 24,047	$ 396,226	100.0%	0.0%	$ 322,137	$ 396,226	$ -
Residential Smart $aver®	$ 648,458	$ 88,164	$ 22,748	$ 759,370	100.0%	0.0%	$ 648,458	$ 759,370	$ -
Power Manager®	$ 2,038,578	$ -	$ 46,463	$ 2,085,041	100.0%	0.0%	$ 2,038,578	$ 2,085,041	$ -
Peak Time Rebate Pilot Program	$ 428,999	$ -	$ -	$ 428,999	100.0%	0.0%	$ 428,999	$ 428,999	$ -
Total Costs, Net Lost Revenues, Shared Savings	$ 5,163,049	$ 922,822	$ 97,599	$ 6,183,471			$ 4,838,881	$ 5,859,303	$ 324,168

NonResidential Program Summary (A)

	Costs	Lost Revenues	Shared Savings	Total	Allocation of Costs (B) Electric	Gas	Electric Costs	Budget (Costs, Lost Revenues, & Shared Savings) Electric	Gas
Business Energy Saver (C)	$ 1,070,184	$ 128,985	$ 175,543	$ 1,374,712	100.0%	0.0%	$ 1,070,184	$ 1,374,712	NA
Smart $aver® Non-Residential	$ 2,286,676	$ 330,875	$ 339,287	$ 2,956,838	100.0%	0.0%	$ 2,286,676	$ 2,956,838	NA
PowerShare®	$ 801,600	$ -	$ 77,572	$ 879,172	100.0%	0.0%	$ 801,600	$ 879,172	NA
Total Costs, Net Lost Revenues, Shared Savings	$ 4,158,460	$ 459,860	$ 592,402	$ 5,210,722			$ 4,158,460	$ 5,210,722	NA
Total Program	$ 9,321,509	$ 1,382,683	$ 690,001	$ 11,394,192					

(A) Costs, Lost Revenues (for this period and from prior period DSM measure installations), and Shared Savings for Year 11 of portfolio.
(B) Allocation of program expenditures to gas and electric in accordance with the Commission's Order in Case No. 2014-00388.
(C) Small Business Energy Saver and SmartPath are indiviual sets of measures that are part of a single and larger program referred to as Business Energy Saver beginning July 1, 2023.

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

July 2024 to June 2025
as Amended 8.15.24

	Program Costs (A)
Electric Rider DSM	
Residential Rate RS	$ 5,859,303
Distribution Level Rates Part A DS, DP, DT, GS-FL, EH & SP	$ 4,331,550
Transmission Level Rates & Distribution Level Rates Part B	$ 879,172
Gas Rider DSM	
Residential Rate RS	$ 324,168

(A) See Appendix B, page 2 of 7

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

Year	July 2024 - June 2025
Projected Annual Electric Sales kWH	
Rate RS	1,510,718,457
Rates DS, DP, DT, GS-FL, EH, & SP	2,293,314,113
Rates DS, DP, DT, GS-FL, EH, SP, & TT	2,493,833,113
Projected Annual Gas Sales CCF	
Rate RS	61,109,198

Kentucky DSM Rider

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

July 2024 to June 2025

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	$ (3,585,519)	$ 5,859,303	$ 2,273,784	1,510,718,457	kWh	$ 0.001505	$/kWh
Distribution Level Rates Part A DS, DP, DT, GS-FL, EH & SP	$ 2,869,155	$ 4,331,550	$ 7,200,704	2,293,314,113	kWh	$ 0.003140	$/kWh
Transmission Level Rates & Distribution Level Rates Part B TT	$ 480,217	$ 879,172	$ 1,359,388	2,493,833,113	kWh	$ 0.000545	$/kWh
Distribution Level Rates Total DS, DP, DT, GS-FL, EH & SP						$ 0.003685	$/kWh
Gas Rider DSM							
Residential Rate RS	$ (937,098)	$ 324,168	$ (612,930)	61,109,198	CCF	$ (0.010030)	$/CCF
Total Rider Recovery			$ 10,220,946				

(A) (Over)/Under of Appendix B page 1 multiplied by the average three-month commercial paper rate for 2023 to include interest on over or under-recovery in accordance with the Commission's order in Case No. 95-312. Value is: **1.042500**
(B) Appendix B, page 2.
(C) Appendix B, page 4.

Allocation Factors based on July 2022-June 2023

Summary of Load Impacts July 2022 Through June 2023 (1)

Residential Programs	kWh	% of Total Res Sales	ccf	% of Total Res Sales	Elec % of Total % of Sales	Gas % of Total % of Sales
Low Income Neighborhood	451,265	0.0314%	-	0.0000%	100%	0%
Low Income Services	163,836	0.0114%	4,731	0.0086%	57%	43%
My Home Energy Report	1,970,273	0.1369%	-	0.0000%	100%	0%
Residential Energy Assessments	503,954	0.0350%	-	0.0000%	100%	0%
Residential Smart $aver®	1,563,474	0.1086%	-	0.0000%	100%	0%
Power Manager®	-	0.0000%	-	0.0000%	100%	0%
Peak Time Rebate Pilot Program	-	0.0000%	-	0.0000%	100%	0%
Total Residential	4,652,802	0.3233%	4,731	0.0086%		
Total Residential (Rate RS) Sales For July 2022 Through June 2023	1,439,169,083	100%	54,799,958	100%		

(1) Load Impacts Net of Free Riders at Meter

Allocation Factors Projected

Summary of Load Impacts July 2024 Through June 2025 (1)

Residential Programs	kWh	% of Total Res Sales	ccf	% of Total Res Sales	Elec % of Total % of Sales	Gas % of Total % of Sales
Low Income Neighborhood	655,428	0.0434%	-	0.0000%	100%	0%
Low Income Services	186,456	0.0123%	5,765	0.0094%	56.7%	43.3%
My Home Energy Report	13,491,615	0.8931%	-	0.0000%	100%	0%
Residential Energy Assessments	930,330	0.0616%	-	0.0000%	100%	0%
Residential Smart $aver®	1,481,003	0.0980%	-	0.0000%	100%	0%
Power Manager®	-	0.0000%	-	0.0000%	0%	0%
Total Residential	16,744,832	1.1084%	5,765	0.0094%		
Total Residential (Rate RS) Sales Projected	1,510,718,457	100%	61,109,198	100%		

(1)Load Impacts Net of Free Riders at Meter

KY.P.S.C. Gas No. 2
Thirty-~~Seventh~~ Eighth Revised Sheet No. 62
Cancels and Supersedes
Thirty-~~Sixth~~ Seventh Revised Sheet No. 62
Page 1 of 1

Duke Energy Kentucky
1262 Cox Road
Erlanger, Kentucky 41018

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. 61 of this Tariff.

The DSMR to be applied to residential customer bills is $(0.010030) per hundred cubic feet. ~~(R)~~

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 service customer bills is $0.00 per hundred cubic feet.

Issued by authority of an Order by the Kentucky Public Service
Commission dated ~~December 21, 2023~~XXXX in Case No. ~~2023~~2024-~~00354~~00264.
Issued: ~~January 8~~August 15, 2024
Effective: ~~January 10~~September 15, 2024
Issued by Amy B. Spiller, President /s/ Amy B. Spiller

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. 61 of this Tariff.

The DSMR to be applied to residential customer bills is $(0.010030) per hundred cubic feet.

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 service customer bills is $0.00 per hundred cubic feet.

Duke Energy Kentucky
1262 Cox Road
Erlanger, KY 41018

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.~~001352~~ 001505 per kilowatt-hour. (~~R~~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.~~003503~~ 003685 per kilowatt-hour. (I)

The DSMR to be applied for transmission service customer bills is $0.~~000514~~ 000545 per kilowatt-hour. (I)

Duke Energy Kentucky
1262 Cox Road
Erlanger, KY 41018

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 $0.001505 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 $0.003685 per kilowatt-hour. (I)

The DSMR to be applied for transmission service customer bills is $0.000545 per kilowatt-hour. (I)

Measure	Technology	Program	Category	Type
EFM Cooler Motor Controls - EFM replacing SP	Food Service Prodcuts	Smart $aver® Non-Residential	Add	Non-Residential
EFM Freezer Motor Controls - EFM replacing SP	Food Service Prodcuts	Smart $aver® Non-Residential	Add	Non-Residential
Chiller System Tune Up_Air Cooled Chiller	HVAC Products	Smart $aver® Non-Residential	Add	Non-Residential
Chiller System Tune Up_Water Cooled Chiller	HVAC Products	Smart $aver® Non-Residential	Add	Non-Residential
H.E. Condensing Unit (HECU) grtr or equal to135 kBtu	HVAC Products	Smart $aver® Non-Residential	Add	Non-Residential
Heat Pump Water Heater	HVAC Products	Smart $aver® Non-Residential	Add	Non-Residential
Switched Reluctance Motors (SRMs)	HVAC Products	Smart $aver® Non-Residential	Add	Non-Residential
VRF air cooled Heat Pump 135-240kBtuh	HVAC Products	Smart $aver® Non-Residential	Add	Non-Residential
VRF air cooled Heat Pump 65-135kBtuh	HVAC Products	Smart $aver® Non-Residential	Add	Non-Residential
VRF air cooled Heat Pump grtr 240kBtuh	HVAC Products	Smart $aver® Non-Residential	Add	Non-Residential
VRF air cooled Heat Pump lt. 65kBtuh	HVAC Products	Smart $aver® Non-Residential	Add	Non-Residential
VRF Wtr cooled Heat Pump 65-135kBtuh	HVAC Products	Smart $aver® Non-Residential	Add	Non-Residential
VRF Wtr cooled Heat Pump grtr 135kBtuh	HVAC Products	Smart $aver® Non-Residential	Add	Non-Residential
VRF Wtr cooled Heat Pump lt. 65kBtuh	HVAC Products	Smart $aver® Non-Residential	Add	Non-Residential
LED Indoor Non-Stacked (400 to 699W) rplc or ILO 1000W HID	Lighting Products	Smart $aver® Non-Residential	Add	Non-Residential
LED Indoor Non-Stacked lt. 400W rplc or ILO 600W HID	Lighting Products	Smart $aver® Non-Residential	Add	Non-Residential
LED Exterior Retrofit Kit for HID fixture greater than 250W	Lighting Products	Smart $aver® Non-Residential	Add	Non-Residential
LED Exterior Retrofit Kit for HID fixtures up to 250W	Lighting Products	Smart $aver® Non-Residential	Add	Non-Residential
LED Highbay retrofit kit rplc 251-400W HID fixture	Lighting Products	Smart $aver® Non-Residential	Add	Non-Residential
LED Highbay retrofit kit rplc HID fixture greater than 400W	Lighting Products	Smart $aver® Non-Residential	Add	Non-Residential
FEI driven H.E. constant speed fans	Pumps and Motors Products	Smart $aver® Non-Residential	Add	Non-Residential
FEI driven H.E. variable speed fans	Pumps and Motors Products	Smart $aver® Non-Residential	Add	Non-Residential
PEI driven H.E. Constant Speed Pumps	Pumps and Motors Products	Smart $aver® Non-Residential	Add	Non-Residential
PEI driven H.E. Variable Speed Pumps	Pumps and Motors Products	Smart $aver® Non-Residential	Add	Non-Residential
Walk-in Coolers_Freezers Permanent Magnet Synchronous Motor	Pumps and Motors Products	Smart $aver® Non-Residential	Add	Non-Residential
Heated Desiccant Compressed Air Dryer	Process Equipment Products	Smart $aver® Non-Residential	Add	Non-Residential

Status Update for Duke Energy Kentucky Energy Efficiency and Demand Response Programs; 2024-2026

Planned[1] Evaluation, Measurement and Verification Activities and Evaluation Reports

Residential Customer Programs	Program/Measure	Last Evaluation completion	Next Evaluation ==>	Q1 2024	Q2 2024	Q3 2024	Q4 2024	Q1 2025	Q2 2025	Q3 2025	Q4 2025	Q1 2026	Q2 2026	Q3 2026	Q4 2026
Low Income Neighborhood	Neighborhood	12/20/2022											M&V	M&V	M&V
Low Income Services	Refrigerator Replace	7/31/2013	TBD												
	Weatherization/Payment Plus	7/31/2013													
	Pay For Performance	N/A													
My Home Energy Report	MyHER	2/12/2014		M&V	M&V	Report								M&V	M&V
Residential Energy Assessments	HEHC	8/7/2020							M&V	M&V	M&V	M&V	Report*		
Residential Smart Saver®	HVAC	9/26/2023										M&V	M&V	M&V	M&V
	Specialty Bulbs/Online Savings Store	10/6/2022												M&V	M&V
	Water Measures	7/19/2024		M&V	M&V	Report									
	Multi-Family	1/30/2024		Report											
Power Manager		8/31/2020		M&V	M&V	Report									
Peak Time Rebate Pilot	Peak Time Rebate	5/18/2023													M&V

Non-Residential Customer Programs	Program/Measure	Last Evaluation completion	Next Evaluation ==>	Q1 2024	Q2 2024	Q3 2024	Q4 2024	Q1 2025	Q2 2025	Q3 2025	Q4 2025	Q1 2026	Q2 2026	Q3 2026	Q4 2026
Small Business Energy Saver		11/10/2022												M&V	M&V
Smart $aver® Non-Res, Custom		1/18/2022										M&V	M&V	M&V	Report
Smart $aver® Non-Res, Prescriptive		7/24/2019		M&V	M&V	M&V	Report								
PowerShare		2/14/2017				M&V	M&V	Report							

[1] Future Evaluation Report dates are projections only. Actual report dates will vary depending on program participation, time to achieve a significant sample and the time needed to collect adequate data.
* Postponed timing due to pandemic program suspension; program participation levels

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

Smart $aver 2020-2022 Evaluation Report

Duke Energy Kentucky

Submitted to Duke Energy

Date: September 26, 2023

Principal Authors:

Danielle Côté-Schiff Kolp, Senior Manager

Marlee Konikoff, Research Analyst

Alex Opipari, Consultant

Greg Sidorov, Senior Consultant

Keegan Skoretz, Energy Efficiency Analyst

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Contents

1. Executive Summary

1.1. Program Summary

The Smart $aver program offers incentives for Duke Energy Kentucky's (DEK) existing and new construction residential customers. These are designed to improve their homes' energy efficiency through installations of energy-efficient heating, ventilating, and air conditioning (HVAC) units, smart thermostats, heat pump water heaters, variable-speed pool pumps, duct sealing, and attic insulation with air sealing.

A tiered incentive structure for eligible HVAC equipment, along with optional smart thermostats, offers larger rebates for higher-efficiency units. Though the program does not offer smart thermostats as a standalone incentive, these are available at Duke Energy's online marketplace. Therefore, customers must receive a rebate for a new HVAC system to qualify for this additional $65 incentive through this program. Independent, prequalified contractors provide the program to customers, installing eligible energy-efficiency measures consistent with program standards and guidelines and submitting the rebate application documentation on the customers' behalf.

1.2. Evaluation Objectives and Results

This report presents the evaluation activities' results and findings for the Smart $aver program; the evaluation team conducted these for the July 1, 2020—March 31, 2022, evaluation period.

1.2.1. Impact Evaluation

The impact evaluation was divided into two tasks: determining gross savings, followed by quantifying net savings. The evaluation team reviewed the program database to help inform the design of the evaluation effort and sampling approach. Activities included engineering desk analyses to estimate gross savings for all program measures during the evaluation period. Measurements from the recently completed Duke Energy Indiana (DEI) metering study (n=44) were adjusted for typical DEK weather conditions to estimate operation loads of air source heat pumps and central air conditioners.

Net savings reflected the degree that gross impacts resulted from program-specific efforts and incentives. The evaluation team determined free ridership and spillover rates using attribution surveys of program participants and contractors. Table 1-1 provides the program-level results for Smart $aver.

Table 1-1: Program Impact Results

Measurement	Reported	Realization Rate	Gross Verified	Net-to-Gross Ratio	Net Verified
Energy (kWh)	1,088,307	70.0%	761,667	64.90%	494,343
Summer Demand (kW)	191.1	50.8%	97.1		63.0
Winter Demand (kW)	100.7	61.4%	61.8		40.1

During the July 1, 2020—March 31, 2022 evaluation period, the program provided rebates for 2,485 measures installed in single-family homes. This resulted in 762 MWh in gross verified energy savings and 494 MWh in net verified energy savings. As shown in Figure 1-1 and Figure 1-2, the program primarily incentivized HVAC equipment and add-on smart thermostats, accounting for approximately 80% of verified energy savings.

Figure 1-1: Count of Smart $aver Rebated Measures

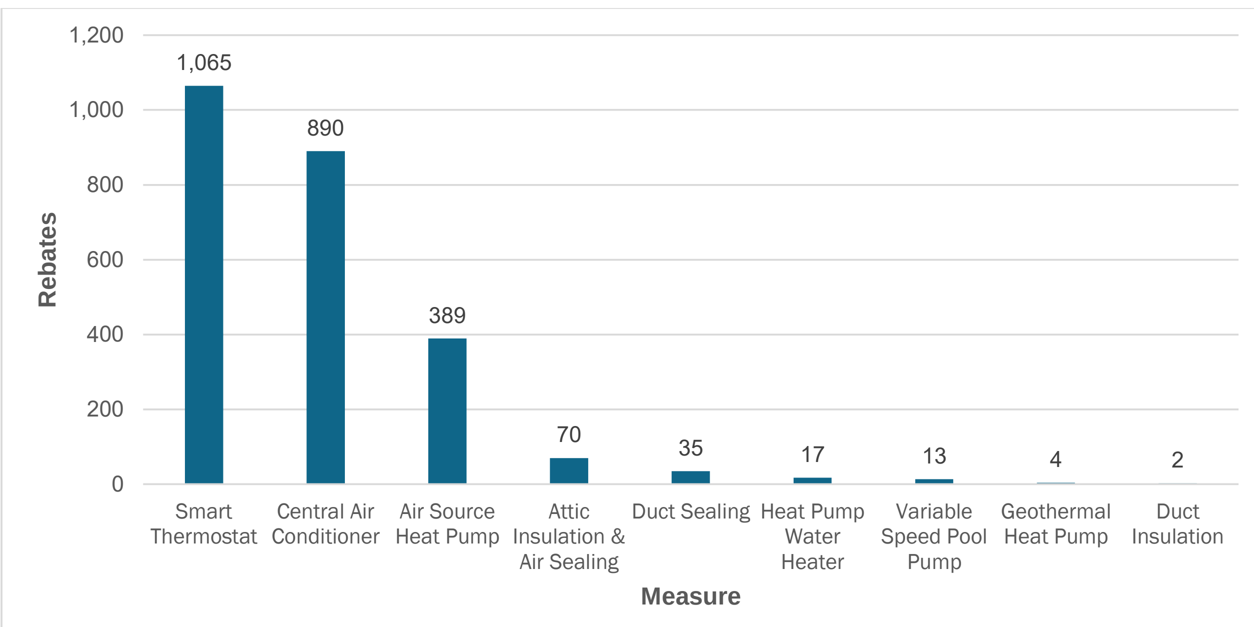
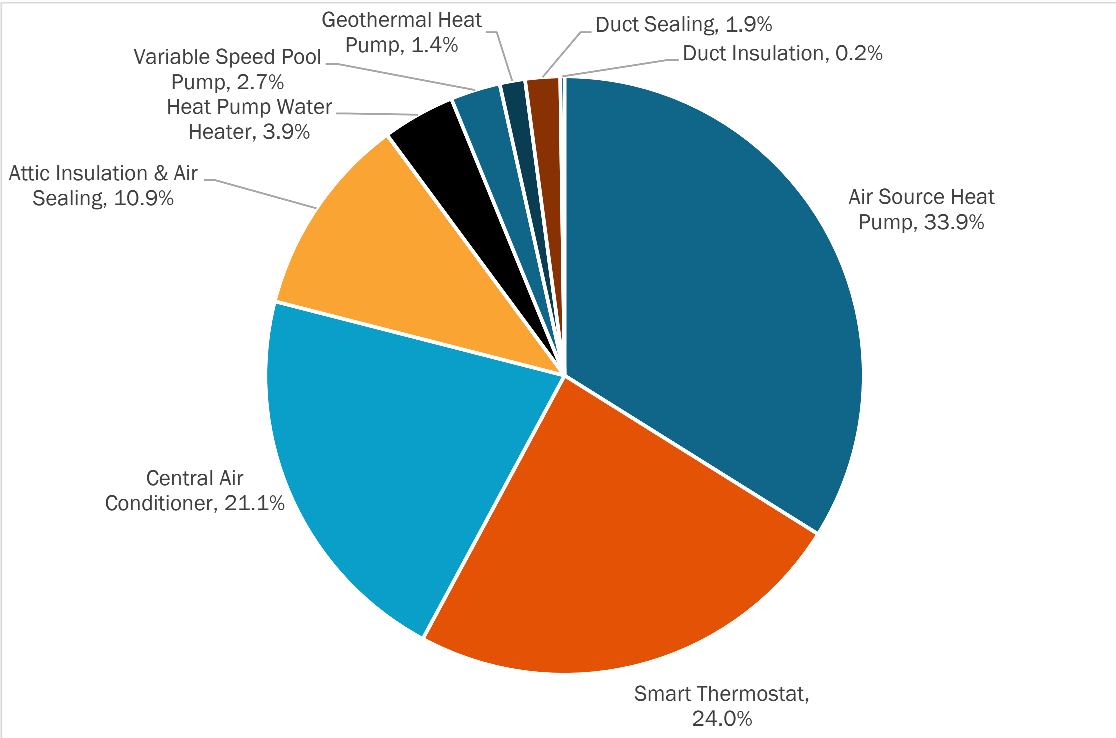


Figure 1-2: Smart $aver Verified Energy Savings Portion by Measure



The evaluation resulted in verified savings with a wide range of realization rates. Specific measure savings findings include the following:

- **Air source heat pumps** achieved 107% and 359% energy realization rates for Tier 2 and Tier 3, respectively, primarily due to heating energy savings. The energy realization rate for Tier 3 air source heat pumps is extremely high, as reported per-unit energy savings for Tier 3 air source heat pumps was lower than that of Tier 2 air source heat pumps. Tier 3 air source heat pumps produced negative summer kW savings due to significant portions of new units having a low energy efficiency ratio (EER) below the baseline.
- Multiple factors significantly decreased **central air conditioner** savings. Many air conditioning units rebated through the program had low capacities and low EERs. This contributed to low energy savings and low summer demand savings. A change in the federal code governing the fan efficiency ratio (FER) reduced winter demand savings to zero as well as reducing energy savings.
- **Attic insulation and air sealing** achieved reasonable energy realization rates. A significant portion of the population, however, had missing air-sealing parameters, reducing confidence in these results.

- The **smart thermostat** measure achieved a 33% energy realization rate, though the source of reported saving assumptions for this measure remains unknown.
- **Geothermal heat pumps** achieved very high realization rates due to the measure's low reported savings.
- **Duct sealing** reported savings were applied as deemed savings. It was found that the program database included CFM measurement parameters for only 14% of this measure population.
- Due to very low participation rates, evaluation planning specified deemed savings as applied to **heat pump water heaters**, **variable speed pool pumps**, and **duct insulation** measures.

Table 1-2 presents each rebated measure's per-unit verified gross energy and demand savings.

Table 1-2: Gross Verified Impacts by Measure (Per Unit)

Measure	Energy Savings (kWh)			Summer Demand Savings (kW)			Winter Demand Savings (kW)		
	Reported	Realization Rate	Gross Verified	Reported	Realization Rate	Gross Verified	Reported	Realization Rate	Gross Verified
Central Air Conditioner	273.76	66.05%	180.81	0.1235	41.47%	0.0512	0.0395	0.00%	0.0000
Smart Thermostat	497.98	34.41%	171.38	0.0000	N/A	0.0000	0.0000	N/A	0.0000
Air Source Heat Pump	424.71	156.28%	663.75	0.0911	33.84%	0.0308	0.1051	105.70%	0.1111
Geothermal Heat Pump	285.85	912.17%	2607.39	0.1154	394.91%	0.4557	0.0309	1,586.94%	0.4905
Variable Speed Pool Pump	1580.00	100.00%	1580.00	0.5900	100.00%	0.5900	0.0000	N/A	0.0000
Attic Insulation & Air Sealing	1162.00	102.02%	1185.48	0.3144	65.51%	0.2059	0.3023	62.60%	0.1893
Heat Pump Water Heater	1763.00	100.00%	1763.00	0.1350	100.00%	0.1350	0.2013	100.00%	0.2013
Duct Sealing	410.00	100.00%	410.00	0.3395	100.00%	0.3395	0.0000	N/A	0.0000
Duct Insulation	876.00	100.0%	876.00	0.7253	100.0%	0.7253	0.000	N/A	0.000

*Realization rates may not exactly equal verified savings divided by reported savings, due to rounding of the figures given in this table.

1.2.2. Net-to-Gross

Net-to-gross (NTG) assessment measures the extent that utility programs motivate customers to undertake energy-saving installations that, otherwise, they would not have performed. The NTG formula utilizes free ridership (FR), participant spillover (PSO), and nonparticipant spillover (NPSO): NTG = 100% - FR + PSO + NPSO. Inserting free ridership and spillover estimates into the NTG formula produced a 64.90% NTG value for the combined 2020-2022 DEK program measures, as shown in Table 1-3. This result remains relatively in line with previous evaluations in DEI's territory from 2020-2021, which produced a 68% NTG value.

Table 1-3: Net-to-Gross Results

NTG Type	FR	PSO	NPSO	NTG
Program Measures (Self-Report)	42.78%	5.27%	2.41%	64.90%

Each NTG component estimate is derived from the following sources:

- FR: The participant survey included an FR battery, consisting of change and influence components, to assess participants actions in the program's absence.
- PSO: Participant surveys assessed whether participants installed additional measures after their program participation and whether this could be attributed to the Smart $aver program.
- NPSO: Trade ally surveys assessed whether these trade allies installed energy-efficient measures for nonparticipating customers, attributing their efficient measure recommendations to their program involvement.

1.2.3. Process Evaluation

This process evaluation assessed the following: customer and trade ally experiences; why and how rebated energy-saving measures were implemented through Smart $aver; and methods to improve program design and implementation. In answering these research questions, the evaluation team interviewed program and implementer staff (n=2) and "high volume" trade allies (n=2) as well as a random sample of trade allies (n=3), and participants (n=58).[1]

[1] High-volume trade allies include companies in the top 20% of trade allies in terms of the number of rebated measures for a given measure type.

Program Successes

The Smart $aver Program succeeded in the following areas.

- **Overall, participants were highly satisfied with Smart $aver.** Participants especially expressed satisfaction with their contractors and their upgrade projects as well as with Duke Energy overall.

- **Interviewed trade allies appreciated the enhanced trade ally portal.** Trade allies reported satisfaction with the incentive application submission process and the trade ally portal application tracking system.

- **Trade allies proved to be Smart $aver's most successful marketing channel.** Participant surveys demonstrated that trade allies served as the primary source of program awareness and played the most influential role in customers' decisions to implement rebated measures. Furthermore, most trade allies reported that, typically, their customers had not heard of Smart $aver rebates until the trade allies informed them of the offers. This emphasizes the importance of the trade allies to the Smart $aver program.

Program Challenges

Trade allies and participants highlighted the following concerns:

- **Duke Energy consumer communications could improve.** Few participants (23%) heard about the Smart $aver program through Duke Energy. Overall, the majority of participants heard about Smart $aver rebates from their contractor (45%). Fewer participants hear about rebates over email (14%) or through direct (paper) mail or bill inserts (7%). Of participants offering suggestions for improvements, several suggested Duke Energy discuss methods for moving to renewable energy or for providing greater clarity on which parties submit the rebate.

- **Portal updates may remain necessary to ensure the complete satisfaction of trade allies.** Despite the interviewed trade allies' high satisfaction ratings for the portal, surveyed trade allies reported lower satisfaction levels. Suggestions for improvements include the following:

  - Provide a $100 incentive to trade allies to complete the application through the portal.
  - Offer website portal access through an app; so trade allies can input customer information and upload equipment pictures while on the job.
  - Clarify wording on the rebate application to indicate whether sales have been completed or remain pending.
  - Clarify error explanations in submissions.

1.3. Evaluation Conclusions and Recommendations

Based on the findings, the evaluation team suggests the following recommendations for program improvements.

Conclusion 1: Program design updates could improve savings results.

Recommendation 1: Consider applying the following updates to the program design:

- Add an additional tier for SEER 18+ for central air conditioners (CACs) and air source heat pumps (ASHPs)
- Add a ductless mini-split heat pump offering
- Consider adding an EER requirement to CAC and ASHP measures (as this impacts summer kW)
- Separate ground source heat pumps from the Tier 3 ASHP and assign specific savings for each measure

Conclusion 2: Trade allies make good use of the updated portal system.

Recommendation 2: Trade allies' multiple suggestions for application improvements included the following:

- Better explain why an application may be returned as invalid/in error
  - Respondents noted that submission errors sometimes remained unclear, leading to trade allies reopening submissions and searching manually for possible errors
- Offer the portal through an app; so trade allies can make updates while in the field
- Clarify the portal system's tracking to determine whether rebates remain incomplete, complete, or pending

Conclusion 3: Though most respondents expressed satisfaction with the incentives, some customers and trade allies suggested alternatives.

Recommendation 3: Consider making the default incentive payment through a check as issues sometimes arise with gift cards expiring before people can use them. If this is not possible, communicate with customers that should their gift card expire before use, they may request a reissue up to one year after participation.

Recommendation 4: Trade allies are the most commonly cited way that customers learned of the program and they complete the incentive application process (for most measures). Trade allies interviewed and surveyed noted that the time-consuming incentive application posed a barrier for completing the rebates. Consequently, Duke might consider reinstating a direct incentive for trade allies.

Conclusion 4: Measure parameters were recorded for only 44% of attic insulation and air-sealing participants and 14% of duct-sealing participants.

Recommendation 5: Require that contractors collect cubic feet per minute (CFM) measurement data before and after performing air sealing or duct sealing, as the program did for measures prior to February 25, 2021.

- Attic Insulation and Air Sealing
  - Pre-Sealing CFM
  - Post-Sealing CFM
- Duct Sealing
  - Pre-Sealing CFM
  - Post-Sealing CFM
  - Pre-Sealing CFM Whole House
  - Post-Sealing CFM Whole House

Conclusion 5: Lower incentive levels reduce participation and may increase free ridership rates.

Recommendation 6: Consider raising customer incentive levels to increase participation and efficiency and to lower free ridership.

2. Introduction

2.1. Program Description

2.1.1. Overview

The Smart $aver program offers Duke Energy Kentucky (DEK) existing and new construction residential customers incentives for improving their home's energy efficiency through the installation of energy-efficient heating, ventilating, and air conditioning (HVAC) units, smart thermostats, heat pump water heaters, variable-speed pool pumps, duct sealing, and attic insulation with air sealing. A tiered incentive structure for eligible HVAC equipment, along with an optional smart thermostat, offers larger rebates for higher-efficiency units. The program does not offer standalone smart thermostat incentives (though these are available in the online marketplace). Customers must receive rebates for a new HVAC system to qualify for the additional incentive.

Independent prequalified contractors (i.e., trade allies) provide the program, installing eligible energy efficiency measures (EEMs) consistent with program standards and guidelines. Additionally, they submit rebate application documentation on the customer's behalf. Though trade allies receive no monetary incentives for measures installed in existing buildings, builders become eligible to receive rebates for qualified HVAC equipment installed in residential new construction projects.

2.1.2. Energy Efficiency Measures

Table 2-1 summarizes EEMs included in the Smart $aver program.

Table 2-1: 2021 Smart $aver Measures and Incentives

Measures		Rebate Amount	Details
Central Air Conditioner		Tier 2: $200 Tier 3: $300	Tier 2: 15 and 16 SEER, with electrically commutated motor (ECM) Tier 3: 17 SEER or greater, with ECM
Heat Pump	*Air Source*	Tier 2: $300 Tier 3: $400	Tier 2: 15 and 16 SEER, with ECM Tier 3: 17 SEER or greater, with ECM
	Geothermal	Tier 3: $400	Tier 3: 19 EER or greater, with ECM
Smart Thermostat		$65	Add-on incentive for HVAC participants
Attic Insulation & Air Seal		$250	R-19 or below to R-30 or greater; decrease home air leakage by 5% or more; a minimum of 1,000 square feet of air-conditioned attic space

Measures	Rebate Amount	Details
Variable Speed Pool Pump	$300	Equipment must be an ENERGY STAR® qualified variable-speed pool pump for use with main filtration of in-ground residential swimming pool
Heat Pump Water Heater	$350	ENERGY STAR® qualified units; must have an EF ≥ 2
Duct Sealing	$100/duct system	Decrease air duct leakage by 12% or more

2.2. Program Implementation

Blackhawk Engagement Solutions (BES) chiefly implements the Smart $aver program, managing the trade ally registration process, incentive application submission and fulfillment, the trade ally online portal, and the program call center. As part of the prequalification process, all contractors seeking to participate must enter into a Letter of Agreement or a Prequalified Contractor Participation Agreement. The program's website lists contractors that meet program requirements as prequalified. The prequalified contractors receive permission to promote Smart $aver program measures and to identify themselves as program contractors.

Upon customer selection, contractors complete the requested installation in accordance with Smart $aver Program standards and guidelines as well as applicable building codes. Contractors use the online portal to submit incentive applications. Prequalified contractors provide itemized invoices with sufficient detail describing measures installed.

Upon receiving the application, BES verifies the application is complete and accurate, and follows up with customers or contractors to resolve any discrepancies. DEK staff conduct quality control inspections on a random sample (5%+) of installed measures. Inspections are shared across contractors, with new contractors and those with quality issues inspected at a higher rate. Upon application approval, participating customers (and, where applicable, builders or trade allies) receive the incentive.

DEK provides marketing through several channels, including direct-mail campaigns, the utility website, participating contractor outreach and advertising, and contractor associations. Additionally, DEK performs trade ally outreach and training services.

Eligibility

DEK residential account holders must reside within DEK electric service territory to qualify for Smart $aver rebates. All customer program participants must be on a DEK residential electric rate. The program remains open to existing residential electric service customers living in single-family homes, condominiums, mobile homes, townhomes, and duplexes. Builders also may apply for HVAC rebates for residential new construction projects.

2.3. Key Research Objectives

Overarching project goals followed 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."*

Thus, evaluation seeks to achieve two key objectives:

1) Document and measure program effects and determine whether the program meets its goals in serving as a reliable energy resource (impact evaluation).
2) Help understand why such effects occurred (net-to-gross [NTG]) and identify ways to improve the program (process evaluation).

2.3.1. Impact

Project impact evaluation processes, where applicable, followed standard industry protocols and definitions, adopting the Department of Energy (DOE) Uniform Methods Protocol as an example. As part of program evaluation planning, the evaluation team identified the following activities:

- Quantify accurate and supportable energy (kWh) and demand (kW) savings for energy-efficient measures and equipment implemented in participants' homes.
- Assess the customers' free rider rates and determine spillover effects from the customers' and contractors' perspectives.
- Benchmark verified, measure-level energy impacts to applicable technical reference manuals (TRMs) and other similar Duke programs in other jurisdictions.
- For program planning purposes, the evaluation team provided estimated per-unit savings by measure (to the extent possible).

2.3.2. Process

The process evaluation's design sought to support organizational learning and program adaptation. Consequently, the evaluation team sought to research several program delivery and customer experience elements, as outlined below:

Awareness and Engagement:

- How aware are customers of the Smart $aver program?
- What are the primary information sources (e.g., trade allies, program website, bill inserts) that customers use to learn more about the program?
- How do customers typically learn about energy-efficient technologies?
- How are trade allies engaged in the Smart $aver program, and what is the most effective engagement source (e.g., implementer, program website)?
- Is there a need for additional program marketing and/or for providing marketing support to trade allies?

Program Satisfaction:

- How satisfied are participants with their overall program experience, their contractors, and the quality of the installation, incentive turnaround, and energy savings following installation? Additional questions addressed their satisfaction with Duke Energy.
- How satisfied are trade allies with the program?

Program Influence:

- Does the program influence participants to engage in other Duke Energy energy-efficiency programs?
- Does the program increase contractor's knowledge of energy-efficient technologies?
- Does the program increase how often participating contractors promote energy-efficient equipment and services to their customers?

Challenges and Opportunities for Improvement:

- Do inefficiencies or challenges exist with the application, incentive turnaround, or trade allies?
- What training opportunities could be offered to trade allies to help them more effectively sell rebated equipment?

- How engaged are trade allies in using the implementer web portal or other program resources?

Participant Characteristics:

- What are the demographic characteristics of those participating in the program?

2.4. Evaluation Overview

The evaluation team divided its approach into the following key tasks to meet the outlined goals:

Task 1 – Develop and manage an evaluation plan to describe the processes to be followed in completing the evaluation tasks outlined in this project.

Task 2 – Conduct a process review to determine how successfully the program is delivered to market and identify improvement opportunities.

Task 3 – Verify gross energy and peak demand savings resulting from Smart $aver through conducting an engineering analysis of the population.

Task 4 – Determine net savings resulting from Smart $aver through on-line surveys with a sample of participants and trade allies.

As the evaluation plan has been previously completed and approved, the following two subsections provide more detailed descriptions of the impact and process evaluations.

2.4.1. Impact Evaluation

The impact evaluation comprised of a gross savings analysis and a net savings analysis. Techniques used to conduct the evaluation, measurement, and verification (EM&V) activities included a database review, an *ex ante* savings review, TRM-based engineering analysis, and web surveys with participants and trade allies to determine the NTG ratio.

Net impacts reflect the degree that gross savings result from program efforts and incentives. Utilizing self-report methods, the evaluation team estimated free ridership and spillover for the sample through surveys with program participants and nonparticipant spillover from trade allies. The ratio of net verified savings to gross verified savings provides the NTG ratio as an applied scaling factor to reported savings.

In Section 2.4.3, Table 2-2 summarizes the number of surveys and on-site inspections completed. The evaluation team drew samples to target a 90% confidence and 10% precision rate at the program level.

2.4.2. Process Evaluation

Process evaluations tell a qualitative story behind a quantitative impact evaluation by providing an understanding of the program in its unique context. Process evaluations seek to perform systematic assessments of an energy efficiency program by generating data that achieve the following outcomes:

- Document program operations
- Recommend improvements to increase the program's efficiency and effectiveness
- Assess stakeholder satisfaction

These outcomes can inform program planning, existing program implementation, or program redesign efforts. Process evaluations typically cover all program aspects, including its design, implementation, marketing and outreach, data tracking, quality assurance, customer and stakeholder feedback, and market conditions. By evaluating the broad context in which a program operates, evaluators can recommend realistic improvements.

Evaluators typically examine program aspects through the following mechanisms:

- Database and document review
- Interviews with program staff and key stakeholders, such as trade allies
- Surveys with customers
- Benchmarking research

Information from participating customers and trade allies, gathered through process evaluation activities, can be measured and analyzed to form the basis of a NTG ratio. For example, participant surveys used to assess participant satisfaction also provide opportunities to ask participants about their participation motivations and the program's influence on their decisions—both of which serve as key components of a free ridership calculation. Similarly, participant surveys can be used to assess whether participants installed additional energy savings measures (which may be attributed to spillover).

2.4.3. Summary of Activities

Techniques utilized to conduct EM&V activities and to meet the evaluation's goals included field inspections and metering, web surveys with program participants and trade allies, program database reviews and in-depth interviews (IDI) with utility, implementer, and trade ally staff. Table 2-2 summarizes activities Resource Innovations conducted as part of the Smart $aver program process and impact evaluations for the period of July 1, 2020—March 31, 2022.

Table 2-2: Summary of Evaluation Activities

Target Group	Population	Achieved Sample	Method
Participants	1,420	58	Online Survey
Duke Energy Program Staff	N/A	1	In-depth Interview (IDI)
Implementer Staff	N/A	1	IDI
Most Active Trade Allies	9	2	IDI
Trade Allies	58	3	Online Survey
Engineering Analysis	2,485	2,485	Analysis

3. Impact Evaluation

3.1. Methodology

The evaluation team performed an impact evaluation to evaluate energy and demand savings attributable to the Smart $aver program. The evaluation divided into two research areas: determining gross savings and net savings. Gross savings are energy and demand savings found at a participant's home that directly result from measures installed and rebated through the program. Net savings reflect the degree to which the gross savings result from program efforts and funds. The evaluation team verified energy and demand savings attributable to the Smart $aver program by conducting the following impact evaluation activities:

- Database and *ex ante* savings review.
- Sampling of participating measures.
- Adjustment of on-site metering for air source heat pump and central air conditioner replacements collected in DEI to DEK typical weather to estimate hours of operation and associated loads.
- Estimating gross verified savings using data collected through previous tasks and applying appropriate TRM algorithms to complete engineering analysis.
- Comparing DEK *ex ante* savings to gross-verified savings to determine program- and measure-level realization rates.
- Applying attribution surveys to estimate NTG ratios and program-level net-verified savings.

Impact evaluation activities result in realization rate calculations, which can be applied to reported savings documented in program-tracking records. Consequently, the realization rate serves as the ratio of savings determined from the EM&V activities to program-reported savings.

3.2. Database and *Ex Ante* Review

The program database review provided details that informed all evaluation activities. The evaluation team oriented the evaluation's scope based on information referenced from the program database, including the number of rebates for each measure and measure-specific installation details. These data were considered in designing approaches and methods to evaluate the program.

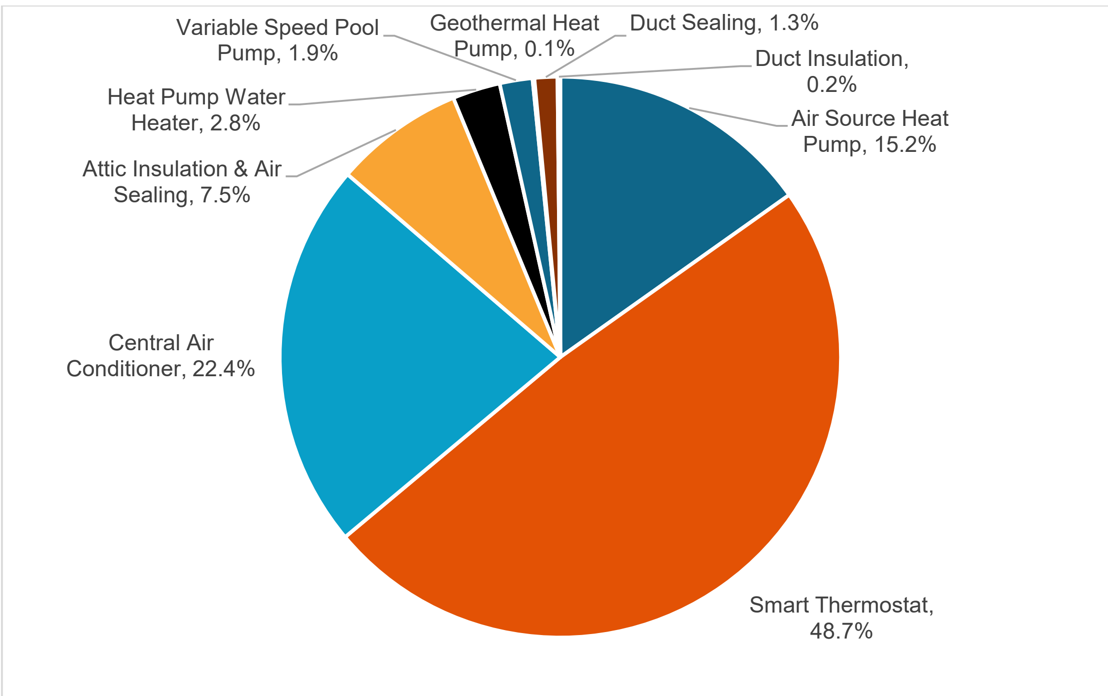
The evaluation team also reviewed *ex ante* savings values (i.e., program reported savings) for each measure rebated during the evaluation period. This review consisted of benchmarking *ex ante* savings against previous evaluation results for the DEK Smart $aver program, the Duke Energy Ohio Smart $aver program, and regional TRMs. This allowed the evaluation team to understand if the program's assumed savings values aligned with expectations.

3.3. Sampling Plan and Achievement

For the July 1, 2020—March 31, 2022, evaluation period, smart thermostats, air source heat pumps, and central air conditioners served as the largest measure contributors for reported energy savings.

The evaluation team requested a participation database extract of 2020, 2021, and 2022 program results, including counts and details on installed measures. As shown in Figure 3-1, the distribution of reported energy savings was based on measure counts from the participation database, which provided insights regarding those measures with a greater influence on total program savings.

Figure 3-1: Smart $aver Reported Energy Savings Portion by Measure



3.4. Description of Analysis

The evaluation team applied varying analysis techniques based on the measure technology, the measure's prominence within the program, and the availability of data on baseline and retrofit savings. A database of program participation provided useful information about measures installed, participants, and some measure-specific parameters. Table 3-1 shows the analysis approach applied to each measure.

Table 3-1: Analysis Approach

Measure	Approach
Central Air Conditioner	Engineering analysis
Air Source Heat Pump	Engineering analysis
Geothermal Heat Pump	Engineering analysis
Smart Thermostat	Engineering analysis
Attic Insulation & Air Seal	Engineering analysis & Desk review
Duct Sealing	Deemed
Variable Speed Pool Pump	Deemed
Heat Pump Water Heater	Deemed
Duct Insulation	Deemed

The following sections describe the different impact analysis approaches used for each program measure analyzed.

3.4.1. Analysis, Regression, EFLH Calculation

Due to the program's low program population, the evaluation team did not conduct a metering study for this program jurisdiction. In lieu of this, meter data recently collected from DEI's territory (n=63) was adjusted to typical DEK weather conditions. DEI's meter study established a relationship between device operation hours (such as the effective full load hours (EFLH)) and outdoor air temperatures.

Figure 3-2: DEI Cooling Runtime as a Function of Temperature

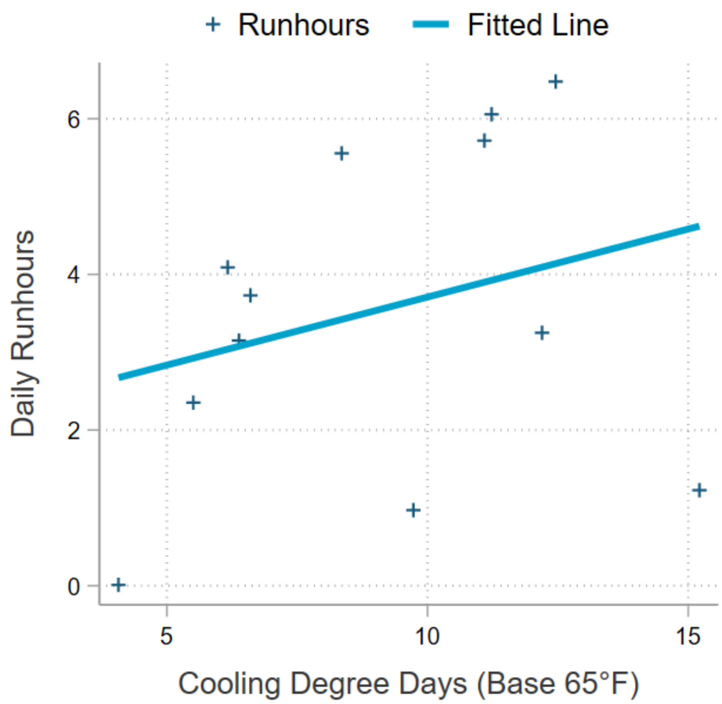


Table 3-2 shows the regression output for the relationship described in Figure 3-2. The key value to consider is the Cooling Degree Day (CDD) coefficient of 0.52. This term indicates that DEI customers used an average of 0.52 hours (or approximately 31 minutes) of additional cooling per CDD.

Table 3-2: DEI $EFLH_{cool}$ Regression Output

Model Term	Coefficient	Std. Err.	t-stat	P-value	90% Confidence Interval
CDD	0.52	0.020	25.49	0.000	± 6.45%

Figure 3-3 shows the relationship between average daily runtimes and heating degree days (HDD). Each blue + represents the average air source heat pump runtime in hours for each day in the heating dataset (i.e., each day with an average daily temperature below 65°F).

Figure 3-3: DEI Heating Runtime as a Function of Temperature

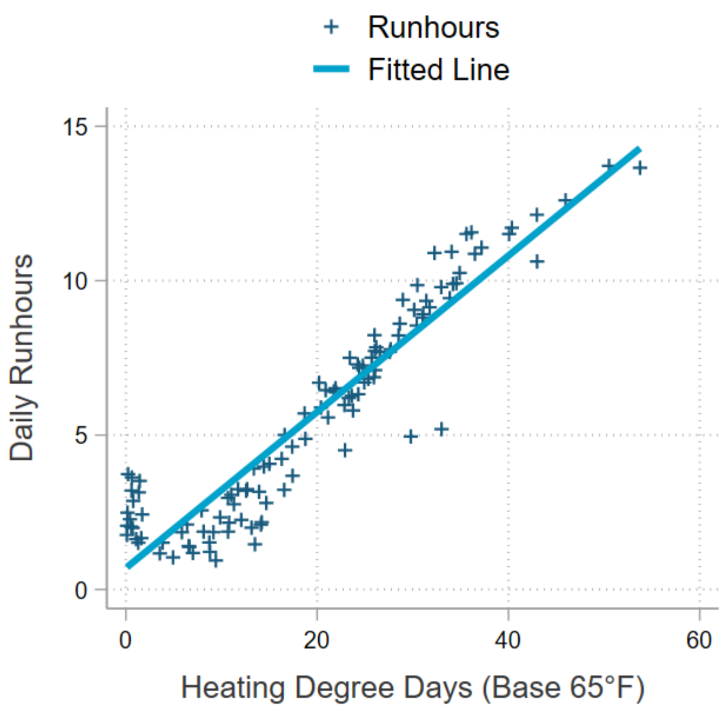


Table 3-3 shows the regression output for the relationship described in Figure 3-3. The coefficient term 0.28 indicates that DEI customers used an average of 0.28 hours (or approximately 17 minutes) of additional heating per HDD.

Table 3-3: DEI $EFLH_{heat}$ Regression Output

Model Term	Coefficient	Std. Err.	t-stat	P-value	90% Confidence Interval
HDD	0.28	0.002	114.99	0.000	± 1.43%

The evaluation team utilized hourly TMY3 data for the Covington, KY, weather station to calculate DEK's annual CDD and HDD for DEK, using those values to estimate $EFLH_{cool}$ and $EFLH_{heat}$ for each jurisdiction. Table 3-4 shows regression coefficients, annual CDD, annual HDD, and estimated EFLH values for each season. $EFLH_{cool}$ and $EFLH_{heat}$ were calculated by multiplying each term's regression coefficient by the average CDD and HDD values determined using TMY3 data.

Table 3-4: DEK EFLH Calculations

Term	Regression Coefficient	Annual Degree Days	EFLH	Relative Precision (at 90% CI)
CDD	0.52	1,187	617	6.45%
HDD	0.28	5,254	1,474	1.43%

The field data collected by Resource Innovations also provided the peak summer cooling demand coincidence factor (CF_{summer}). Just as the EFLH serves as a necessary component of the annual energy savings calculation, the peak coincidence factor is a necessary component of the peak demand savings calculation. This report defines the peak demand coincidence factor as the probability that cooling equipment will operate during system peak hours. The CF term's basic form—a ratio of hourly load to full load during a given hour of the day—is shown in Equation 3-1.

Equation 3-1: Coincidence Factor

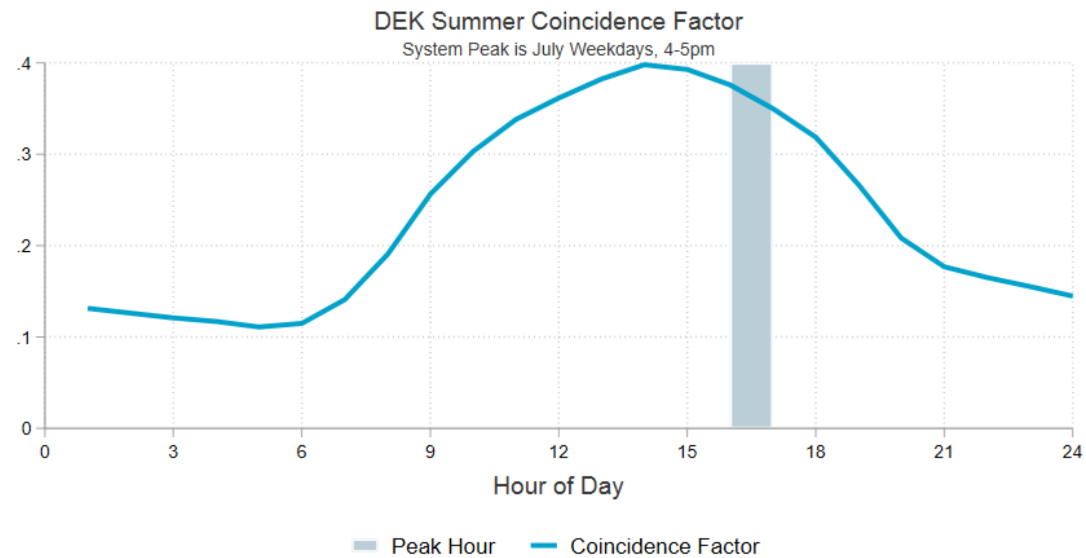
$$CF_h = \frac{Hourly\ Load_h\ (kW)}{Full\ Load\ (kW)}$$

Where:

Hourly Load	=	*Electric demand of the unit at hour h*
Full Load	=	*Electric demand draw of the unit when operating at full power*

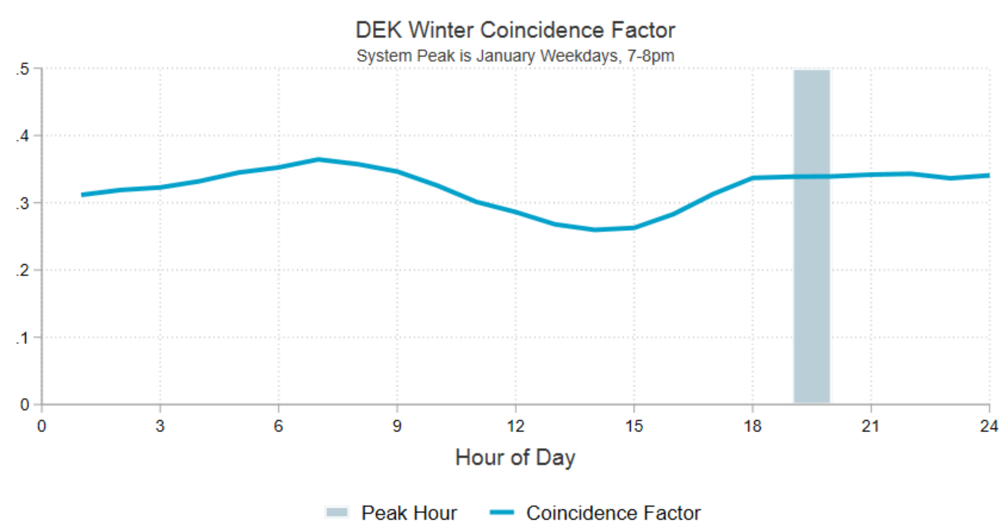
The evaluation team calculated the peak demand coincidence factor to estimate peak demand savings for the sample. A system's peak demand period refers to the period during which the highest power level is needed to satisfy its electric demand requirements. DEK defines its summer peak period as July weekdays between 4:00 pm and 5:00 pm (hour ending 17). Figure 3-4 shows the average CF_{summer} load curve for the metered sample. The system's peak period is highlighted in light blue. The CF_{summer} during the system peak is 0.35.

Figure 3-4: Summer Peak Demand Coincidence Factor



The evaluation team also calculated the peak winter heating demand coincidence factor. DEK defines its winter peak period as January weekdays between 7:00 pm and 8:00 pm (hour ending 20). Figure 3-5 shows the average CF_{winter} load curve for each weekday of January. The system's winter peak period is highlighted in light blue. The CF_{winter} during the system peak is 0.339.

Figure 3-5: Winter Peak Demand Coincidence Factor



3.4.2. Engineering Analysis

The following sections describe the engineering analyses performed for the central air conditioner, air source heat pump, and geothermal heat pump measures. Savings are calculated for each individual participant before rolling these up to determine average unit savings.

3.4.2.1. Central Air Conditioner Savings Calculation

The evaluation of central air conditioner measures used an engineering analysis of each participant, applying algorithms provided in Mid-Atlantic TRM V10.0, as outlined in Equation 3-2 and Equation 3-3.

Equation 3-2: Central Air Conditioner Energy Savings Algorithm

$$\Delta kWh = EFLH_{cool} \times kBtuh_{cool} \times \left(\frac{1}{SEER_{base}} - \frac{1}{SEER_{ee}}\right)$$

Equation 3-3: Central Air Conditioner Demand Savings Algorithm

$$\Delta kW_{Summer} = kBtuh_{cool} \times \left(\frac{1}{EER_{base}} - \frac{1}{EER_{ee}}\right) \times CF_{Summer}$$

Table 3-5 provides savings parameter inputs for central air conditioner measures and their sources. Parameters sourced from Mid-Atlantic TRM V10.0 or the adjusted DEI metering study (discussed in Section 3.4.1) were applied to each participant in the dataset. Savings could then be calculated for each participant using these parameters as well as the efficiency ratios and capacities specific to the participant. Population averages from the program dataset are provided for comparison.

Table 3-5: Inputs for Central Air Conditioning Energy and Demand Savings

Variable	Source	2023 Evaluation	
		Tier 2	Tier 3
$EFLH_{cool}$	Adjusted DEI Metering Study	617	
$kBtuh_{cool}$	Population Average	31.4	34.7
$SEER_{base}$	Mid-Atlantic TRM V10.0	14.0	
$SEER_{ee}$	Population Average	15.6	17.8
EER_{base}	Mid-Atlantic TRM V10.0	11.8	
EER_{ee}	Population Average	12.7	12.8

Variable	Source	2023 Evaluation	
		Tier 2	Tier 3
CF_{Summer}	Adjusted DEI Metering Study	0.350	
ECM kWh Savings	Secondary Sources	0	
ECM Winter kW Savings	Secondary Sources	0	

Table 3-5 shows that central air conditioning participants, on average, installed a new unit around 2.5 to 3 tons in capacity and above efficiency ratio baselines. However, significant EER variation was observed in the measure population, particularly among Tier 3 central air conditioners. Approximately 29% of Tier 3 central air conditioners installed through the program achieved an EER less than or equal to the 11.8 baseline, as specified by Mid-Atlantic TRM v10.0. These units produce summer demand savings less than or equal to zero.

Additionally, Table 3-5 shows zero savings associated with electrically commutated motor (ECM) furnace fans. The presence of reported winter demand savings for central air conditioners suggests savings were expected for installations of ECM furnace fans due to the more efficient furnace fan motor operating year-round as part of the HVAC system. On July 3, 2019, however, the federal code was updated governing fan efficiency ratios (FER) of residential furnace fans. This update included an increase to the minimum FER required of a furnace fan. Consequently, ECM furnace fans now serve as an effective baseline for residential furnace fan motors. Therefore, savings can no longer be attributed to ECM furnace fans, unless it can be shown that the installed fan's FER exceeds the minimum federal code. Thus, winter demand savings were set to zero.

Table 3-6 presents energy and demand savings for central air conditioners.

Table 3-6: Central Air Conditioner Gross Verified Savings (Per Unit)

Tier	Measurement	Reported Savings	Realization Rate	Verified Savings
2	Energy (kWh)	261.63	53.98%	141.22
	Summer Demand (kW)	0.1118	53.79%	0.0602
	Winter Demand (kW)	0.0404	0.00%	0.0000
3	Energy (kWh)	317.86	102.16%	324.73
	Summer Demand (kW)	0.1658	11.26%	0.0187
	Winter Demand (kW)	0.0361	0.00%	0.0000

*Realization rates may not exactly equal verified savings divided by reported savings, due to rounding of the figures given in this table.

3.4.2.2. Air Source Heat Pump Savings Calculation

For each participant, engineering analysis for air source heat pump measures was conducted using algorithms given in Mid-Atlantic TRM V10.0, as outlined in Equation 3-4 and Equation 3-5.

Equation 3-4: Air Source Heat Pump Energy Savings Algorithm

$$\Delta kWh = EFLH_{cool} \times kBtuh_{cool} \times \left(\frac{1}{SEER_{base}} - \frac{1}{SEER_{ee}}\right) + EFLH_{heat} \times kBtuh_{heat} \times \left(\frac{1}{HSPF_{base}} - \frac{1}{HSPF_{ee}}\right)$$

Equation 3-5: Air Source Heat Pump Demand Savings Algorithms

$$\Delta kW_{Summer} = kBtuh_{cool} \times \left(\frac{1}{EER_{base}} - \frac{1}{EER_{ee}}\right) \times CF_{Summer}$$

$$\Delta kW_{Winter} = kBtuh_{heat} \times \left(\frac{1}{HSPF_{base}} - \frac{1}{HSPF_{ee}}\right) \times CF_{Winter}$$

Table 3-7 shows savings parameter inputs for air source heat pump measures. Parameters sourced from Mid-Atlantic TRM V10.0 or the adjusted DEI metering study discussed in Section 3.4.1 were applied to each participant in the dataset. Savings were calculated for each participant using these parameters, as well as the efficiency ratios and capacities specific to the participant. Population averages from the program dataset are provided for comparison.

Table 3-7: Inputs for Air Source Heat Pump Energy and Demand Savings

Variable	Source	2023 Evaluation	
		Tier 2	Tier 3
$EFLH_{cool}$	Adjusted DEI Metering Study	617	
$kBtuh_{cool}$	Population Average	28.7	31.5
$SEER_{base}$	Mid-Atlantic TRM V10.0	14.0	
$SEER_{ee}$	Population Average	15.5	18.2
EER_{base}	Mid-Atlantic TRM V10.0	11.8	
EER_{ee}	Population Average	12.5	12.0
$EFLH_{heat}$	Adjusted DEI Metering Study	1,474	
$kBtuh_{heat}$	Population Average	27.8	30.8

Variable	Source	2023 Evaluation	
		Tier 2	Tier 3
$HSPF_{base}$	Mid-Atlantic TRM V10.0	8.2	
$HSPF_{ee}$	Population Average	8.9	9.5
CF_{Summer}	Adjusted DEI Metering Study	0.350	
CF_{Winter}	Adjusted DEI Metering Study	0.339	

Table 3-7 shows that air source heat pump participants, on average, installed a new unit around 2 or 3 tons in capacity and above efficiency ratio baselines. The measure population, however, exhibited significant variation in EER, particularly among Tier 3 air source heat pumps. Approximately 81% of Tier 3 air source heat pumps installed through the program achieved an EER of less than or equal to the 11.8 baseline as specified by Mid-Atlantic TRM v10.0. These units produce summer demand savings less than or equal to zero.

The majority of air source heat pump savings are derived from heating savings, which account for approximately 73% of energy savings for this measure.

Table 3-8 and Table 3-9 show energy and demand savings for air source heat pumps.

Table 3-8: Air Source Heat Pump Gross Verified Savings by Season (Per Unit)

Season	Tier	Energy Savings (kWh)	Summer Demand Savings (kW)	Winter Demand Savings (kW)
Cooling	2	125.75	0.0448	0.0
	3	316.62	-0.0033	
Heating	2	389.18	0.0	0.0896
	3	710.60		0.1635
Total	2	**514.94**	**0.0448**	**0.0896**
	3	**1027.22**	**-0.0033**	**0.1635**

Table 3-9: Air Source Heat Pump Gross Verified Savings (Per Unit)

Tier	Measurement	Reported Savings	Realization Rate	Verified Savings
2	Energy (kWh)	481.57	106.93%	514.94
	Summer Demand (kW)	0.0812	55.19%	0.0448
	Winter Demand (kW)	0.1354	66.14%	0.0896
3	Energy (kWh)	285.85	359.36%	1,027.22
	Summer Demand (kW)	0.1154	-2.82%	-0.0033
	Winter Demand (kW)	0.0309	529.10%	0.1635

*Realization rates may not exactly equal verified savings divided by reported savings, due to rounding of the figures given in this table.

3.4.2.3. Geothermal Heat Pump Savings Calculation

Geothermal heat pumps make use of constant ground temperatures to provide heating and cooling and to operate at higher efficiency levels than air source heat pumps. The Smart $aver program provides incentives for these systems to encourage participants to install higher-efficiency HVAC systems for their homes. The original DEI EFLH metering study excluded geothermal heat pumps, however, the evaluation team estimated savings based on the assumption that the heating and cooling EFLH for a geothermal heat pump serves as an equivalent to an air source heat pump. Equation 3-6 and Equation 3-7 provides savings algorithms for geothermal heat pump measures.

Equation 3-6: Geothermal Heat Pump Energy Savings Algorithm

$$\Delta kWh = EFLH_{cool} \times kBtuh_{cool} \times \left(\frac{1}{SEER_{base}} - \frac{1}{EER_{ee}}\right) + EFLH_{heat} \times kButh_{heat} \times \left(\frac{1}{HSPF_{base}} - \frac{1}{COP_{ee} \times 3.412}\right)$$

Equation 3-7: Geothermal Heat Pump Demand Savings Algorithms

$$\Delta kW_{Summer} = kBtuh_{cool} \times \left(\frac{1}{EER_{base}} - \frac{1}{EER_{ee}}\right) \times CF_{Summer}$$

$$\Delta kW_{Winter} = kBtuh_{heat} \times \left(\frac{1}{HSPF_{base}} - \frac{1}{COP_{ee} \times 3.412}\right) \times CF_{Winter}$$

Table 3-10 shows savings parameter inputs for geothermal heat pump measures. The team applied the parameters sourced from Mid-Atlantic TRM V10.0 or the adjusted DEI metering study (discussed in Section 3.4.1) to each participant in the dataset. Savings were calculated for each participant using these parameters as were efficiency ratios and capacities specific to the participant. Population averages from the program dataset are provided for comparison.

Table 3-10: Inputs for Geothermal Heat Pump Gross Verified Savings

Variable	Source	2023 Evaluation
$EFLH_{cool}$	Adjusted DEI Metering Study	617
$kBtuh_{cool}$	Population Average	39.9
$SEER_{base}$	Mid-Atlantic TRM V10.0	14.0
EER_{base}	Mid-Atlantic TRM V10.0	11.8
EER_{ee}	Population Average	19.6
$EFLH_{heat}$	Adjusted DEI Metering Study	1,474
$kBtuh_{heat}$	Population Average	32.2
$HSPF_{base}$	Mid-Atlantic TRM V10.0	8.2
COP_{ee}	Population Average	3.9
CF_{Summer}	Adjusted DEI Metering Study	0.350
CF_{Winter}	Adjusted DEI Metering Study	0.339

Reported savings for this measure, provided by Duke Energy, were given as the same savings value as Tier 3 air source heat pumps. This results in high realization rates for all savings types, as geothermal heat pumps typically have a higher capacity and are more efficient than air source heat pumps.

Table 3-11 and Table 3-12 provide energy and demand savings for geothermal heat pumps.

Table 3-11: Geothermal Heat Pump Gross Verified Savings by Season (Per Unit)

Season	Energy Savings (kWh)	Summer Demand Savings (kW)	Winter Demand Savings (kW)
Cooling	476.07	0.4557	0.0
Heating	2,131.32	0.0	0.4905
Total	**2,607.39**	**0.4557**	**0.4905**

Table 3-12: Geothermal Heat Pump Gross Verified Savings (Per Unit)

Measurement	Reported Savings	Realization Rate	Verified Savings
Energy (kWh)	285.85	912.17%	2,607.39
Summer Demand (kW)	0.1154	394.91%	0.4557
Winter Demand (kW)	0.0309	1,586.94%	0.4905

*Realization rates may not exactly equal verified savings divided by reported savings, due to rounding of the figures given in this table.

3.4.2.4. Smart Thermostat

Smart thermostats provide energy savings by optimizing the runtime of the homes HVAC equipment. Customers who enroll in the Smart $aver smart thermostat option through the program must also enroll in a HVAC upgrade measure. Demand impacts from smart thermostats are assumed to be zero, unless the thermostats are used in participation of a demand response program. The smart thermostat energy savings algorithm is given in Equation 3-8.

Equation 3-8: Smart Thermostat Energy Savings Algorithm

$$\Delta kWh = \%Savings_{cool} \times \left(\frac{kBTUh_{cool}}{SEER} \times EFLH_{cool}\right) + \%Savings_{heat} \times \left(\frac{kBTUh_{heat}}{HSPF} \times EFLH_{heat}\right)$$

Table 3-13 shows inputs for smart thermostats savings. The evaluation considered system capacity and efficiency listed in the program database, DEK adjusted EFLH values from the DEI metering study, and assumed savings fractions from Mid-Atlantic TRM v10 to estimate impacts for this measure.

Table 3-13: Inputs for Smart Thermostat Gross Verified Savings

Variable	Source	2023 Evaluation
$EFLH_{cool}$	Adjusted DEI Metering Study	617
$kBtuh_{cool}$	Population Average	32.2
SEER	Population Average	16.1
$\%Savings_{cool}$	Mid-Atlantic TRM V10.0	7%
$kBtuh_{heat}$	Population Average	28.9
HSPF	Population Average	9.0
$EFLH_{heat}$	Adjusted DEI Metering Study	1,474
$\%Savings_{heat}$	Mid-Atlantic TRM V10.0	6%

The method used here differs from other smart thermostat evaluations in other program jurisdictions, as an engineering analysis was used in place of an AMI analysis. Smart thermostat impacts are summarized in Table 3-14.

Table 3-14: Smart Thermostat Gross Verified Savings (Per Unit)

Measurement	Reported Savings	Realization Rate	Verified Savings
Energy (kWh)	497.98	34.41%	171.38
Summer Demand (kW)	0	N/A	0
Winter Demand (kW)	0	N/A	0

3.4.3. Combined Engineering Analysis and Desk Review

The following sections describe the combined engineering analysis and desk review for the Attic Insulation and Air Sealing measure. The evaluation team applied an engineering analysis to determine the attic insulation savings portion for each participant. The desk review of air sealing savings resulted from determining average inputs for air sealing from each participant (for which data were available). The team used this to calculate typical air sealing savings applied to all participants who received this measure.

3.4.3.1. Attic Insulation and Air Sealing

The evaluation considered attic insulation and air sealing data provided by the program database to inform savings calculations for this measure. These inputs included baseline and retrofit insulation R-values and the attic area.

To estimate impacts of this measure's attic insulation component, the evaluation team utilized the savings algorithm from Mid-Atlantic TRM V9.0 as the most recent Mid-Atlantic TRM v10.0 does not include residential envelope measures. Weather data, based on typical meteorological year (TMY3) in Covington, KY, was used where needed. Equation 3-9 and Equation 3-10 provide algorithms used. Table 3-15 shows input parameters for these algorithms.

Equation 3-9: Attic Insulation Energy Savings Algorithms

$$\Delta kW\mathrm{h}_{cool} = \frac{\left(\frac{1}{R_{exist}} - \frac{1}{R_{new}}\right) \times CDH \times DUA \times Area}{1{,}000 \times \eta_{cool}} \times ADJ_{cool} \times \%_{cool}$$

$$\Delta kW\mathrm{h}_{heat} = \frac{\left(\frac{1}{R_{exist}} - \frac{1}{R_{new}}\right) \times HDD \times 24 \times Area}{1{,}000{,}000 \times \eta_{heat}} \times 293.1 \times ADJ_{heat} \times \%_{electric\ cool}$$

Equation 3-10: Attic Insulation Demand Savings Algorithms

$$\Delta kW_{summer} = \frac{\Delta kW\mathrm{h}_{\ cool}}{EFLH_{cool}} \times CF_{Summer}$$

$$\Delta kW_{winter} = \frac{\Delta kW\mathrm{h}_{\ \mathrm{heat}}}{EFLH_{\mathrm{heat}}} \times CF_{Winter}$$

Table 3-15: Inputs for Attic Insulation Energy and Demand Savings

Variable	Source	2023 Evaluation
R_{exist}	Population Average	15.3
R_{new}	Population Average	49.2
Area	Population Average	1,896
CDD	Calculated from Covington, KY TMY3	28,496
HDD	Calculated from Covington, KY TMY3	5,254

Variable	Source	2023 Evaluation
η_{cool}	Mid-Atlantic TRM v9, weighted	12.6
η_{heat}	Mid-Atlantic TRM v9, weighted	2.01
$ADJ_{attic\ cool}$	Mid-Atlantic TRM v9	0.80
$ADJ_{attic\ heat}$	Mid-Atlantic TRM v9	0.60
DUA	Mid-Atlantic TRM v9	0.75
$\%_{cool}$	Duke Energy 2019 Residential End-Use Study	99%
$\%_{electric\ heat}$	Duke Energy 2019 Residential End-Use Study	39%
$EFLH_{cool}$	Adjusted DEI Metering Study	617
$EFLH_{heat}$	Adjusted DEI Metering Study	1,474
CF_{Summer}	Adjusted DEI Metering Study	0.350
CF_{Winter}	Adjusted DEI Metering Study	0.339

Table 3-15 shows a large difference between existing insulation (R_{Exist}) and newly installed insulation (R_{New}), while Table 3-16 shows attic insulation gross verified energy savings by season.

Table 3-16: Attic Insulation Gross Verified Savings by Season (Per Home)

Season	Energy Savings (kWh)	Summer Demand Savings (kW)	Winter Demand Savings (kW)
Cooling	133.75	0.0759	0.0
Heating	424.05	0.0	0.0976
Total	557.79	0.0759	0.0976

All participants who installed attic insulation were required to air-seal the attic plane to reduce air leakage from conditioned areas of the home. Savings for this measure component are separated from the insulation improvement and calculated using pre- and post-retrofit blower door results provided by the program database. Equation 3-11 and Equation 3-12 provide the savings algorithms from Mid-Atlantic TRM V9.0. Table 3-17 shows input parameters for air sealing. The measure's air sealing portion was calculated through a desk review that utilized average input parameters, given air sealing CFM measurements were populated for only 44% of the measure population.

Equation 3-11: Air Sealing Energy Savings Algorithm

$$\Delta kWh_{\ cool} = \frac{\frac{CFM_{base} - CFM_{retrofit}}{N_{cool}} \times 60 \times CDH \times DUA \times 0.018 \times LM \times \%_{cool}}{1{,}000 \times \eta_{cool}}$$

$$\Delta kWh_{\ heat} = \frac{\frac{CFM_{base} - CFM_{retrofit}}{N_{heat}} \times 60 \times 24 \times HDD \times DUA \times 0.018 \times 293.1 \times \%_{electric\ heat}}{1{,}000{,}000 \times \eta_{heat}}$$

Equation 3-12: Air Sealing Demand Savings Algorithms

$$\Delta kW_{summer} = \frac{\Delta kWh_{\ cool}}{EFLH_{cool}} \times CF_{Summer}$$

$$\Delta kW_{winter} = \frac{\Delta kWh_{\ \mathrm{heat}}}{EFLH_{\mathrm{heat}}} \times CF_{Winter}$$

Table 3-17: Inputs for Air Sealing Energy and Demand Savings

Variable	Source	2023 Evaluation
CFM_{exist}	Population Average	4,049
CFM_{new}	Population Average	2,896
N_{cool}	Mid-Atlantic TRM V9.0	34.6
N_{heat}	Mid-Atlantic TRM V9.0	22.2
CDH	Calculated from Covington, KY TMY3	28,496
HDD	Calculated from Covington, KY TMY3	5,254
DUA	Mid-Atlantic TRM V9.0	0.75
LM	Mid-Atlantic TRM V9.0	3.78
$\%_{cool}$	Duke Energy 2019 Residential End-Use Study	99%
$\%_{electric\ heat}$	Duke Energy 2019 Residential End-Use Study	39%
η_{cool}	Mid-Atlantic TRM v9, weighted	12.6
η_{heat}	Mid-Atlantic TRM v9, weighted	2.01
$EFLH_{cool}$	Adjusted DEI Metering Study	617
$EFLH_{heat}$	Adjusted DEI Metering Study	1,474
CF_{Summer}	Adjusted DEI Metering Study	0.350
CF_{Winter}	Adjusted DEI Metering Study	0.339

Table 3-17 shows that measure recipients reduced air leakage by an average of 1,153 CFM. Table 3-18 shows air sealing gross verified energy savings.

Table 3-18: Air Sealing Gross Verified Savings (Per Home)

Energy Savings (kWh)	Summer Demand Savings (kW)	Winter Demand Savings (kW)
627.69	0.1301	0.0917

Table 3-19 provides total savings for the combined attic insulation and air-sealing measures.

Table 3-19: Attic Insulation and Air Sealing Gross Verified Savings (Per Home)

Measurement	Reported Savings	Realization Rate	Verified Savings
Energy (kWh)	1,162.00	102.02%	1,185.48
Summer Demand (kW)	0.3144	65.51%	0.2059
Winter Demand (kW)	0.3023	62.60%	0.1893

*Realization rates may not exactly equal verified savings divided by reported savings, due to rounding of the figures given in this table.

3.4.4. Deemed Analysis

Due to low program participation levels, the evaluation team applied deemed savings from the previous evaluation for variable speed pool pumps, heat pump water heaters, and duct insulation measures. The evaluation team also applied deemed savings to the duct sealing measure, as critical analysis parameters were missing for a majority of duct sealing participants.

3.4.4.1. Duct Sealing

Duct sealing produces energy savings by reducing air leaks in the system. Duct sealing CFM measurements were populated for only 14% of participants who received this measure. Due to missing measurement data, the evaluation team applied deemed savings for this measure.

Savings for the duct sealing measure are presented in Table 3-20.

Table 3-20: Duct Sealing Gross Verified Savings (Per Home)

Measurement	Reported Savings	Realization Rate	Verified Savings
Energy (kWh)	410.00	100.00%	410.00
Summer Demand (kW)	0.3395	100.00%	0.3395
Winter Demand (kW)	0.0000	N/A	0.0000

*Realization rates may not exactly equal verified savings divided by reported savings, due to rounding of the figures given in this table.

3.4.4.2. Variable Speed Pool Pumps

Variable speed pool pumps save the participant significant energy savings by reducing flow rates through a pump. Reducing pump flow by 50% saves an expected 87% of energy needed to operate the system.[2]

[2] Based on pump affinity laws relating power (P) to flow rate (q), where [$P_1 / P_2 = (q_1 / q_2)$ ^ 3]. Setting flow [$q_2 = 0.5 * q_1$] results in [$P_2 = 0.125 * P_1 = (1 - 0.875) * P_1$]. Hours of operation are assumed to be consistent.

Due to low participation levels, the evaluation team applied deemed savings for this measure. Table 3-21 shows energy and demand savings for variable-speed pool pumps.

Table 3-21: Variable Speed Pool Pump Gross Verified Savings (Per Unit)

Measurement	Reported Savings	Realization Rate	Verified Savings
Energy (kWh)	1,580.00	100.00%	1,580.00
Summer Demand (kW)	0.5900	100.00%	0.5900
Winter Demand (kW)	0.0000	N/A	0.0000

3.4.4.3. Heat Pump Water Heater

Heat pump water heaters provide energy savings by capturing heat from the surrounding air to produce hot water for domestic uses. Due to low participation rates, deemed savings were applied for this measure. Table 3-22 shows energy and demand savings for heat pump water heaters.

Table 3-22: Heat Pump Water Heater Gross Verified Savings (Per Unit)

Measurement	Reported Savings	Realization Rate	Verified Savings
Energy (kWh)	1,763.00	100.00%	1,763.00
Summer Demand (kW)	0.1350	100.00%	0.1350
Winter Demand (kW)	0.2013	100.00%	0.2013

3.4.4.4. Duct Insulation

Duct insulation provides energy savings by preventing heat loss or gain through a duct system. Due to low participation levels, the team applied deemed savings for this measure. Table 3-23 shows energy and demand savings for duct sealing.

Table 3-23: Duct Insulation Gross Verified Savings (Per Unit)

Measurement	Reported Savings	Realization Rate	Verified Savings
Energy (kWh)	876.00	100.00%	876.00
Summer Demand (kW)	0.7253	100.00%	0.7253
Winter Demand (kW)	0.0000	N/A	0.0000

3.5. Targeted and Achieved Confidence and Precision

Development of the Smart $aver evaluation plan sought to achieve a target goal of 10% relative precision at the 90% confidence interval for the program as a whole. As shown in Table 3-24, the evaluation team reported confidence and precision for the program surveys at +/- 8.7% at the 90% confidence level.

Table 3-24: Targeted and Achieved Confidence and Precision

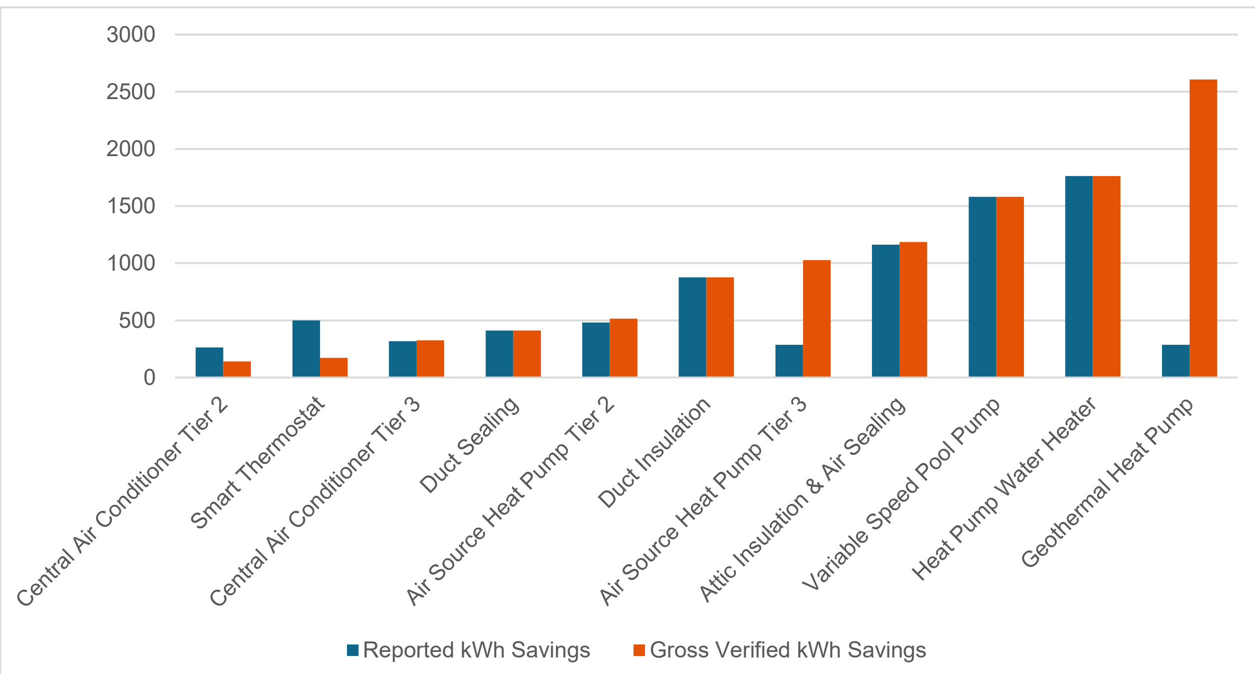
Program	Targeted Confidence/Precision	Achieved Confidence/Precision
Smart $aver	90/10.0	90/8.7

3.6. Program Results

3.6.1. Results per Unit

Figure 3-6 shows reported and verified per-unit energy savings. Earlier subsections discuss measure realization rates.

Figure 3-6: DEK Smart $aver 2021 Reported and Verified Energy Savings (Per Unit)



This evaluation indicated energy realization rates above 100% for Tier 3 central air conditioners as well as for air source and geothermal heat pump measures. Smart thermostats, Tier 2 central air conditioners and duct sealing showed low realizations rates. Low summer demand realization rates for HVAC measures primarily resulted from the low EER of new equipment. Evaluation of central air conditioner measures resulted in no verified winter demand savings, as savings arising from ECM furnace fans have been reduced to zero (due to an update in federal efficiency regulations). Table 3-25, Table 3-26, and Table 3-27 provide per-unit energy and demand savings and realization rates for each measure.

Table 3-25: Average Reported and Gross Verified Energy Savings (Per Unit)

Measure	Reported Energy Savings per Unit (kWh)	Realization Rate	Verified Gross Energy Savings per Unit (kWh)
Central Air Conditioner Tier 2	261.63	53.98%	141.22
Central Air Conditioner Tier 3	317.86	102.16%	324.73
Air Source Heat Pump Tier 2	481.57	106.93%	514.94
Air Source Heat Pump Tier 3	285.85	359.36%	1,027.22
Geothermal Heat Pump	285.85	912.17%	2,607.39
Smart Thermostat	497.98	34.41%	171.38
Variable Speed Pool Pump	1,580.00	100.00%	1,580.00
Attic Insulation & Air Sealing	1,162.00	102.02%	1,185.48
Heat Pump Water Heater	1,763.00	100.00%	1,763.00
Duct Sealing	410.00	100.00%	410.00
Duct Insulation	876.00	100.00%	876.00

*Realization rates may not exactly equal verified savings divided by reported savings, due to rounding of the figures given in this table.

Table 3-26: Reported and Gross Verified Summer Demand Savings (Per Unit)

Measure	Reported Summer Demand Savings per Unit (kW)	Realization Rate	Verified Gross Summer Demand Savings per Unit (kW)
Central Air Conditioner Tier 2	0.1118	53.79%	0.0602
Central Air Conditioner Tier 3	0.1658	11.26%	0.0187
Air Source Heat Pump Tier 2	0.0812	55.19%	0.0448
Air Source Heat Pump Tier 3	0.1154	-2.82%	-0.0033
Geothermal Heat Pump	0.1154	394.91%	0.4557
Smart Thermostat	0.0000	N/A	0.0000
Variable Speed Pool Pump	0.5900	100.00%	0.5900
Attic Insulation & Air Sealing	0.3144	65.51%	0.2059
Heat Pump Water Heater	0.1350	100.00%	0.1350
Duct Sealing	0.3395	100.00%	0.3395
Duct Insulation	0.7253	100.00%	0.7253

*Realization rates may not exactly equal verified savings divided by reported savings, due to rounding of the figures given in this table.

Table 3-27: Reported and Gross Verified Winter Demand Savings (Per Unit)

Measure	Reported Winter Demand Savings per Unit (kW)	Realization Rate	Verified Gross Winter Demand Savings per Unit (kW)
Central Air Conditioner Tier 2	0.0404	0.00%	0.0000
Central Air Conditioner Tier 3	0.0361	0.00%	0.0000
Air Source Heat Pump Tier 2	0.1354	66.14%	0.0896
Air Source Heat Pump Tier 3	0.0309	529.10%	0.1635
Geothermal Heat Pump	0.0309	1,586.94%	0.4905
Smart Thermostat	0.0000	N/A	0.0000
Variable Speed Pool Pump	0.0000	N/A	0.0000
Attic Insulation & Air Sealing	0.3023	62.60%	0.1893
Heat Pump Water Heater	0.2013	100.00%	0.2013
Duct Sealing	0.0000	N/A	0.0000
Duct Insulation	0.0000	N/A	0.0000

*Realization rates may not exactly equal verified savings divided by reported savings, due to rounding of the figures given in this table.

3.6.2. Impact Results Summary

Table 3-28, Table 3-29, and Table 3-30 show program-level energy savings, demand savings, and realization rates for each measure.

Table 3-28: Reported and Verified Gross Energy Savings

Measure	Rebates	Reported Energy Savings (kWh)	Realization Rate	Gross Verified Energy Savings (kWh)
Central Air Conditioner Tier 2	698	182,617	54%	98,575
Central Air Conditioner Tier 3	192	61,030	102%	62,349
Air Source Heat Pump Tier 2	276	132,913	107%	142,122
Air Source Heat Pump Tier 3	113	32,301	359%	116,076
Geothermal Heat Pump	4	1,143	912%	10,430
Smart Thermostat	1,065	530,350	33%	182,518
Variable Speed Pool Pump	13	20,540	100%	20,540
Attic Insulation & Air Sealing	70	81,340	102%	82,984
Heat Pump Water Heater	17	29,971	100%	29,971
Duct Sealing	35	14,350	100%	14,350
Duct Insulation	2	1,752	100%	1,752
TOTAL	**2,485**	**1,088,307**	**70%**	**761,667**

*Realization rates may not exactly equal verified savings divided by reported savings, due to rounding of the figures given in this table.

Table 3-29: Reported and Verified Summer Demand Gross Savings

Measure	Rebates	Reported Summer Demand Savings (kW)	Realization Rate	Gross Verified Summer Demand Savings (kW)
Central Air Conditioner Tier 2	698	78.1	54%	42.0
Central Air Conditioner Tier 3	192	31.8	11%	3.6
Air Source Heat Pump Tier 2	276	22.4	55%	12.4
Air Source Heat Pump Tier 3	113	13.0	-3%	-0.4
Geothermal Heat Pump	4	0.5	395%	1.8
Smart Thermostat	1,065	0	N/A	0
Variable Speed Pool Pump	13	7.7	100%	7.7
Attic Insulation & Air Sealing	70	22.0	66%	14.4
Heat Pump Water Heater	17	2.3	100%	2.3
Duct Sealing	35	11.9	100%	11.9
Duct Insulation	2	1.5	100%	1.5
TOTAL	**2,485**	**191.1**	**51%**	**97.1**

*Realization rates may not exactly equal verified savings divided by reported savings, due to rounding of the figures given in this table.

Table 3-30: Reported and Verified Winter Demand Gross Savings

Measure	Rebates	Reported Winter Demand Savings (kW)	Realization Rate	Gross Verified Winter Demand Savings (kW)
Central Air Conditioner Tier 2	698	28.2	0%	0.0
Central Air Conditioner Tier 3	192	6.9	0%	0.0
Air Source Heat Pump Tier 2	276	37.4	66%	24.7
Air Source Heat Pump Tier 3	113	3.5	529%	18.5
Geothermal Heat Pump	4	0.1	1,587%	2.0
Smart Thermostat	1,065	0	N/A	0
Variable Speed Pool Pump	13	0	N/A	0
Attic Insulation & Air Sealing	70	21.2	63%	13.2
Heat Pump Water Heater	17	3	100%	3
Duct Sealing	35	0	N/A	0
Duct Insulation	2	0	N/A	0
TOTAL	**2,485**	**100.7**	**61%**	**61.8**

*Realization rates may not exactly equal verified savings divided by reported savings, due to rounding of the figures given in this table.

The air source heat pump measure contributed significantly to the program's 85% energy realization rate. This resulted from high per-unit verified energy savings as well as the large number of air source heat pumps rebated through the Smart $aver program. The program's 45% summer demand realization rate primarily resulted from negative savings attributable to Tier 3 air source heat pump measures. Central air conditioners contributed no winter demand savings, resulting in a significant decrease in program-level winter demand savings.

Table 3-31 presents total program reported and verified savings.

Table 3-31: DEK Smart $aver 2020-2022 Gross Program Savings

Measurement	Rebates	Reported	Realization Rate	Gross Verified
Energy (kWh)	2,485	1,088,307	70.0%	761,667
Summer Demand (kW)		191	50.8%	97.1
Winter Demand (kW)		101	61.4%	61.8

4. Net-To-Gross

The evaluation team used participant survey data to calculate a NTG ratio for Smart $aver. NTG reflects the effects of free ridership (FR) as well as participant spillover (PSO) and nonparticipant spillover (NPSO) 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. Department of Energy [DOE], 2014).[3] Spillover refers to program-induced adoption of additional energy-saving measures by participants who did not receive financial incentives or technical assistance for installing these additional measures (U.S. DOE, 2014). The evaluation team used the following formula to calculate the NTG ratio:

$$NTG = 100\% - FR + PSO + NPSO$$

4.1. Free Ridership

Free ridership estimates how much the program influenced participants' participation in the Smart $aver initiative. Free ridership ranges from 0% to 100%, with 0% meaning no free ridership and 100% meaning total free ridership.

The evaluation team used participant survey data to estimate free ridership. Several survey questions served to identify what participants would have installed in the incentive's absence.

The team's free ridership calculation methodology consists of two components: free ridership change (FRC) and free ridership influence (FRI), as shown in the following equation:

$$FR = 50\% \times FRC + 50\% \ \times FRI$$

4.1.1. Free Ridership Change

The FRC reflects what participants reported they would have done had the program not provided a participation incentive. For each respondent, the survey assessed the FRC for equipment the participant would have purchased had Duke Energy rebates and information been unavailable as well as determining the participant's timing in likely purchasing the unit.

Specifically, the survey asked respondents to indicate the following in the program's absence: whether they would not have installed the unit; whether they would have bought a less-expensive or less-efficient unit; whether they would have bought a unit at the same efficiency and paid full cost; or

[3] 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.*

if they “don’t know” what they would have done in the incentive’s absence. For participants who would still have bought a unit, the survey asked whether this unit would be less efficient, or the same efficiency, or if they did not know what they would have done. A follow-up question determined when they would have likely purchased the unit.

For each participant and measure, the evaluation team assigned one of the FRC values shown in Table 4-1.

Table 4-1: Free Ridership Change Values

Q1 Response	Q2 Response	FRC Value
Would not have installed	N/A	0%
Would have bought a less expensive or less efficient unit	At the same time	75%
	Within 6 months	50%
	Within a year	25%
	Later than a year	0%
	Don’t know	25%
Would have bought the exact same efficiency and paid the full cost	At the same time	100%
	Within 6 months	67%
	Within a year	33%
	Later than a year	0%
	Don’t know	50%
Don’t know	At the same time	50%
	Within 6 months	37.5%
	Within a year	12.5%
	Later than a year	0%
	Don’t know	N/A

Each respondents’ answers to the two FRC questions were calculated, with savings weighted to derive an overall program average. The program-weighted FRC value was calculated as 74%.

4.1.2. Free Ridership Influence

FRI assesses how much influence the program had on a participant's decision to purchase the measure. The survey asked respondents to rate how much influence that 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"). Program-related factors included the following:

- The rebate received
- Information or advertisements from DEK, including its website
- Recommendations from contractors
- Other reasons [specified]

FRI is based on the highest-rated item in the FRI battery. Based on that rating, the evaluation team assigned the FRI scores shown in Table 4-2.

Table 4-2: Free Ridership Influence Values

Highest Influence Rating	FRI Value
0	100%
1	90%
2	80%
3	70%
4	60%
5	50%
6	40%
7	30%
8	20%
9	10%
10	0%

This resulted in an FRI of 11%.

4.1.3. Total Free Ridership

The evaluation team calculated total free ridership by measure by calculating the average between each measure's change and its influence score, then savings-weighting each result with evaluated per-unit savings for each unit installed by respondents to derive the overall total. Table 4-3 presents measure-specific and overall FR estimates. As measure-level details were not statistically significant, the table includes these only for illustrative purposes.

Table 4-3: Self-Report Free Ridership Results

Measure	Population	Count	Savings	FRC	FRI	Full FR
Central Air Conditioner	890	34	181	87%	14%	50%
Air Source Heat Pump	389	12	664	86%	11%	48%
Smart Thermostat	350	0	163	51%	12%	31%
Attic Insulation and Air Sealing	70	8	1,185	73%	9%	41%
Duct Sealing	35	5	410	31%	16%	24%
Heat Pump Water Heater	17	5	1,763	65%	4%	35%
Variable Speed Pool Pump	13	0	1,580	N/A	N/A	N/A
Geothermal Heat Pump	4	1	2,607	100%	0%	50%
Duct Insulation	2	0	876	N/A	N/A	N/A
Savings Weighted	**1,770**	**65**	**N/A**	**74%**	**11%**	**43%**

4.2. Spillover

4.2.1. Participant Spillover

Spillover estimates energy savings from additional energy improvements made by participants influenced by the program; it is used to adjust gross savings. The evaluation team used participant survey data to estimate spillover. The survey asked respondents to indicate non-rebated energy-saving measures they implemented since participating in the program. The evaluation team then asked participants to rate the program's influence on their decision to purchase these additional energy-saving measures, using a scale of 0 to 10, where 0 means "not at all influential" and 10 means "extremely influential."

The team converted the ratings to a percentage that represented the program-attributable percentage of measure savings, from 0% to 100%. The team applied the program-attributable percentage to savings associated with each reported spillover measure to calculate PSO for that measure. The team defined per-unit energy savings for the reported spillover measures based primarily on previous Duke Energy Smart $aver evaluations as well as other recent program evaluations to remain consistent across programs. These drew upon ENERGY STAR® calculators and algorithms, parameter assumptions listed in the Illinois TRM v2.2, and other sources.

As Duke Energy offered program incentives for a variety of energy-saving measures throughout the evaluation period, the team 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, the team excluded savings from measures that appeared in another program's tracking data from the estimation of spillover savings.

The evaluation team calculated participant spillover as follows:

$$Participant\ SO = \frac{\sum PSO\ \ kWh}{Sample\ Gross\ Program\ Savings\ kWh}$$

Where:

$$PSO = (Number\ Installed * Deemed\ Measure\ Savings) * Program\ Influence\ on\ Non - Rebated\ Measure$$

Of 58 completed surveys, 20 measures were defined as potential spillover measures. Eight of these received 0% program influence. The 12 remaining measures had total calculated savings of 1,953 kWh for the sample population:

$$PSO = \frac{\sum PMSO}{\sum Sample\ Gross\ Program\ Savings}$$

$$PSO = \frac{1{,}953}{37{,}069} = 5.27\%$$

These calculations produced a participant spillover estimate of 5.27% for the DEK program.

4.2.2. Nonparticipant Spillover

The evaluation team calculated eligible equipment installs made by nonparticipants influenced by participating trade allies but not receiving rebates. The survey asked respondents to indicate non-rebated energy-saving measures they had recommended to customers. The team then asked trade allies to rate the influence the program had on their business practice of recommending those measures to customers, using a scale of 0 to 10, where 0 means "not at all influential" and 10 means "extremely influential." The team converted the ratings to a percentage representing the program-attributable percentage of measure savings, from 0% to 100%.

The team then applied the program-attributable percentage to savings associated with each reported spillover measure to calculate NPSO for that measure. Per-unit energy savings for the reported spillover measures were derived from verified gross measure savings.

Each surveyed trade ally was asked a series of questions to determine the number of measures they installed within Duke Energy's territory that qualified as energy-efficient measures and did not receive a rebate. Despite talking to five trade allies in total, the interviews and surveys covered 82% of non-Smart Thermostat measures. NPSO only emerged for the central air conditioner and air source heat pump measures. As the survey did not reach the entire program trade ally population, the team extrapolated the results to the population. Table 4-4 shows NPSO results.

Table 4-4: NPSO Results

Rebated Measures	Quantity	Covered by Interviews/ Surveys	Coverage	Spillover Measures	Extrapolated SO	Per Unit Savings	Total SO Savings
Central Air Conditioner	890	726	82%	32.8	40.2	181	7,268
Air Source Heat Pump	389	372	92%	16.0	16.7	664	11,115

The evaluation team calculated NPSO as follows:

$$NPSO = \frac{\sum NP\ Measure\ SO\ \ kWh\ Extrapolated\ to\ population\ \times Program\ Influence}{Gross\ Program\ Savings\ kWh}$$

$$NPSO = \frac{18{,}383\ kWh}{761{,}667\ kWh} = 2.41\%$$

These calculations produced an NPSO estimate of 2.41% for the DEK program.

4.3. Net-to-Gross

Inserting the NTG component estimates into the NTG formula (NTG = 100% – FR + PSO + NPSO) produced an NTG value of 64.90% for the DEK program, after savings-weighting each measure result and including smart thermostats, as shown in Table 4-5.

Table 4-5: Net-to-Gross Results

Measure	FR	PSO	NPSO	NTG
Central Air Conditioner	50.43%	5.27%	2.41%	57.25%
Air Source Heat Pump	48.32%			59.36%
Smart Thermostat	31.43%			76.25%
Attic Insulation and Air Sealing	41.08%			66.61%
Duct Sealing	23.63%			84.06%
Heat Pump Water Heater	34.50%			73.18%
Variable Speed Pool Pump	0.0%			107.68%
Geothermal Heat Pump	50.00%			57.68%
Duct Insulation	0.0%			107.68%
Total	42.78%	5.27%	2.41%	64.90%

The evaluation team applied this NTG ratio to program-wide verified gross savings to calculate Smart $aver net savings, as shown in Table 4-6.

Table 4-6: DEK Program Level Savings

Measurement	Population	Gross Verified	NTG Ratio	Net Verified
Energy (kWh)	2,485	761,667	64.90%	494,343
Summer Demand (kW)		97		63.0
Winter Demand (kW)		62		40

5. Process Evaluation

The following sections describe methods used to collect data for the process evaluation as well as the evaluation's important findings.

5.1. Summary of Data Collection Activities

The evaluation team based the process evaluation on telephone interviews as well as telephone and web surveys with program and implementer staff, trade allies, and participants, as summarized in Table 5-1.

Table 5-1: Summary of Process Evaluation Data Collection Activities

Target Group	Method	Sample Size
Program Staff	Phone in-depth interview	1
Implementation Staff	Phone in-depth interview	1
High-Volume Trade Allies[a]	Phone in-depth interview	2
Trade Allies (various rebate volumes)	Web/Phone survey	3
Program Participants	Web survey	58

[a] High-volume trade allies are companies in the top 20% of trade allies in terms of the number of rebated measures for a given campaign.

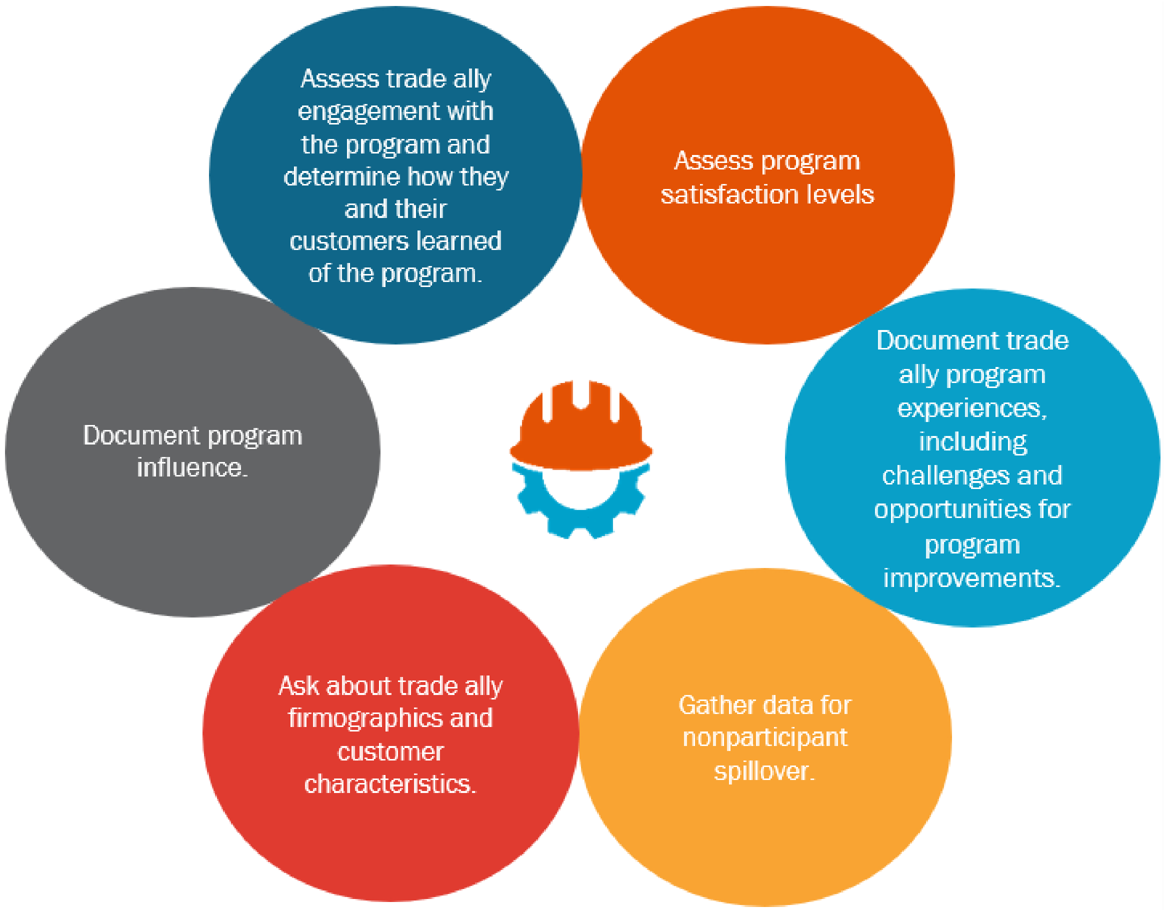
5.1.1. Program and Implementer Staff

The evaluation team conducted interviews with the Smart $aver Program Manager along with a senior manager from the implementation staff to understand how the program worked and to capture their insights regarding the program's operations, challenges, expectations, and interactions with market actors and customers.

5.1.2. Trade Allies

Participating contractors —"trade allies"— served as the primary Smart $aver program delivery channel. In fall 2022, the evaluation team conducted two in-depth interviews with high-volume Smart $aver trade allies. Additionally, the team used a web instrument to survey three trade allies, addressing various program topics (i.e., satisfaction with the program and program-related challenges), as shown in Figure 5-1. Unless noted otherwise, all reported trade ally results derive from the initial survey.

Figure 5-1. Trade Ally Research Objectives



5.1.3. Participants

The surveys addressed 58 Smart $aver participants who received rebates through the program. This data collection activity sought to achieve the following: establish a more detailed understanding of customers' experience with the program; identify potential areas for program improvements; and collect data to inform NTG estimates. Figure 5-2 documents specific participant survey research objectives.

Figure 5-2: Participant Research Objectives

5.1.3.1. Process Evaluation Findings

The following subsections describe program successes and challenges as well as opportunities for program improvements.

5.1.4. Trade Ally Perspective

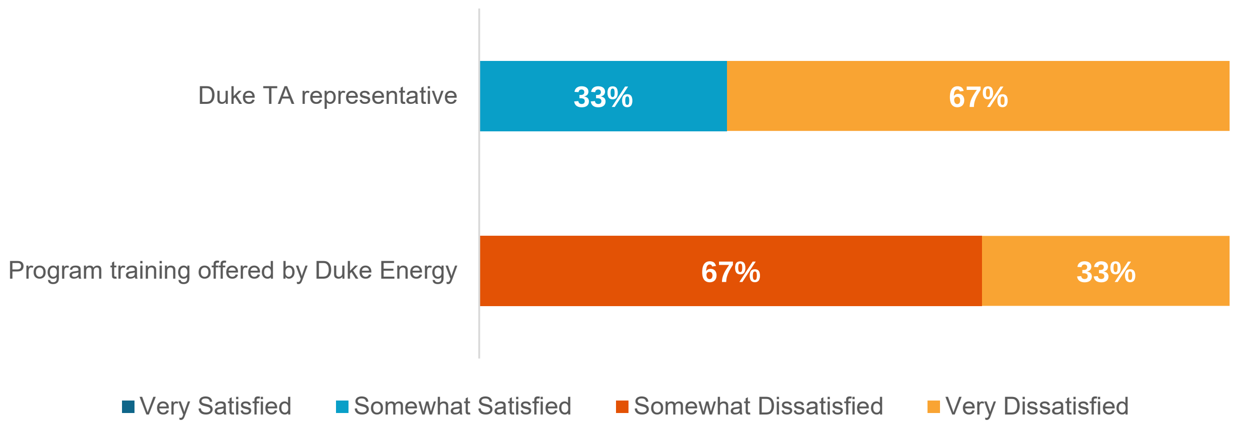
This section reports results from trade ally surveys regarding their experience participating in the Smart $aver program in the DEK jurisdiction.

5.1.4.1. Training

The evaluation team asked trade allies about their satisfaction with program assistance measures (e.g., participants' Duke Energy trade ally representatives) as well as program training offered by

Duke Energy. As shown in Figure 5-3, trade allies generally expressed overall dissatisfaction with the program assistance. It is, however, important to note that the small sample size may indicate that those answering the survey did so to voice their dissatisfaction. Dissatisfied respondents found it time consuming to contact their representative or simply did not know who their representative was. Those dissatisfied with program training noted that the training did not help them sell higher-efficiency products; consequently, they found it difficult to justify the time required to undertake the training. Alternatively, some interviewed trade allies noted that their trade ally representatives were motivated and available when they needed them. Interviewed trade allies also reported that the trainings presented some useful information.

Figure 5-3: Satisfaction with Program Assistance Factors (n=3)



5.1.4.2. Recruiting Customers into Smart $aver

The evaluation team asked trade allies about their customers' primary reasons for replacing their duct work, water heating, thermostats, or insulation. Customers who updated duct work (33%), thermostats (23%), and insulation (32%) primarily sought to save energy or lower their energy bills. Those updating their water heaters primarily were motivated by the program incentive's availability (36%). While trade allies reported that their customers updated their equipment to save money on energy bills, they also reported that most new HVAC units (60%) replaced broken or aging systems, and that few customers replaced fully functional standard-efficiency HVAC units with high-efficiency units just to achieve energy savings.

Participant findings (discussed in Section 5.1.5) corroborate these trade ally reports, as less than one-half of HVAC replacement participants reported replacing a newer HVAC unit that remained in good working condition. HVAC systems replaced by respondents averaged 16 years old.

Trade ally survey data, further corroborated by participant survey data (Section 5.1.5) reveals trade allies were largely responsible for recruiting customers into the program. All surveyed trade allies said their customers "rarely" or "never" asked about Smart $aver. Rather, trade allies typically introduced their customers to Smart $aver rebate opportunities. Due to the small sample size, however, the evaluation team could not draw meaningful conclusions across measure types. Consequently, this report presents results in aggregate rather than by measure type.

Further, two out of three surveyed trade allies expressed dissatisfaction with DEK's program marketing (one expressed being somewhat satisfied). The two dissatisfied trade allies attributed their criticism to not seeing marketing for the program. It is important to note that the program team focuses marketing efforts on eligible customers only, and not trade allies. However, trade allies proved critical in bringing new households into the program by raising participants' awareness of the program and by educating customers about energy-efficiency benefits and the availability of Smart $aver rebates. Therefore, if trade allies were to see the marketing, they may be better able to educate their customers on the program.

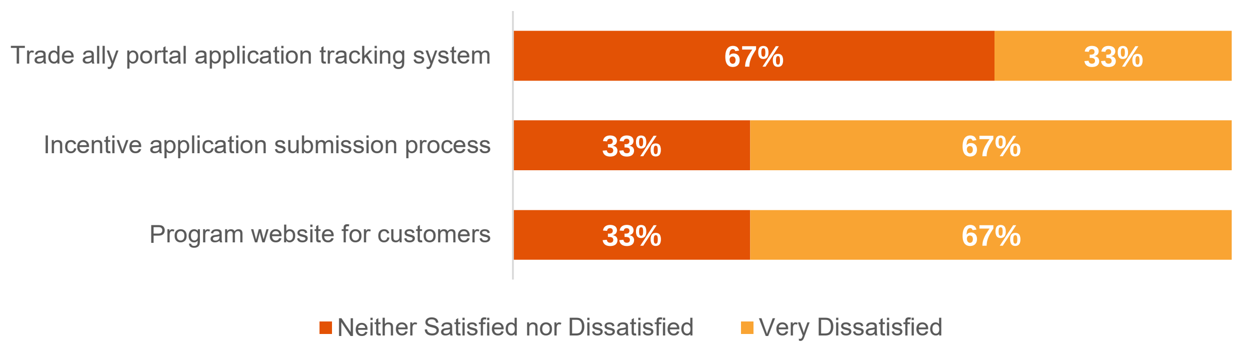
5.1.4.3. Rebate Application Process

Smart $aver transitioned to an online application system (the "trade ally portal") in April 2016, with an enhanced version of the system introduced in 2021. The evaluation team asked trade allies how frequently they experienced problems or frustrations using both the old portal and the new enhanced portal. Two of three surveyed trade allies reported that they "frequently" or "always" experienced problems or frustrations with the old Rebate Application Entry and Tracking Platform. One trade ally reported that issues have persisted, another reported that issues have improved somewhat, and one noted that issues have been completely resolved. When asked specifically about the enhanced trade ally portal, one trade ally reported they still have challenges, one reported they do not have challenges, and one did not know if they had challenges.

Trade allies reporting that they experienced problems or frustrations with the rebate application process typically cited challenges with understanding error messages from submissions and a lack of clarity on whether sales went through or were pending.

Due to these challenges and frustrations, surveyed trade allies were neutral or dissatisfied with the online systems. Two of three trade allies were neither satisfied nor dissatisfied with the trade ally portal application tracking system, and two of three trade allies were very dissatisfied with the incentive application submission process and the program website for customers, as shown in Figure 5-4.

Figure 5-4: Trade Ally Satisfaction with Online Systems (n=3)



5.1.4.4. Program Influence on Trade Allies

Trade ally survey results revealed that the program may not have influenced energy-efficiency services offered by contractors in the trade ally network. While one surveyed trade ally reported their knowledge of energy-efficient products and services increased since becoming involved with Smart $aver, the trade ally did not attribute this to the Smart $aver program's influence.

Most HVAC trade allies reported that Smart $aver at least partially influenced their recommendations of qualifying HVAC measures, with the majority (80%) indicating that Smart $aver proved moderately influential. The Smart $aver program, however, seemed to have no influence on stocking energy-efficient equipment as all three trade allies reported their stocking practices did not change after their program participation.

5.1.4.5. Suggestions for Improvement

To increase satisfaction, trade allies had a few suggestions for program improvement, including:

- Offer trade allies a $100 incentive to complete the application
- Provide an app for the rebate application process so trade allies can input customer information, take pictures, and upload information of model serial numbers while on the job
- Scale lead prices to the project's size
- Clarify wording on the rebate application system to determine if sales have cleared or remain pending
- Include more demographic questions on the online application system
- Increase communication between BES and trade allies

- Develop a system to ensure trade allies feel valued by the program (e.g., awards to recognize years of service, recognition in newsletters, lunch with program representatives)
- Provide clearer explanations of submission errors

5.1.5. Participant Experience

5.1.5.1. Participant Awareness

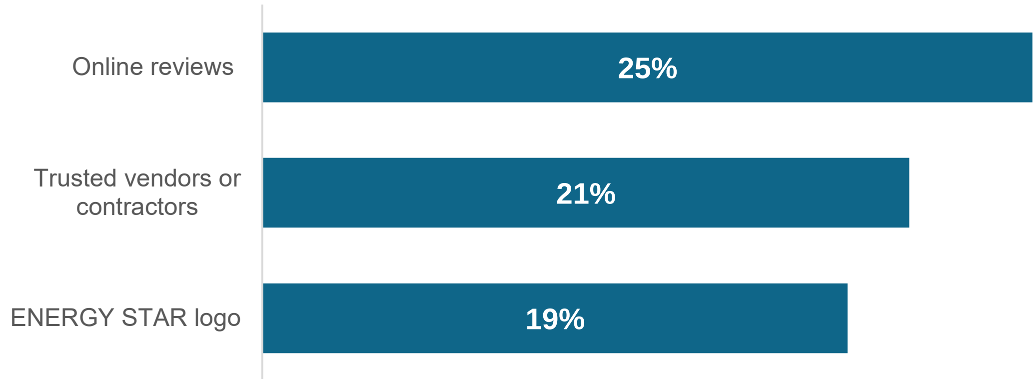
Trade allies serve as the primary way consumers learned about the program, as shown by almost one-half (45%) of participants citing their contractor as their program awareness source (shown in Table 5-2). Only 30% of participants learned about Smart $aver via Duke Energy's marketing efforts; fewer participants said they learned about the program from Duke Energy's website (23%), direct (paper) mail (7%), or the Internet (0%).

Table 5-2: Source of Smart $aver Program Awareness (Multiple Responses Allowed)

Source of Program Awareness	n=56
Trade ally	45%
Duke Energy website	23%
Email	14%
Direct (paper) mail	7%
Other	7%
Word of mouth	4%

Respondents typically reported searching the Internet for information on ways to save energy at their residence, with the highest proportion of surveyed participants (25%) reporting reading online reviews about products for energy-saving information, as shown in Figure 5-5. Just under one-quarter (21%) of respondents reported talking to trusted vendors or contractors; 19% reported looking for products with the ENERGY STAR® logo.

Figure 5-5: Source of Energy-Saving Information (Multiple Responses Allowed) (n=119)

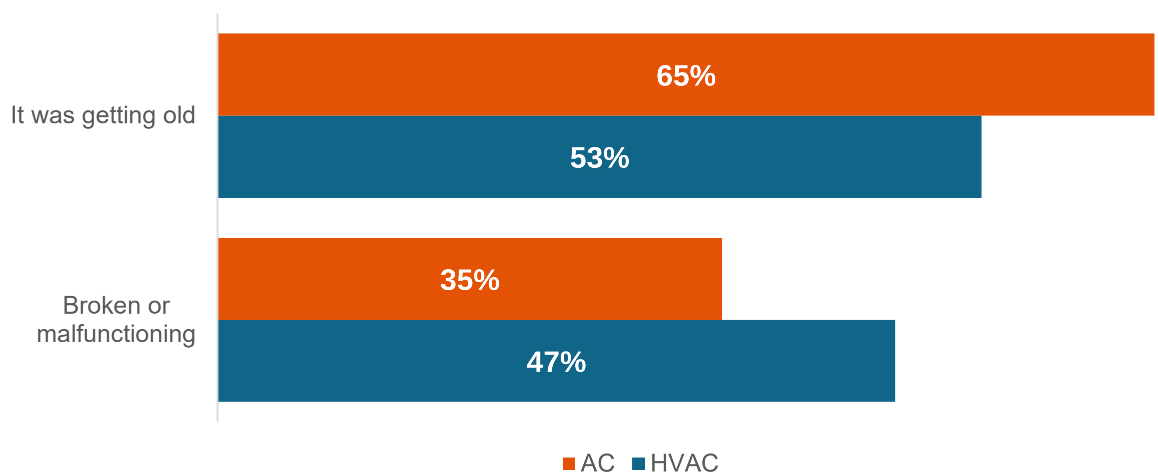


5.1.5.2. Participation Motivations

The evaluation team asked participants a series of questions designed to determine why they selected qualifying Smart $aver measures. For participants who installed equipment measures, the team asked about the condition of previous equipment replaced, followed by asking why they chose an energy-efficient version of that equipment.

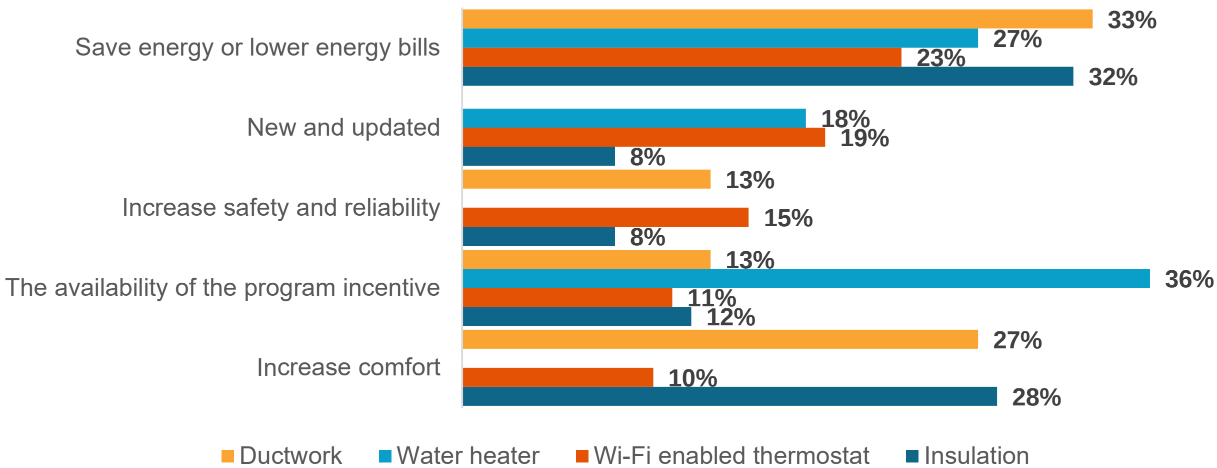
Overall, a slight majority of participants (65%) who replaced their air conditioners reported doing so as it was "getting old." Of participants replacing HVAC systems, just under one-half (47%) did so as it was "broken or malfunctioning." No participants replaced equipment in good working condition.

Figure 5-6: Reasons for Equipment Replacement (AC n=31); HVAC n=15)



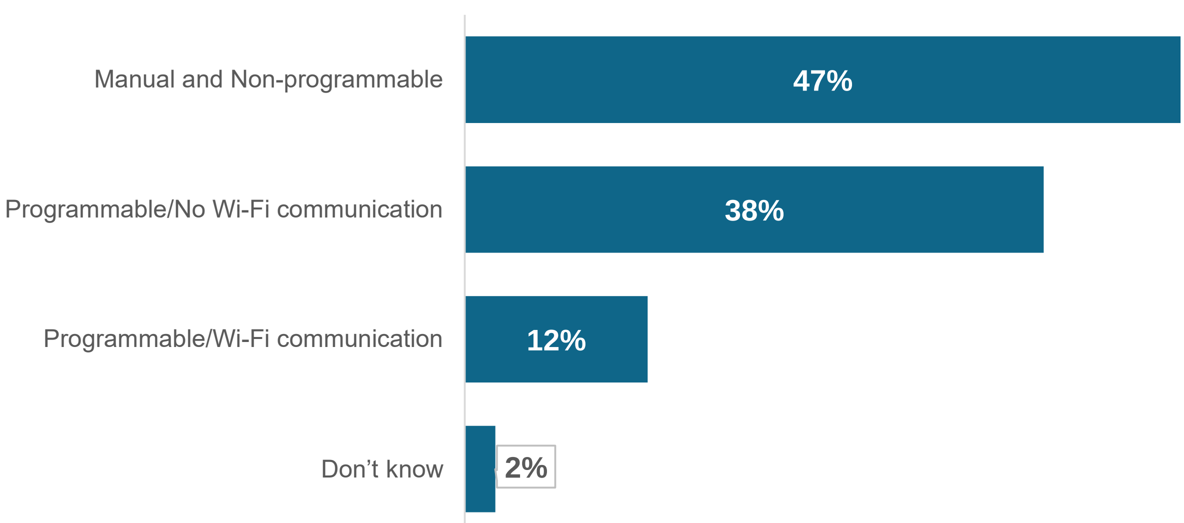
Typically, participants selected energy-efficient HVAC equipment over standard efficiency models to use less energy or to accrue monetary savings, as shown in Figure 5-7.

Figure 5-7: Motivation for Installing Energy Efficient Equipment Broken by Measure (Multiple Responses Allowed) (n=112)



As shown in Figure 5-8, participants mainly replaced manual and non-programmable thermostats, indicating large potential remains for increased adoption.

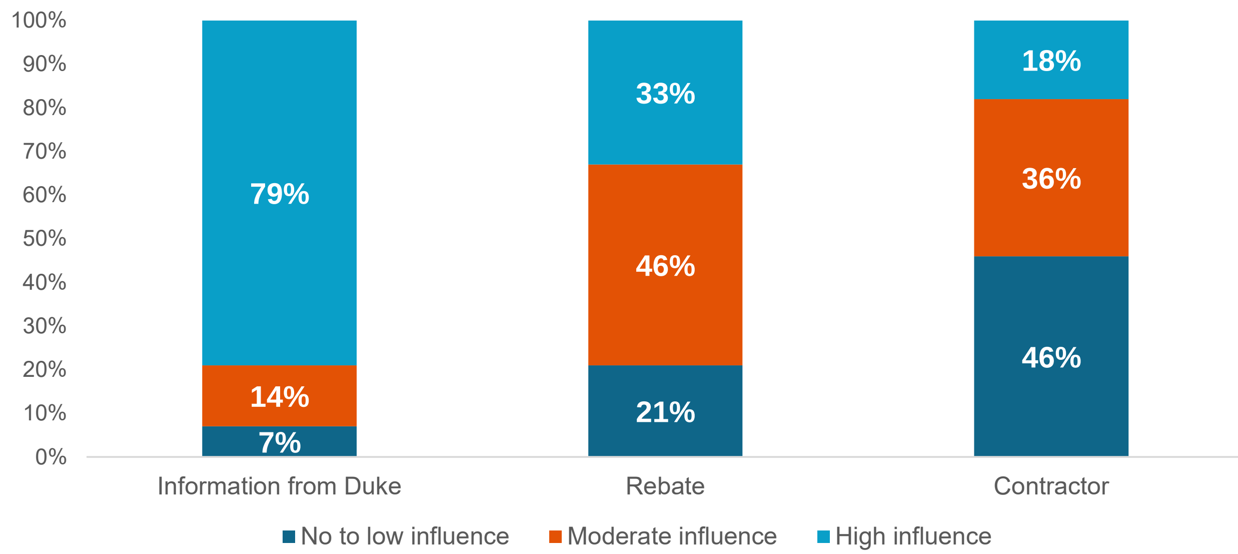
Figure 5-8: Thermostats Replaced by Type (n=34)



5.1.5.3. Program Influence

Overall, the highest proportion of participants (45%) learned of Smart $aver rebates from their contractors. Still, Duke Energy information proved the greatest influence on participants to purchase efficient measures.

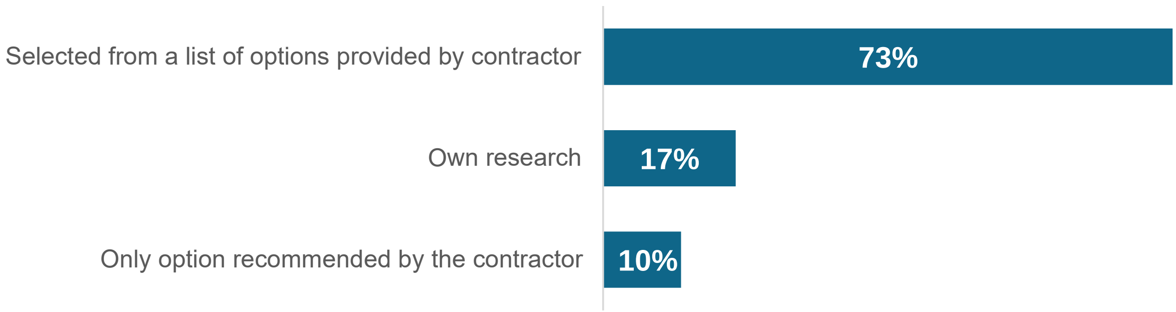
Figure 5-9: Influential Factors in Decision to Purchase Efficient Measures* (n=28)



*Participants were asked to rate each factor using a 0 to 10 scale, with 0 meaning "not at all influential" and 10 meaning "extremely influential." Responses ranging from 0 to 3 indicated low influence, 4 to 7 indicated moderate influence, and 8 to 10 indicated high influence.

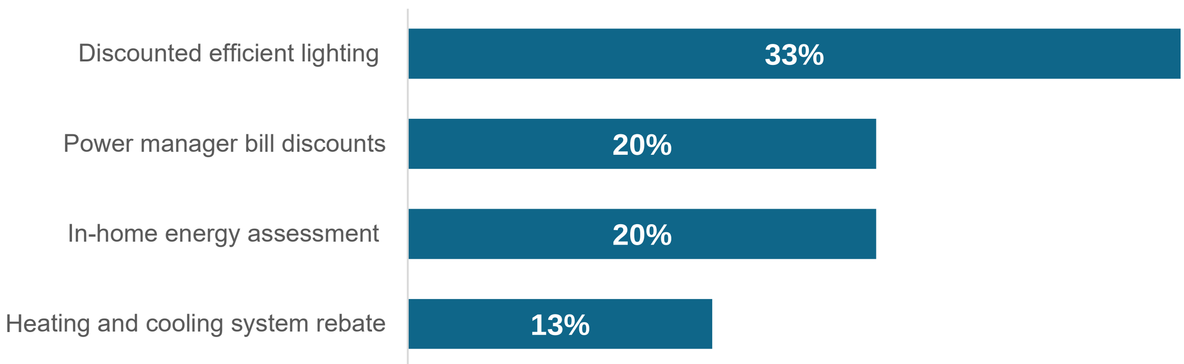
Surveys asked participants how they decided which products they would install through the Smart $aver program. The majority of participants (73%) chose their installed product based on a contractor-provided recommendation list. More than one-half of participants (59%) said that if their contractor did not offer high-efficiency products, they would have sought a different contractor that could install a rebate-qualified high-efficiency unit. Figure 5-10 illustrates how participants selected equipment for installation.

Figure 5-10: How Participants Selected Equipment to Install (n=41)



Just over one-third of participants (37%) reported familiarity with other DEK energy-efficiency rebates. Participants knew the most about discounted efficient lighting (19%) and heating and cooling system rebates (19%). Of 41% of participants familiar with other Duke Energy rebates, under one-half (45%) reported receiving another rebate. Figure 5-11 shows the most commonly received rebates.

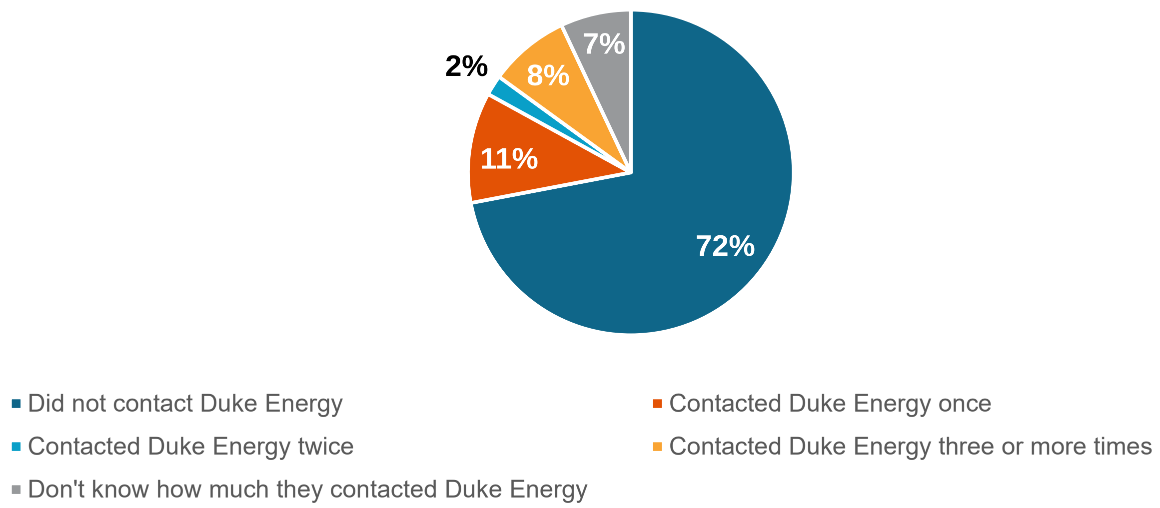
Figure 5-11: Participation in Other Duke Energy Programs (Multiple Responses Allowed) (n=15)



5.1.5.4. Participant Experience with the Program

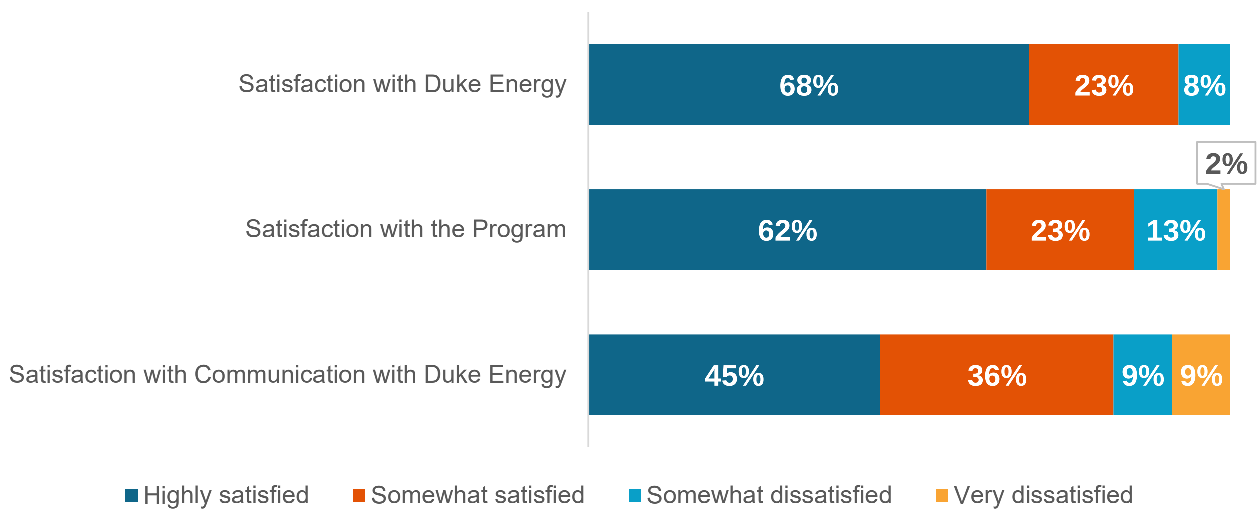
Almost three-quarters of surveyed participants (72%) reported not contacting Duke Energy program staff with questions while participating in the program. Of the 28% of participants who contacted program staff, most (11%) contacted them once. Most of those doing so (58%) reported contacting staff over the phone.

Figure 5-12: Frequency of Communication with Duke Energy (n=54)



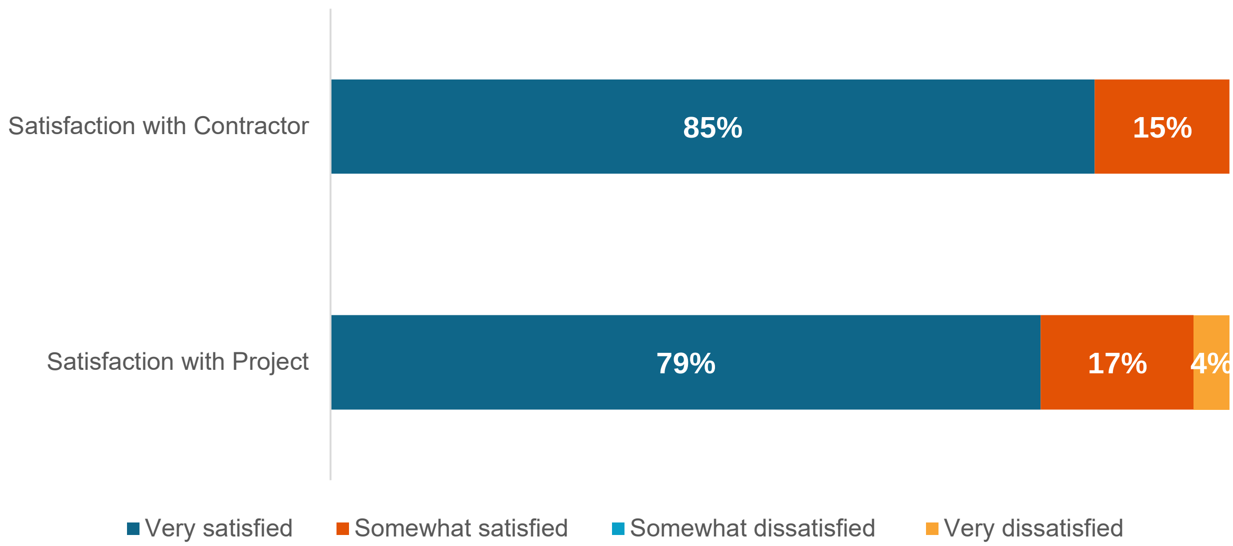
Most participants reported high satisfaction levels with the Smart $aver rebate program, as shown in Figure 5-13. The majority (85%) reported satisfaction with the Smart $aver program. Further, most participants reported satisfaction with Duke Energy in general (91%) and with their communications with Duke Energy (81%).

Figure 5-13: Participant Satisfaction with the Program (n=54)



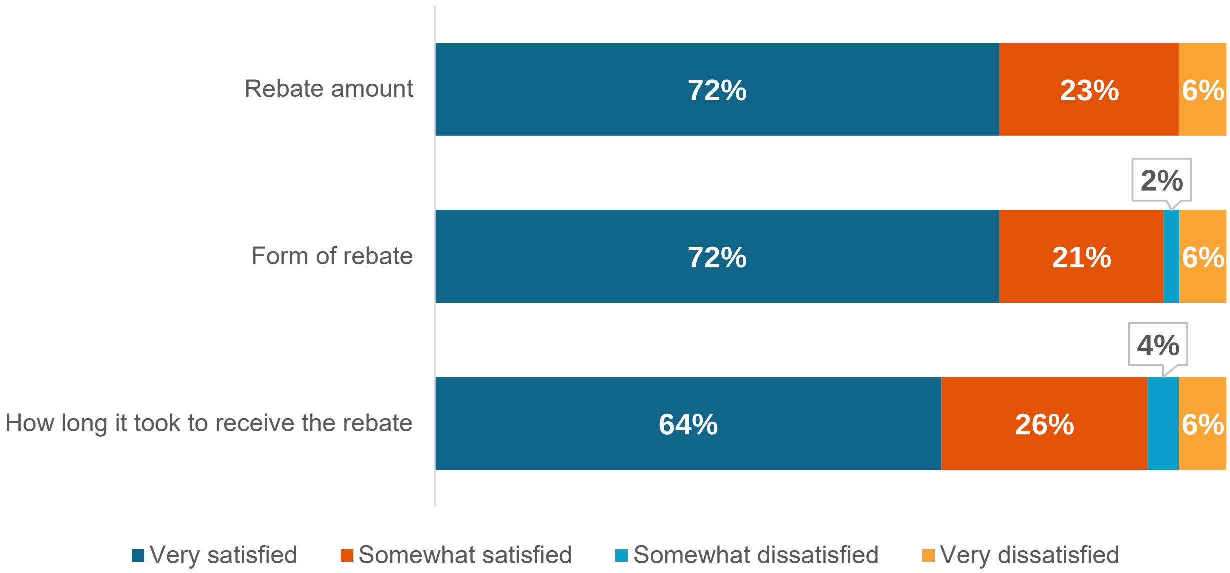
Regarding the completed project and the contractor, Figure 5-14 shows all participants expressed satisfaction with their contractor (85% were very satisfied) and the majority of participants (96%) expressed satisfaction with the project.

Figure 5-14: Participant Satisfaction with Contractor and Project (n=54)



Generally, participants were satisfied with the rebate amount (95%), the time required to receive the rebate (90%), and the rebate's form (93%) (see Figure 5-15). The majority of participants (81%) received their rebate as a physical prepaid gift card.

Figure 5-15: Satisfaction with Rebates (n=54)



To further understand Smart $aver's effect on participant attitudes towards Duke Energy, the evaluation team asked whether their program participation resulted in a positive, neutral, or negative effect on their overall satisfaction with Duke Energy. Overall, participation proved beneficial, with nearly three-quarters of respondents (74%) reporting a positive effect.

Although savings did not pose a driving factor for participants' program satisfaction, more than one-half (63%) reported savings on their electric bills following completion of their last project, as shown in Table 5-3.

Table 5-3: Resulting Energy Savings on Electric Bill

Experienced Savings on Electric Bill	n=54
Yes, they noticed savings	63%
No - they looked but did not notice any savings	20%
No - they looked but it is too soon to tell	7%
They did not look	4%
Don't know	6%
Total	100%

The evaluation team asked respondents if they had suggestions for improving the program. The primary suggestions included the following:

- Use a different company for gift card incentives; one participant reported issues with the gift card website's functionality and their customer service
- Provide paper checks instead of gift cards
- Add additional measures to the rebate options (e.g., VRF systems, solar panels, auxiliary equipment)
- Greater clarity on those submitting the rebate and who to follow up with concerning rebates
- Increased assistance for customers to move to renewable energy

5.1.6. Participant Demographics

The evaluation team surveyed 58 Smart $aver participants who received rebates through the program. All surveyed participants reported owning their home. Nearly all (83%) reported living in a single-family detached home, as shown in Table 5-4. Additionally, all respondents reported living at the residence where the work was performed.

The participant sample proved highly educated, with over one-half of the respondents having a bachelor's degree (37%), a graduate degree (17%), or a doctorate (6%). The highest proportion of respondents reported earning over $100k a year (34%), though 15% of respondents preferred not to report their income.

Table 5-4: Participant Housing Type

Housing Type	n=53
Single-family detached home	83%
Row house, town house, or a condominium with two or more units but no common areas	9%
Factory manufactured single-family home	0%
Other	2%
Multifamily apartment or condominium with four or more units and common areas	6%
Total	100%

The highest proportion of homes were built between 2000 and 2009 (28%) or before 1960 to 1969 (26%), with almost one-half of homes (48%) measuring between 1,001—2,000 square feet. The majority of participants had natural gas furnaces as heating systems (70%). More than one-half of respondents reported natural gas as their fuel source (59%).

6. Conclusions and Recommendations

Based on the evaluation's findings, the evaluation team provides the following conclusions and suggestions for program improvements:

Conclusion 1: Program design updates could improve savings results.

Recommendation 1: Consider the following program design updates:

- Add an additional tier for SEER 18+ for CACs and ASHPs
- Add a ductless mini-split heat pump offering
- Consider adding an EER requirement to CAC and ASHP measures (given this impacts summer kW)
- Separate GSHP from Tier 3 ASHP and assign specific savings to each

Conclusion 2: Trade allies make good use of the updated portal system.

Recommendation 2: Trade allies offered the following suggestions for application improvements:

- Better explanations if the application returns as invalid/in error
  - Submission errors sometimes remained unclear, leading trade allies to reopen submissions and search manually for errors
- Offer the portal as an app so trade allies can make updates while on the job
- Clarify the tracking system within the portal system to determine whether rebates are incomplete, complete, or pending

Conclusion 3: Though most respondents expressed satisfaction with the incentives, some customers and trade allies voiced alternatives.

Recommendation 3: Consider offering payment through checks as issues arose with gift cards expiring before people could use them.

Recommendation 4: Customers commonly learned of the program from trade allies, and trade allies completed the incentive application process for most measures. Trade allies interviewed and surveyed reported the incentive application process as time consuming, posing as a barrier to those seeking to complete the rebates. As a result, Duke Energy may consider reinstating a direct incentive for trade allies.

Conclusion 4: Measure parameters were recorded for only 44% of attic insulation and air-sealing participants and 14% of duct-sealing participants.

Recommendation 5: Require contractors collect CFM measurement data before and after performing air sealing or duct sealing, as required for these measures prior to February 25, 2021.

- Attic Insulation and Air Sealing
  - Pre-Sealing CFM
  - Post-Sealing CFM
- Duct Sealing
  - Pre-Sealing CFM
  - Post-Sealing CFM
  - Pre-Sealing CFM Whole House
  - Post-Sealing CFM Whole House

Conclusion 5: Lower incentive levels reduce participation and can increase free ridership rates.

Recommendation 6: Consider increasing customer incentive levels to improve participation and efficiency and to reduce free ridership.

Appendix A Summary Form

Description of program

The Smart $aver program offers Duke Energy existing residential customers incentives for improving their homes' energy efficiency through the installation of energy-efficient heating, ventilation, and air conditioning (HVAC), smart thermostats, pool pumps, water-heating equipment replacements, duct sealing, duct insulation, and attic insulation with air sealing.

Date	2020-2022
Region(s)	Kentucky
Evaluation Period	July 1, 2020—March 31, 2022
Annual Gross MWh Savings	762
Annual Gross MW Savings	0.09 (summer), 0.06 (winter)
Net-to-Gross Ratio	64.90%
Process Evaluation	Yes
Previous Evaluation(s)	2012-2013

Evaluation Methodology

Impact Evaluation Activities

Web surveys (n=58) and analysis of nine unique measures

Impact Evaluation Findings

- Realization rates:
  - 70% (energy); 51% (summer demand); 61% (winter demand)

Process Evaluation Activities

- Participant web surveys (n=58)
- Trade ally web and phone surveys (n=3)
- One interview with program staff
- One interview with program implementer
- Two interviews with high-volume trade allies

Process Evaluation Findings

- Overall, participants and trade allies are satisfied with the Smart $aver program.
- Interviewed trade allies appreciate the enhanced trade ally portal.
- The desire to save energy or lower energy bills served as the primary motivators for customers to install energy-efficient equipment.
- Trade allies serve as Smart $aver's most successful marketing channel.
- Trade allies believe ductless mini splits should be added to the program.

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Appendix B Measure Impact Results

Table B-1: DEK 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)	FR	PSO	NPSO	Net-to-Gross Ratio (Energy)
Central Air Conditioner Tier 2	141.225	0.0602	0.0000	54.0%	42.78%	5.27%	2.41%	64.90%
Central Air Conditioner Tier 3	324.733	0.0187	0.0000	102.2%				
Air Source Heat Pump Tier 2	514.936	0.0448	0.0896	106.9%				
Air Source Heat Pump Tier 3	1,027.222	-0.0033	0.1635	359.4%				
Geothermal Heat Pump	2,607.393	0.4557	0.4905	912.2%				
Smart Thermostat	171.378	0.0000	0.0000	34.4%				
Variable Speed Pool Pump	1,580.000	0.5900	0.0000	100.0%				
Attic Insulation & Air Sealing	1,185.483	0.2059	0.1893	102.0%				
Heat Pump Water Heater	1,763.000	0.1350	0.2013	100.0%				
Duct Sealing	410.000	0.3395	0.0000	100.0%				
Duct Insulation	876.000	0.7253	0.0000	100.0%				

Appendix C Participant Demographics

Figure C-1: Participant Demographics

Ownership Status	
Own	100%
Rent	0%

Living Arrangement	
Live at residence	100%
Do not live at residence	0%

Education	
High school or less	15%
Some college	24%
Bachelor's degree	37%
Graduate degree	17%
Doctorate	6%
Prefer not to say	2%

Income	
<$35k	2%
$35k to <$50k	13%
$50k to <$75k	17%
$75k to <$100k	20%
$100k+	34%
Prefer not to say	15%

Figure C-2: Participant Household Characteristics

Year Home was Built	
Before 1960-1969	26%
1970-1979	9%
1980-1989	17%
1990-1999	17%
2000-2009	28%
2010-2019	4%
2020-2021	0%
Don't Know	0%

Fuel Source	
Electric	39%
Natural Gas	59%
Other	2%

Home Square Feet	
Less than 1,000	2%
1,001-2,000	48%
2,001-3,000	33%
3,001-4,000	7%
4,001-5,000	4%
>5,000	0%
Don't Know	6%

Heating System	
Natural gas furnace	70%
Heat pump	16%
Other	7%
Don't know	7%

Appendix D Survey Instruments and In-Depth Interview Guides

Program Staff In-Depth Interview Guide

Introduction
Today, we'll be discussing your role in the Carolinas, Progress, and Kentucky Smart $aver Programs. We would like to learn about your experiences in administering this program during the time period between May 1st, 2020, and April 30th, 2021 for Carolinas and Progress, and July 1st 2020 to March 30th, 2022 for Kentucky.

Your comments are confidential. If I ask about areas you are unsure about, please feel free to tell me 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 find the information.

I would like to record this interview for my note-taking purposes. Do I have your permission?
Roles & Responsibilities

1. Are your role(s) the same for Carolina, Progress, and Kentucky as they were for the Indiana program? If not, how do the roles differ across jurisdictions?

Program Changes and Targets

2. Have any aspects of the program changed for these jurisdictions during this time period? Why were these changes made?
    1. Ask about quality install removal – was this the same for these jurisdictions as it was for Indiana? Tier 1 was removed, and all QI was dropped
    2. Ask if the portal and web applications were enhanced across all jurisdictions

3. How well do you think Carolinas, Progress, and Kentucky Smart $aver programs are structured now to meet your energy savings goals in 2022?

If not mentioned, ask:

a. When we spoke about Indiana, you mentioned that you were considering making some changes to the tier levels. Are you considering these changes for these other jurisdictions as well? Are you considering any other measures or incentive structures to add to the program? If so, what and why?

b. Are you considering offering any financing options to encourage more customers to participate in the program? If so, what are your thoughts as to how the program might implement this?

c. Are there any other program enhancements you are considering? When we discussed Indiana, there was some mention of creating a bucket for mini splits. Is this a consideration across the board for all jurisdictions?

d. Do you feel the program has engaged enough trade allies to generate enough participation to reach your 2022 savings goals?

Application Processing

Now I'd like to hear about program processes.

4. Does your implementer have the same responsibilities in these jurisdictions as they do for Indiana (i.e., rebate application processing, rebate incentive fulfillment, customer care call center services, and IT for the Trade Ally Portal)? Do they provide any other services?

5. Please describe the application processing process. Specifically, what happens after an application is received? *(Probes: Does implementer log receipt of submission, verifies there are no errors on the application, approves or rejects application, mail/email/deposit funds, provide report to Duke Energy, etc.? Are trade allies still submitting paper applications or are all applications submitted online now?)*
   a. Comparing across jurisdictions, are there any differences in how applications are processed between these programs? If so, what are the differences?

   b. *[If the application processing varies between Indiana and Ohio/Carolinas programs, ask:]* Is there anything that you have learned from the differences that has led to you wanting to make changes to the Carolinas, Progress, or Kentucky programs? If so, what would you like to change?
      - Is Duke Energy trying to standardize the application tracking and processing across all Duke Energy Smart $aver/HVAC programs?

6. What are the most common errors or problems with rebate applications? Are these the same across all jurisdictions (e.g., account related issues with names and addresses not matching, etc.)
   b. How often do these occur?
   c. How are these application errors tracked/monitored internally with your implementer?
   d. Are these issues reported to Duke Energy?
   e. Does Duke Energy get involved at any point, or does the implementer handle these issues?
   f. Is there a certain time or times of year when you see the most problems?
   g. Are there some trade allies or types of trade allies that generally have more errors/problems than others?
   h. In the last few years, what actions have been taken by Duke Energy and/or the Implementer to reduce issues with application submissions? *(Probes: Education, training, changes in forms, submission process changes, etc.)*
      - Have these actions been effective?

7. Which parts of the application processing do you think work particularly well? Why?
    a. Which parts work less well? Why?

Q8. What is the satisfaction amongst recipients of the mode (digital payment, gift/credit card, etc.) and timeline of rebate payments? How do you know?

QA/QC

Now, let's talk briefly about Quality Assurance / Quality Control.

9. Does Duke Energy require on-site inspections of at least some number of HVAC or other projects done through the Carolinas, Progress, and Kentucky programs? If so, what proportion of projects are inspected? Has COVID impacted this?

10. We have heard that Duke Energy staff conducts these inspections. Is this correct?

11. What are typical types of QA/QC issues that come up?
    a. How often do these come up?
    b. Are the issues more common with certain trade allies or certain equipment?
    c. How are the issues addressed?

Communication

Next, I'd like to hear briefly about how communication processes are working between Duke Energy, the implementer, and trade allies.

12. From our conversation about the Indiana territory we got a sense of how often you communicate with implementer staff and what is discussed at these meetings. Is this the same for Carolinas, Progress, and Kentucky? If not, how does the communication frequency and topics discussed differ?

    1. *From Indiana for reference:* twice weekly meetings, development meeting Mondays, business operations meeting Wednesdays, monthly customer service calibration (listen to customer calls), bi-weekly leadership meeting – has been a beneficial change, very pleased with responses and feedback, they are proactive

13. How do you and/or your implementer communicate program changes to trade allies? What challenges, if any, have you had in communicating program changes to trade allies?

14. How often do you have to resolve an issue with a trade ally or a customer? What types of issues come up?

Tracking & Reporting

15. From our conversation about the Indiana territory, we got a sense of the tracking and reporting data that you receive from the implementer or internally about the program. Is this the same for Carolinas, Progress, and Kentucky? If not, how does the tracking and reporting of data differ?

1. *From Indiana for reference:* Reporting dashboards have been helpful, they can look at them every day – 2015 started with Blackhawk, took about a year to build out, continued to enhance them "business object reports" gives all the details on counts/%, can request ad hoc reports too, TA rates, inspections, invalids. Monday.com project management. BH has been very accommodating when there is a request.

   a. In what form are these data provided? To whom is it provided? How often is it provided?
   b. Is there information that you need about the program but are not getting?
   c. What reports or other information provided by the implementer or internally that you find to be most useful? Least useful (if anything)? Why?

   d. Do you or the implementer collect and track any information on baseline equipment such as efficiency or age of replaced equipment? If not, is this baseline information collected by the trade allies?

   e. Thinking of the smart thermostat measure, what information do you collect and track on that measure?
      - [*If not addressed*] Does the program require trade allies to program the temperature setting on the new thermostat? [*If yes*] At what setting do contractors program the thermostat? [*If not*] Do you track the default temperature setting of the installed thermostats? Are you able to collect this information via the wi-fi connection?

Trade Allies

From what we know, participation of the trade ally network is vital to the success of the program. I'd like to hear a bit more detail about how the program works with trade allies.

   a. Is trade ally recruitment for participation the same or different for the Carolinas, Progress, and Kentucky program as compared to what we discussed for the Indiana territory? (*Note to interviewer: contractors must complete a Trade Ally registration form to be considered a Trade Ally. There are two separate forms: one for HVAC and one for Insulate and Seal measures.*) Do you know what percent of potentially qualified trade allies are in the program? Has this percent increased, decreased, or stayed the same? [*If increased or decreased*] Why did it increase/decrease?

16. What is your sense of what motivates trade allies to pre-qualify and participate in the program? How do you know?

17. What services or support do you offer to your participating trade allies? Let's start with:
    a. Marketing support? Do you offer co-op advertising materials for these jurisdictions? Anything else?
       a. *From Indiana for reference:* Advertise rebates, Duke energy newsletter, "Find It Duke" has replaced co-branding, there are still some that ask for it

b. How about training support for these jurisdictions? (*Probe about sales, program, or other training*)
   a. *From Indiana for reference:* Used to do twice annual in-person trainings, but also include webinars. Once a year per measure. Both live and recorded, not on the portal currently, they are emailed to everyone and can be shared. Lots of other info available.
c. Anything else?

18. Do contractors use the Duke Energy website and/or Trade Ally portal to locate information about the program? How do you know?

19. Are there any other services you would like to provide to trade allies in the near future? If so, what?

20. Have you recently had to remove any trade allies from your list of participating contractors in these jurisdictions due to disengagement or inability to perform according to program requirements? If so, how many did you have to remove? (*Probe: Do you have a list?)*

21. What have you heard from trade allies regarding their interest in any new equipment/technology or any new incentives/offerings?

Marketing & Outreach

Now, I'd like to hear about the current status of marketing activities for the program in the DEC/DEP and DEK jurisdictions. Where the marketing is the same, please note that. If the marketing is different, please let us know how it differs across jurisdictions.

22. How do you market the program?

23. Could you provide us with blocking charts, marketing expenditures, or reach and frequency of marketing for the Carolinas, Progress, and Kentucky Smart $aver HVAC programs?

24. How does Duke Energy decide which marketing strategy to implement?
   a. How do you typically measure the success of the marketing campaign(s)?

25. [*If they offer co-op marketing materials to trade allies*] How many trade allies use these co-op marketing materials? Do you have a goal for how many should use these materials?

26. Have you recently begun, or planning to, include expanded marketing efforts to non-English speaking customers? Or any other recent and/or planned Diversity, Equity, Inclusion (DEI) strategies?

27. Thinking about customers, are there any additional opportunities for expanding market penetration that the program is currently pursuing, or planning to pursue?

[Probe as needed] For example, are there other…
a. Population segments to target?
b Trade allies to target?

Q29. Do you survey and track residential customer and/or business customer satisfaction metrics? If so, when? How? What have you been seeing, generally, regarding customer satisfaction with the Smart $aver program?

Wrap-up

29. What would you say are the greatest strengths of the Smart $aver Program in each jurisdiction that we discussed today?

30. What challenges are you facing in delivering this program to the market - currently or in the near future?

31. What would you say most needs to be changed about the program?

32. What would you say is the single best thing you have done during the relevant time periods (between May 1st, 2020, and April 30th, 2021 for Carolinas and Progress, and July 1st 2020 to March 30th, 2022 for Kentucky) to foster program participation and customer satisfaction?

33. What would you say is the main thing you are planning in the short term to foster program participation and customer satisfaction?

34. What would you personally like to learn from this program evaluation?

35. Is there anything else about the program that we have not discussed that you feel should be mentioned?

Close:

Those are all of my questions. Thank you very much for your time.

Implementer Staff In-Depth Interview Guide

Introduction

My firm, Resource Innovations, on behalf of Duke Energy Carolinas, Progress, and Kentucky (DEC/DEP and DEK), is conducting an evaluation of the Smart $aver program. Since your organization is involved in rebate application processing, fulfillment, and customer call center services for this program, we would like to get your valuable perspective on how the program works.
Before we begin the interview, I would like to record this interview for my note-taking purposes. Do I have your permission? *[If needed: It is simply so that I can go back and clean up my notes after we are done talking, as to ensure I accurately captured everything you said.]*

Roles & Responsibilities

1. Julie and Thomas, we spoke to you already when we evaluated the Indiana region, so we have a sense of your role and responsibilities with regard to the Smart $aver program. Does this differ at all for the DEC/DEP and DEK jurisdictions? And Dora, what are your roles and responsibilities with the Smart $aver program? How long have you been in this role?

Program Expectations and Market Response

First, I'd like to discuss a few questions about program participation and program performance. The timeframe I'll be asking you about in this survey is July 1st, 2020, through March 30th, 2022.

2. Thinking of Duke Energy program participation goals, how have participation levels been in DEC/DEP and DEK during this timeframe, relative to program expectations?
3. Have you noticed any differences in the participation rates by things like geography, home type, age, ethnicity/race, measures installed, or something else? [*If any, ask*] What accounts for these differences?
4. Are there any additional opportunities for expanding market penetration that the program is currently pursuing in the DEC/DEP and DEK regions? If not, should the program consider expanding their market penetration?
   [Probe as needed] For example, are there other…
   - Incentive structures that should be considered?
   - Measures that should be considered?
   - Population segments to target?
   - Trade ally targets?
   - Any others?
5. What, if any, barriers do you see to expanding market penetration? [*If any, ask*] What do you think can be done to overcome those barriers?

Communication

Now, I'd like to hear about communication processes, starting with internal communication.

6. When we discussed Indiana, we got a sense of the communication you have with other implementer staff and with Duke Energy regarding the Smart $aver program. Is the frequency the same for DEC/DEP and DEK as it is for DEI?
   [If not mentioned, ask]
   - With whom do you communicate and/or meet with about the program?
   - What is the frequency of these meetings?
   - What is the purpose/objective of these meetings?
   - Have there been any challenges?
7. Do you have any other regular but informal communications with any Duke Energy staff regarding the program?
8. Overall, how would you characterize your communications with Duke Energy? Are your interactions positive, negative, or neutral? [*If any issues, ask*] What are they? Any suggested improvements/solutions?

Application Processing

Next, I'd like to hear about application and rebate processing.

9. We discussed the application processing when we discussed the Indiana jurisdiction. Is the application processing from the point when the application is received through the final

rebate processing steps the same for DEC/DEP and DEK as it is for DEI? [*Probes: Implementer log receipt of submission, verifies there are no errors on the application, approves or rejects application, mail/email/deposit funds, provide report to Duke Energy, etc.)*

- How long does it typically take? *[Probe: KPI metric versus actual (in days)]*
- Does the timeline differ for different offerings/measures?
- Do you only process online applications? Or, do customers or trade allies (on behalf of customers) still submit paper applications? *[If any]* What percentage would you say are still paper? What are the timelines for online versus paper rebates?
- What is the process for ensuring applications and rebates are processed in a timely fashion?

10. Between July 1st, 2020, and March 30th, 2022, were any changes been made to the program application process in the DEC/DEP or DEK regions? [*If yes*] What was the change? When was the change made? Why? What is the impact?
11. What are the most common errors/problems with applications?
    - How often do these occur?
    - How are these application errors tracked/monitored internally at your firm?
    - How are these reported to Duke Energy?
    - Is there a certain time (or times) of year when you see the most problems?
    - In the last year, what actions have been taken by your firm or by Duke to reduce errors/problems with the application submissions? *(Probes: Education, training, changes in online or paper forms, submission process changes, etc.)*
        - Have these actions been effective?
12. [*If not addressed*] What type of information is typically incorrect or missing on the application? *[If any]* Is this by the customer or Trade Ally or both? Why do you think this is?
13. Which parts of the application processing do you think work particularly well and why?
    - Which parts work less well? *[If any]* Why?

Trade Ally Network

The next section of questions will be regarding Trade Allies. We did discuss trade allies when we spoke to you regarding Indiana. If anything is the same as DEI, you can just mention that and we can move on. If anything with the trade allies in these jurisdictions differ from what we discussed with DEI, we would like to know that.

14. We understand you provide an IT platform for the Trade Ally Portal where trade allies can submit applications. What, if any, feedback have you received from trade allies in the DEC/DEP and DEK regions about this portal?
15. What, if any, feedback have you received from trade allies in the DEC/DEP and DEK jurisdictions about the program in general?
16. Do you know how changes in the program are communicated to trade allies? Via the trade ally portal? Scheduled trainings? Newsletters? Some other way?
    - [*If implementer is involved in this process*] What success or challenges are you having with communicating program changes? [*If challenges mentioned*] What could be done to resolve the challenges?

17. What suggestions, if any, do you have for improving the program in regards to the trade ally portal or trade allies involvement in application processing?
18. What makes trade allies interested in participating in the program? What benefits do they derive from participating?
19. Have trade allies communicated to you additional or other perceived benefits that the program is not currently supporting? *[If any]* Can you describe? Are you considering these?

Call Center Services

20. Since your firm also provides customer call center services for the Duke Energy Indiana Smart $aver program, can you describe the types of issues customers typically call about in DEC/DEP and DEK?
    - How do you address or resolve these issues?
    - Are there any program improvements that could help reduce the number of calls you get regarding these issues?

21. Duke Energy is responsible for program marketing and awareness campaigns. Are there any improvements that could help increase the number of customer calls inquiring about participation in the program?
22. Do you have customer service metrics you track specifically regarding the performance of your call center? *[If so]* What are they? How are you doing regarding those metrics?
23. Do you have customer service metrics you track outside of the call center, meaning customer program satisfaction? [If so] Who collects this data, by what method is it collected (online survey, etc), and where is it tracked/stored?
24. What are customers generally saying they like the least and the best about the Smart $aver program? Does Duke Energy share this customer feedback on an established regular basis with you the implementer?
25. Have you received any feedback directly from customers about the program in general? If yes, please describe the feedback.

Tracking & Reporting

Now let's talk about the tracking and reporting data that you collect for Duke Energy.

26. Your firm likely has a database for tracking the progress and status of each application. Please tell me what type of information is in this database?
    - [*If not addressed*] What type of demographic & house information do you collect and track in the database?
    - [*If not addressed*] What type of information do you collect and track on the equipment that was replaced? [*Probe: age, efficiency, fuel, size/capacity*]

27. Are there any common data quality issues or errors that your team has encountered? *[If so]* How have you addressed this?
28. What data do you send to Duke Energy on a regular basis?
    - In what form are these data provided?
    - To whom is it provided?
    - How often is it provided?

29. Is there information from this database that Duke Energy staff needs about the program but is not getting? If so, what?
30. Thinking about your tracking system, where do you feel data tracking could be improved or streamlined?

Conclusion

We are almost done. I have a few high-level questions about your overall impressions and feedback.

31. What would you say is/are the most effective way(s) that residential customers engage with the program? Could these or others be leveraged further?
32. What would you say are the greatest strengths of the Smart $aver Program?
33. What would you say are the program areas that are in most need of update or improvement?
34. Is there anything else about the program that we have not yet discussed that you feel should be mentioned?
35. Is it okay if I get in touch with you later in case of any clarifications or if I have any additional questions?

Close

Those are all of my questions. Thank you very much for your time.

Participant Survey

Instrument

Landing Page (Web)

Thank you for participating in this survey effort. It begins with a few questions about your awareness of energy efficiency offerings available through Duke Energy, and then transitions to your experience with the Smart $aver program.

Interviewer Instructions / Introduction (Phone)

[*READ IF CONTACT NAME IS KNOWN:*]

Hello, may I speak with _____.

[*READ IF NAME IS UNKNOWN*] Hi, my name is __________.

I'm calling on behalf of Duke Energy. Our records show that you received a rebate for [**LIST ALL MEASURES**] from the Duke Energy Smart $aver Program during the timeframe of July 1st, 2020, to March 31st 2022.

[*INTERVIEWER – IF PERSON ON PHONE IS UNAWARE OF THE REBATED WORK, ASK TO SPEAK WITH SOMEONE IN THE HOME WHO MIGHT RECALL RECEIVING A REBATE FROM DUKE ENERGY.*

IF PERSON ON PHONE SAYS THEY ARE RENTER (AND/OR THEIR LANDLORD OR PROPERTY MANAGER WAS RESPONSIBLE FOR THE PROJECT), ASK FOR LANDLORD/PROPERTY MANAGER'S NAME AND PHONE NUMBER AND USE THAT AS THE NEW POINT OF CONTACT].

Duke Energy would like your feedback about upgrades that were completed at the residence through the program as well as feedback on your experience with the program itself. Is now a good time to talk?

[*IF NEEDED*]*:* The survey will take about 10 to 15 minutes, depending on the details you have for us.

[*IF NEEDED*: *SCHEDULE A TIME TO CALL THEM TO COMPLETE THE SURVEY*]

Please note that this call may be monitored or recorded for quality assurance purposes.

Building information and screening

[ASK ALL]

Q1. Please indicate the building type that best describes the residence where the upgrades were performed.

[SINGLE RESPONSE]

1. Single-family detached home [*IF NEEDED*: *<u>NOT</u> A DUPLEX, TOWNHOME, OR APARTMENT; ATTACHED GARAGE IS OK*]
2. Factory manufactured single family home
3. Row house or town house or condo, with two or more units but no common area(s) (includes duplex, triplex, fourplex, etc.)
4. Multifamily apartment or condo building, with four or more units and a common area(s)

-96. 96. Other, please specify: [OPEN-ENDED RESPONSE]
-97. 98. I don't know

Awareness

[ASK ALL]

Q2. How did you hear about the Duke Energy Smart $aver **rebate(s)** that you received? Please select all that apply. **[LIST ALL MEASURES THEY RECEIVED FROM SMART $AVER PROGRAM [allow multiple]**

1. Duke Energy program website
2. Direct (paper) mail or bill inserts
3. Email

4. Word of mouth: Friend, family, colleague, etc.
5. From my contractor
6. Online advertisement
7. Billboard
8. Radio
9. Advertisement on bus
10. Other; please specify: [OPEN-ENDED RESPONSE]

[ASK ALL]
Q3. Are you familiar with other energy-efficiency rebates that Duke Energy offers, aside from the **rebate(s) you received**?

[SINGLE RESPONSE]

1. Yes
2. No
-96. 98. I don't know
-97.

[ASK IF Q3= 1 (Yes)]
Q4. Which other rebates are you familiar with? Please select all that apply. [PROGRAMMER: EXCLUDE THE REBATES THAT THEY RECEIVED FROM THE LIST BELOW]

[MULTIPLE RESPONSE]

1. Heat pump water heater rebate
2. Heating and cooling system rebate
3. Geothermal heat pump rebate
4. Smart Wi-Fi enabled thermostat rebate
5. Attic insulation and air seal rebate
6. Duct sealing/insulation rebate
7. In-home energy assessment (Home Energy House Call)
8. Pool pump rebate
9. Outdoor lighting rebate
10. Rebates for Income Eligible customers
11. Rebates available on Duke Energy's Online Store
12. Rebates available through Duke Energy at local retailers for LED bulbs
13. Power Manager bill discounts (for allowing Duke Energy to ramp down air-conditioning or heating during peak usage events, via AC device or smart thermostat)
14. Discounted efficient lighting (CFLs, LEDs, and specialty bulbs)
15. Other – please specify: [OPEN-ENDED RESPONSE]

98. Don't know

[ASK IF Q3= 1 (Yes)]
Q5. Have you received any of these other rebates?

[SINGLE RESPONSE]

1. Yes
2. No
-96. 98. I don't know
-97.

[ASK IF Q5= 1 (Yes) AND MORE THAN ONE ITEM SELECTED IN Q4; IF ONLY ONE ITEM SELECTED IN Q4 AND Q5=1, AUTOCODE Q4 RESPONSE FOR Q6]

Q6. Which rebate(s) did you receive? Please select all that apply. *[Do not read list]*

[MULTIPLE RESPONSE]

1. Heat pump water heater rebate
2. Heating and cooling system rebate
3. Geothermal heat pump rebate
4. Smart Wi-Fi enabled thermostat rebate
5. Attic insulation and air seal rebate
6. Duct sealing/insulation rebate
7. In-home energy assessment (Home Energy House Call)
8. Pool pump rebate
9. Outdoor lighting rebate
10. Rebates for Income Eligible customers
11. Rebates available on Duke Energy's Online Store
12. Rebates available through Duke Energy at local retailers for LED bulbs
13. Power Manager bill discounts (for allowing Duke Energy to ramp down air-conditioning or heating during peak usage events, via AC device or smart thermostat)
14. Discounted efficient lighting (CFLs, LEDs, and specialty bulbs)
15. Other – please specify: [OPEN-ENDED RESPONSE]
98. I don't know

Program Influence

[ASK IF Q5= 1 (Yes)]

Q7. Did you receive the [**Insert rebated measures from Q6**] before or after [**PROJECT#1 LIST**] work was done? [REPEAT THIS QUESTION FOR EACH REBATE OPTION SELECTED IN Q6]

[SINGLE RESPONSE]

1. Before
2. After
3. Both before and after
4. At the same time
-96. 98. Don't know
-97.

[ASK IF Q7= 2 or 3 ("After" or "Both before and after")]

Q8. Using a scale from 0 to 10, where 0 means "Not at all influential" and 10 means "Extremely influential," how influential was the rebate for [**PROJECT#1 LIST**] in your decision to take advantage of Duke Energy's rebate for [**Insert response from Q6**]? [REPEAT THIS QUESTION FOR EACH REBATE OPTION SELECTED IN Q6 WHERE RESPONSE TO Q7=2 ("After") OR Q7=3 ("Both before and after")]

[SINGLE RESPONSE]

0.	0. Not all influential
1.	1.
2.	2
3.	3
4.	4
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Extremely influential
98.	I don't Know

-96.

[ASK IF RESPONDENT HAS A **PROJECT#2 LIST**]

Q9. Using a scale from 0 to 10, where 0 means "Not at all influential" and 10 means "Extremely influential," how influential was the rebate for [**PROJECT#1 LIST**] in your decision to take advantage of additional Duke Energy rebates for [**PROJECT#2 LIST**]?

[SINGLE RESPONSE]

0.	0. Not all influential
1.	1.
2.	2
3.	3
4.	4
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.

10.	10. Extremely influential
98.	I don't Know

Motivations

Next, we'd like to know more about your motivations to participate in the Duke Energy Smart $aver Program.

[ASK IF AIR SOURCE HEAT PUMP, GEOTHERMAL HEAT PUMP, OR CENTRAL AIR CONDITIONER WAS INSTALLED]

Q10. [IF AIR SOURCE HEAT PUMP OR GEOTHERMAL HEAT PUMP WAS INSTALLED] Which of the following best describes the condition of the previous HVAC system that you replaced with a [**PIPE IN WHICHEVER WAS INSTALLED: AIR SOURCE HEAT PUMP OR GEOTHERMAL HEAT PUMP**]?

[IF CENTRAL AIR CONDITIONER WAS INSTALLED] Which of the following best describes the condition of the previous air conditioner that you replaced?

[MULTIPLE RESPONSE]

1. It was broken or malfunctioning
2. It was getting old
3. It was in good working condition
96. Other, please specify: [OPEN-ENDED RESPONSE]
98. I don't know

Q11. [ASK IF AIR SOURCE HEAT PUMP, GEOTHERMAL HEAT PUMP, OR CENTRAL AIR CONDITIONER WAS INSTALLED] Approximately, how many years old was the previous HVAC unit that you replaced with your new [**PIPE IN WHICHEVER WAS INSTALLED: AIR SOURCE HEAT PUMP, CENTRAL AIR CONDITIONER, OR GEOTHERMAL HEAT PUMP**]

[Allow integer response]

Q12. [ASK IF CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP, OR GEOTHERMAL HEAT PUMP WAS INSTALLED] What motivated you to install an **energy efficient** heating/cooling system rather than a less efficient one that would use more energy? Please select all that apply. [RANDOMIZE SELECTION CHOICES]

- *The availability of the program incentive*
- *The ease of participating in the program*
- *Knowing that any equipment or service Duke Energy would incentivize must be reliable*

- *To save energy or lower your energy bills*
- *To be associated with "green" or "sustainable" actions*
- *To increase my comfort*
- *To increase safety and reliability of my heating/cooling system*
- *To get a new heating/cooling system*

96. *Other, please specify [*OPEN-ENDED RESPONSE*]*

98. *I don't know (MAKE ANSWER EXCLUSIVE)*

Q13. [ASK IF CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP, OR GEOTHERMAL HEAT PUMP WAS INSTALLED] I'd like to know how you selected the specific make and model of the [**PIPE IN WHICHEVER WAS INSTALLED: AIR SOURCE HEAT PUMP, CENTRAL AIR CONDITIONER, OR GEOTHERMAL HEAT PUMP**] you purchased. Would you say that you chose it…

1. Yourself, based entirely on your own research?
2. From a list of options provided by the contractor?
3. Because it was the only option recommended by your contractor?

-0. 96. In some other way, please specify: [RECORD OPEN-ENDED RESPONSE]
-1. 98. I don't know

Q14. [ASK IF CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP, OR GEOTHERMAL HEAT PUMP WAS INSTALLED] Suppose the contractor that installed your [**PIPE IN WHICHEVER WAS INSTALLED: AIR SOURCE HEAT PUMP, CENTRAL AIR CONDITIONER, OR GEOTHERMAL HEAT PUMP**] did not offer high efficiency [**PIPE IN WHICHEVER WAS INSTALLED: AIR SOURCE HEAT PUMP, CENTRAL AIR CONDITIONER, OR GEOTHERMAL HEAT PUMP**]s that qualify for Duke rebates. Which of the following is most likely what you would have done[SINGLE RESPONSE]

1. You would have installed the cheaper less efficient unit that would not have qualified for rebates if that's all your contractor offered, or
2. You would have looked for a contractor that could install a rebate-qualified high efficiency unit

-96. 96. Other, please specify: [OPEN-ENDED RESPONSE]
-97. 98. I don't know
-98.
-99. [ASK IF SMART THERMOSTAT WAS INSTALLED]

Q15. Which of the following best describes the old thermostat that you replaced?

1. Manual non-programmable thermostat,
2. Programmable thermostat that does not communicate with your wi-fi network, or
3. Programmable thermostat that communicates with your wi-fi network

96. Other, please specify: [OPEN-ENDED RESPONSE]
98. I don't know

[ASK IF SMART THERMOSTAT WAS INSTALLED]

Q16. What motivated you to install a Wi-Fi enabled thermostat? *Please select all that apply.*

1. *The availability of the program incentive*
2. *The ease of participating in the program*
3. *Knowing that any equipment or service Duke Energy would incentize must be realiable*
4. *To save energy or lower your energy bills*
5. *To be associated with "green" or "sustainable" actions*
6. *To increase my comfort*
7. *To increase reliability of my thermostat*
8. *To get a new and updated thermostat*

96. *Other, please specify [*OPEN-ENDED RESPONSE*]*
98. *I don't know (MAKE ANSWER EXCLUSIVE)*

[ASK IF HEAT PUMP WATER HEATER WAS INSTALLED]

Q17. Which of the following best describes the condition of the previous water heater that you replaced?

1. It was broken or malfunctioning
2. It was getting old
3. It was in good working condition

96. Other, please specify: [[OPEN-ENDED RESPONSE]
98. I don't know

Q18. [ASK IF HEAT PUMP WATER HEATER WAS INSTALLED] Approximately, how many years old was the previous water heater that you replaced with your new heat pump water heater? *[RECORD VERBATIM]*

[ASK IF HEAT PUMP WATER HEATER WAS INSTALLED]

Q19. Where did you install your new heat pump water heater?

1. Garage
2. Basement
3. Closet
4. Laundry room

96. Other, please specify: [OPEN-ENDED RESPONSE]

98. I don't know

[ASK IF HEAT PUMP WATER HEATER WAS INSTALLED and IF Q19<>98 or 99]

Q20. Do you use your HVAC system to heat and cool the [PIPE IN ANSWER FROM Q19] where the heat pump water heater is located?

1. Yes
2. No
96. Other, please specify: [[OPEN-ENDED RESPONSE]
98. I don't know

[ASK IF HEAT PUMP WATER HEATER WAS INSTALLED]

Q21. What motivated you to install an **energy efficient** water heater rather than a less efficient one that would use more energy? *[RECORD VERBATIM] Please select all that apply.*

1. *The availability of the program incentive*
2. *The ease of participating in the program*
3. *Knowing that any equipment or service Duke Energy would incentivize must be reliable*
4. *To save energy or lower your energy bills*
5. *To be associated with "green" or "sustainable" actions*
6. *To increase my comfort*
7. *To increase the safety and reliability of my water heater*
8. *To get a new and updated water heater*
96. *Other, please specify [*OPEN-ENDED RESPONSE*]*
98. *I don't know (MAKE ANSWER EXCLUSIVE)*

[ASK IF DUCT SEALING OR INSULATION WAS PERFORMED/INSTALLED]

Q22. A) [IF DUCT SEALING WAS PERFORMED] What motivated you to repair your ductwork?

B) [IF ATTIC INSULATION WAS INSTALLED] What motivated you to add insulation to your attic? *[RECORD VERBATIM] Please select all that apply.*

1. *The availability of the program incentive*
2. *The ease of participating in the program*
3. *Knowing that any equipment or service Duke Energy would incentivize must be reliable*
4. *To save energy or lower your energy bills*

5. *To be associated with "green" or "sustainable" actions*
6. *To increase my comfort*
7. *To increase the safety and reliability of my ducts*
8. *To get a new and updated ducts*

A. *Other, please specify [*OPEN-ENDED RESPONSE*]*

98. *I don't know (MAKE ANSWER EXCLUSIVE)*

[ASK IF POOL PUMP WAS INSTALLED]

Q23. What motivated you to install an ENERGY STAR pool pump? *Please select all that apply.*

1. *The availability of the program incentive*
2. *The ease of participating in the program*
3. *Knowing that any equipment or service Duke Energy would incentivize must be reliable*
4. *To save energy or lower your energy bills*
5. *To be associated with "green" or "sustainable" actions*
6. *To increase my comfort*
7. *To increase the safety and reliability of my pool pump*
8. *To get a new and updated pool pump*

96. *Other, please specify [*OPEN-ENDED RESPONSE*]*
98. *I don't know (MAKE ANSWER EXCLUSIVE)*

[ASK IF POOL PUMP WAS INSTALLED]

Q24. Approximately what date do you first **open** your pool for the season? [Prompt if needed: "For example June 1st"]

1. [SELECT MONTH AND DAY FROM DROP DOWN]
98. I don't know

[ASK IF POOL PUMP WAS INSTALLED]

Q25. Approximately what date do you **close** your pool for the season? [Prompt if needed: "For example October 30th]

1. [SELECT MONTH AND DAY FROM DROP DOWN]
98. I don't know

Q26. How many hours is the pool pump programmed to run per day? Please respond with a whole number rounded to the nearest number of hours. [Integer response]

1. Hours: [open-ended numerical response greater than or equal 0 and less than or equal to 24]

98. I don't know

Free-ridership

The next few questions ask what you most likely would have done had you NOT received assistance from Duke Energy for the **[LIST ALL MEASURES]**.

[ASK IF THEY INSTALLED: CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP OR GEOTHERMAL HEAT PUMP]

Q27. Regarding heating and cooling, which of the following statements best describes the actions you would have taken if *Duke Energy rebates and information were not available*:

[SINGLE RESPONSE]

1. Would not have installed the [PIPE IN WHICHEVER WAS INSTALLED: CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP OR GEOTHERMAL HEAT PUMP] at all
2. Would have bought a less expensive or less energy efficient heating and cooling system
3. Would have bought the exact same high efficiency [PIPE IN WHICHEVER WAS INSTALLED: **CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP OR GEOTHERMAL HEAT PUMP]**, and paid the full cost

-96. 98. I don't know

[ASK IF Q27=2 or 3]

Q28. You indicated you would have still purchased a/an [**PIPE IN WHICHEVER WAS INSTALLED: CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP OR GEOTHERMAL HEAT PUMP**]. Without the incentive, when would you have likely done so?

1. At the same time
2. Within 6 months
3. Within a year
4. Later than a year

-96. 98. I don't know

-97.

[ASK IF THEY INSTALLED: SMART THERMOSTAT]

Q29. Now we want to ask you about the smart thermostat you got with your [**PIPE IN WHICHEVER WAS INSTALLED: CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP OR GEOTHERMAL HEAT PUMP**]. Which of the following statements best describes the actions you would have taken if *Duke Energy rebates and information were not available*:

[SINGLE RESPONSE]

1. Would not have purchased a new thermostat at all
2. Would have installed a manual non-programmable thermostat
3. A programmable thermostat that is not wi-fi enabled
4. Would have bought the exact same wi-fi thermostat, and paid the full cost

-96. 98. I don't know

[ASK IF Q29 = 2,3,4]

Q30. You indicated you would have still purchased a thermostat. Without the incentive, when would you have likely done so?

1. At the same time
2. Within 6 months
3. Within a year
4. Later than a year

-96. 98. I don't know

[ASK IF THEY INSTALLED: HEAT PUMP WATER HEATER]

Q31. Regarding water heating, which of the following statements best describes the actions you would have taken if *Duke Energy rebates and information were not available*:

[SINGLE RESPONSE]

1. Would not have replaced my water heater
2. Would have bought a less expensive or less energy efficient water heater
3. Would have bought the exact same high efficiency Heat Pump Water Heater, and paid the full cost

-96. 98. I don't know

[ASK IF Q31= 2,3]

Q32. You indicated you would have still purchased a new water heater. Without the incentive, when would you have likely done so?

1. At the same time
2. Within 6 months
3. Within a year
4. Later than a year

-96. 98. I don't know

[ASK IF THEY UPGRADED: ATTIC INSULATION]

Q33. Regarding attic insulation, which of the following statements best describes the actions you would have taken if *Duke Energy rebates and information were not available*:

[SINGLE RESPONSE]

1. Would not have done the attic insulation
2. Would have added less insulation
3. Would have done the exact same upgrade, and paid the full cost

-96. 98. Don't know

[ASK IF Q33= 2]

Q34. You said you would have added less insulation if you had not received the rebate or information from Duke Energy. How much less insulation would you have purchased? Please answer in a percentage, such as "50% less."

1. [RECORD VERBATIM:] ________________

98. I don't know

-96.

[ASK IF Q33= 2 or 3]

Q35. You indicated you would have still added insulation. Without the incentive, when would you have likely done so?

1. At the same time
2. Within 6 months
3. Within a year
4. Later than a year

-96. 98. I don't know

-97.

[ASK IF THEY DID DUCT SEALING]

Q36. Regarding duct sealing, which of the following statements best describes the actions you would have taken if *Duke Energy rebates and information were not available*:

[SINGLE RESPONSE]

1. Would not have had ducts sealed or repaired
2. Would have had the exact same work done, and paid the full cost

-96. 98. I don't know

-97.

[ASK IF Q36= 2]

Q37. You indicated you would have still had your ducts sealed or repaired. Without the incentive, when would you have likely done so?

1. At the same time
2. Within 6 months
3. Within a year
4. Later than a year

-96. 98. I don't know

-97.

[ASK IF THEY INSTALLED A VARIABLE SPEED POOL PUMP]

Q38. Regarding your pool pump, which of the following statements best describes the actions you would have taken if *Duke Energy rebates and information were not available*:

[SINGLE RESPONSE]

1. Would not have installed or replaced the variable speed pool pump
2. Would have bought a less expensive or less energy efficient pool pump, or
3. Would have had the exact same high efficiency pool pump installed, and paid the full cost

-96. 98. I don't know
-97.

[ASK IFQ38 = 2 or 3]
Q39. You indicated you would have still purchased a pool pump. Without the incentive, when would you have likely done so?

1. At the same time
2. Within 6 months
3. Within a year
4. Later than a year

-96. 98. Don't know
-97.

[ASK ALL]
Q40. 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 purchase the [**MEASURE**]? *How influential was…*

[*INTERVIEWER NOTE: 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	0 – Not at all influential	1	2	3	4	5	6	7	8	9	10 – Extremely influential	98 DK	99 RF
The rebate you received													
Information or advertisements from Duke Energy, including their website													
Recommendation from your contractor													
Did anything else influence you? If so, please specify: _______________ [*INTERVIEWER: PROBE IF UNCLEAR. RECORD VERBATIM RESPONSE*]													

[PROGRAMMER: REPEAT Q40 FOR EACH MEASURE IN MEASURE LIST. WHEN REPEATING, CALLERS CAN USE ABBREVIATED LANGUAGE (E.G.: “AND FOR THE INSULATION, HOW INFLUENTIAL WAS…”]

Spillover

Q41. Since receiving your rebate from Duke Energy for the **[LIST ALL SMART $AVER MEASURES],** have you purchased any other products or services to help save energy in your home?

1. Yes
2. No

-96. 98. I don't know

[If Q41= 1]
Q42. 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]

1. Installed energy efficient appliances
2. Moved into an ENERGY STAR home *[VERIFY:“Is Duke Energy still your gas or electricity utility?” Yes/No/I don’t know]*
3. Installed efficient heating or cooling equipment, including a Smart Thermostat
4. Installed efficient windows
5. Added insulation
6. Sealed air leaks in windows, walls, or doors
7. Sealed or insulated ducts
8. Installed LEDs
9. Installed an energy efficient water heater
10. None – no other actions taken [*EXCLUSIVE ANSWER*]

-96. 96. Other, please specify: ____________________
-97. 98. I don't know [*EXCLUSIVE ANSWER*]

[ASK IF Q42 1 THROUGH 9, 96]
Q43. Did you get a rebate from Duke Energy or another organization for any of those products or services? If so, which ones?

YES OR NO ANSWER

[LOGIC] Item
[IF Q42.1 IS SELECTED] 1. Installed energy efficient appliances
[IF Q42.2 IS SELECTED] 2. Moved into an ENERGY STAR home
[IF Q42.3 IS SELECTED] 3. Installed efficient heating or cooling equipment, including a Smart Thermostat
[IF Q42.4 IS SELECTED] 4. Installed efficient windows

[IF Q42.5 IS SELECTED] 5. Installed additional insulation
[IF Q42.6 IS SELECTED] 6. Sealed air leaks in windows, walls, or doors
[IF Q42.7 IS SELECTED] 7. Sealed or insulated ducts
[IF Q42.8 IS SELECTED] 8. Installed LEDs
IF Q42.10 IS SELECTED] 10. Installed an energy efficient water heater
[IF Q42.96 IS SELECTED] **[Q42 open ended response]**
I DID NOT GET ANY DUKE REBATES *[EXCLUSIVE ANSWER]*
98. DON'T KNOW *[EXCLUSIVE ANSWER]*

[ASK IF ANY ITEM IN Q42 WAS SELECTED]

Q44. On a scale of 0 to 10, where 0 means "not at all influential" and 10 means "extremely influential", how much influence did the **[LIST ALL SMART $AVER MEASURES]** Smart $aver program have on your decision to…

[MATRIX QUESTION: SCALE]

[LOGIC] Item	Response
[IF Q42.1 IS SELECTED] 1. Buy energy efficient appliances	0-10 scale with DK
[IF Q42.2 IS SELECTED] 2. Move into an ENERGY STAR home	0-10 scale with DK
[IF Q42.3 IS SELECTED] 3. Buy efficient heating or cooling equipment	0-10 scale with DK
[IF Q42.4 IS SELECTED] 4. Buy efficient windows	0-10 scale with DK
[IF Q42.5 IS SELECTED] 5. Buy additional insulation	0-10 scale with DK
[IF Q42.6 IS SELECTED] 6. Seal air leaks in windows, walls, or doors	0-10 scale with DK
[IF Q42.7 IS SELECTED] 7. Seal or insulate ducts	0-10 scale with DK
[IF Q42.8 IS SELECTED] 8. Buy LEDs	0-10 scale with DK
IF Q42.10 IS SELECTED] 10. Install an energy efficient water heater	0-10 scale with DK
[IF Q42.96 IS SELECTED] **[Q42 open ended response]**	0-10 scale with DK

[ASK IF Q42.1 IS SELECTED AND Q44.1 =NO]

Q45. What kinds of appliance(s) did you buy?

[Do not read list] [MULTIPLE RESPONSE]

1. Refrigerator
2. Stand-alone Freezer
3. Dishwasher
4. Clothes washer
5. Clothes dryer

6. Oven
7. Microwave
-96. 96. Other, please specify: ____________
-97. 98. Don't know
-98. 99. Refused

[ASK IF Q45 = 1-96]
Q46. Was the [INSERT Q45 RESPONSE] an ENERGY STAR or high-efficiency model?

[SINGLE RESPONSE]

1. Yes
2. No
-96. 98. I don't know
-97. 99.
-98. [REPEAT THIS QUESTION FOR EACH ITEM MENTIONED IN Q45]

[ASK IF 45 = 5]
Q47. Does the new clothes dryer use natural gas?

1. Yes - it uses natural gas
2. No – does not use natural gas
-96. 98. I don't know
-97. 99. Refused

[ASK IF Q42.3 IS SELECTED AND Q44.3 > 0]
Q48. What type of heating or cooling equipment did you buy?

[Do not read list] [MULTIPLE RESPONSE]

1. Central air conditioner
2. Window/room air conditioner unit
3. Wall air conditioner unit
4. Air source heat pump
5. Geothermal heat pump
6. Boiler
7. Furnace
8. Wi-Fi-enabled smart thermostat
-96. 96. Other, please specify: _______________
-97. 98. Don't know
-98. 99. Refused

[ASK IF Q48= 6-7]
Q49. Does the new [INSERT Q48 RESPONSE] use natural gas?

1. Yes - it uses natural gas

2. No – does not use natural gas
-96. 98. Don't know
-97. 99. Refused

[ASK IF Q48= 1-7, 96]
Q50. Was the [INSERT Q48 RESPONSE] an ENERGY STAR or high-efficiency model appliance?

[SINGLE RESPONSE]

1. Yes
2. No
-96. 98. I don't know
-97. 99.
-98. [REPEAT THIS QUESTION FOR EACH ITEM MENTIONED IN Q48, EXCLUDING Wi-Fi-enabled thermostat]

[ASK IF Q42.4 IS SELECTED AND Q44.4 =NO]
Q51. How many windows did you install?

1. [RECORD VERBATIM ________________]
98. Don't know
-96.

[ASK IF Q42.5 IS SELECTED AND Q44.5 =NO]
Q52. Did you add insulation to your attic, walls, or below the floor?

[Do not read list] [MULTIPLE RESPONSE]

1. Attic
2. Walls
3. Below the floor
-96. 98. I don't know
-97.

[ASK IF Q52<>98-99]
[PROGRAMMER: REPEAT Q53 FOR EACH ITEM MENTIONED IN Q52]
Q53. Approximately what proportion of the space did you add insulation? [ITEM MENTIONED IN Q52]

1. [RECORD VERBATIM AS % - INPUT MID-POINT IF RANGE IS OFFERED:] ________________[IF NEEDED: Your best estimate is fine]
98. Don't know

[ASK IF Q42.8 IS SELECTED AND Q44.8 =NO]

Q54. How many of LEDs did you install in your property?

1. [RECORD VERBATIM:] _______________[IF NEEDED: Your best estimate is fine]
98. I don't know

[ASK IF Q42.10 IS SELECTED AND Q44.10 =NO]

Q55. Does the new water heater use natural gas?

1. Yes - it uses natural gas
2. No – does not use natural gas
-96. 98. Don't know

[ASK IF Q42.10 IS SELECTED AND Q44.10 =NO]

Q56. Which of the following water heaters did you purchase? [read list]

1. A traditional water heater with a large tank that holds the hot water
2. A tinkles water heater that provides hot water on demand
3. A solar water heater
4. Other, please specify: _______________
-96. 98. I don't know

[ASK IF Q42.10 IS SELECTED AND Q44.10 =NO]

Q57. Is the new water heater an ENERGY STAR model?

[SINGLE RESPONSE]

1. Yes
2. No
-96. 98. Don't know

How Residents Search For Energy Efficiency Information

[ASK ALL]

Q58. Where do you typically search for information on how to save energy at your residence?

[MULTIPLE RESPONSE]

1. Online – read reviews about products
2. Go to utility website
3. Read my utility bill information – it has tips on how to save energy
4. Go to the store and talk to salespeople

5. Look for ENERGY STAR logo on products
6. Talk to trusted equipment vendor or contractor
-96. 96. Other, please specify: [OPEN-ENDED RESPONSE]
-97. 97. Not applicable – I don't typically search for information on how to save energy in my home/property
-98. 98. Don't know

Program Satisfaction and Challenges

The next few questions pertain to your satisfaction with the Smart $aver program.

[ASK ALL]

Q59. How satisfied were you with the rebate dollar amount for [**LAST PROJECT**]? Please use a 0 to 10 scale where 0 means "very dissatisfied," 5 means "neither satisfied nor dissatisfied," and 10 means "very satisfied." [SINGLE RESPONSE]

0.	0. Very dissatisfied
1.	1.
2.	2
3.	3
4.	4
5.	5. Neither satisfied nor dissatisfied
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Very satisfied
97.	N/A
98.	I don't Know

-96.

[ASK ALL]

Q60. How satisfied were you with how long it took to receive that rebate? Please use a 0 to 10 scale where 0 means "very dissatisfied," 5 means "neither satisfied nor dissatisfied," and 10 means "very satisfied." [SINGLE RESPONSE]

0.	0. Very dissatisfied
1.	1.
2.	2
3.	3
4.	4
5.	5. Neither satisfied nor dissatisfied
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Very satisfied
97.	N/A
98.	Don't Know

[ASK IF Q609<5 (Somewhat to Very Dissatisfied)]

Q61. Why did you give that rating? _________[RECORD VERBATIM]

[ASK ALL]

Q62. What was the form of payment in which you received your rebate?

1. Physical prepaid card
2. Digital prepaid card
96. Other: [RESPONSE BOX]
98. I don't know

Q63. How satisfied were you with the form of payment for the rebate amount (physical prepaid card, digital prepaid card, etc) you received? Please use a 0 to 10 scale where 0 means "very dissatisfied," 5 means "neither satisfied nor dissatisfied," and 10 means "very satisfied." [SINGLE RESPONSE]

0.	0. Very dissatisfied
1.	1.

2.	2
3.	3
4.	4
5.	5. Neither satisfied nor dissatisfied
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Very satisfied
97.	N/A
98.	Don't Know

[ASK IF Q672<5 (Somewhat to Very Dissatisfied)]

Q64. Why did you give that rating? _________[RECORD VERBATIM]

[ASK ALL]

Q65. In the course of participating in the Duke Smart $aver program, how often did you contact Duke Energy or program staff with questions?

[Do not read list] [SINGLE RESPONSE]

1. Never
2. Once
3. 2 or 3 times
4. 4 times or more

-96. 98. I don't know

[ASK IF Q62 = 2-4]

Q66. How did you contact them?

[MULTIPLE RESPONSE]

1. Phone
2. Email
3. Fax
4. Letter

5. In person
-96. 98. I don't know

[ASK IF Q65=2-4]

Q67. Using the 0 to 10 scale, how satisfied were you with these communications?

[SINGLE RESPONSE]

0.	0. Very dissatisfied
1.	1.
2.	2
3.	3
4.	4
5.	5. Neither satisfied nor dissatisfied
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Very satisfied
97.	N/A
98.	I don’t Know

[ASK IF Q676<5 (Somewhat to Very Dissatisfied)]

Q68. Why did you give that rating? _________[RECORD VERBATIM]

[ASK ALL]

Q69. Have you noticed any savings on your electric bill since the [**ALL MEASURES**] project?

[SINGLE RESPONSE]

1. Yes, I have noticed savings
2. No – I have looked but did not notice any savings
3. No - I have looked but it is too soon to tell
4. I haven’t look yet but plan to

5. I haven't looked yet and don't plan to
-96. 98. Don't know
-97.

[ASK IF Q69= Yes (if noticed savings)]

Q69_B. How satisfied are you with any savings you noticed on your electric bill since the [**ALL MEASURES**] project? [*INTERVIEWER NOTE: REPEAT SCALE IF NECESSARY: Please use a 0 to 10 scale where 0 means "very dissatisfied," 5 means "neither satisfied nor dissatisfied," and 10 means "very satisfied."*]

[SINGLE RESPONSE]

0.	0. Very dissatisfied
1.	1.
2.	2
3.	3
4.	4
5.	5. Neither satisfied nor dissatisfied
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Very satisfied
98.	Don't Know

[ASK ALL]

Q70. How satisfied are you with your [**ALL MEASURES**] project? [*INTERVIEWER NOTE: REPEAT SCALE IF NECESSARY: Please use a 0 to 10 scale where 0 means "very dissatisfied," 5 means "neither satisfied nor dissatisfied," and 10 means "very satisfied."*] [*INTERVIEWER NOTE: IF RESPONDENT SAYS 'TOO SOON TO TELL,' THEN FOLLOW UP WITH: "So would you say you are "Neither satisfied nor dissatisfied?" or you just don't know yet AND PROBE TO CODE*]

[SINGLE RESPONSE]

0.	0. Very dissatisfied
1.	1.
2.	2
3.	3
4.	4
5.	5. Neither satisfied nor dissatisfied
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Very satisfied
98.	I don't know

[ASK IF Q70<5 (Somewhat to Very Dissatisfied)]

Q71. Why did you give that rating?

1. [*RECORD VERBATIM*] _________
-96. 98. Don't know
-97. 99. Refused

[ASK ALL]

Q72. How satisfied are you with the interaction with the contractors who worked on the [**LAST PROJECT**] project? [*INTERVIEWER NOTE: REPEAT SCALE IF NECESSARY: Please use a 0 to 10 scale where 0 means "very dissatisfied," 5 means "neither satisfied nor dissatisfied," and 10 means "very satisfied."*]

[SINGLE RESPONSE]

0.	0. Very dissatisfied
1.	1.
2.	2
3.	3
4.	4

5.	5. Neither satisfied nor dissatisfied
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Very satisfied
98.	Don't Know

[ASK IF Q72< 5 (Somewhat to Very Dissatisfied)]

Q73. Why did you give that rating?

1. [*RECORD VERBATIM*] ________
-96. 98. Don't know
-97.

[ASK ALL]

Q74. If you were rating your overall satisfaction with the Duke Energy Smart $aver Rebate Program, would you say you were Very Satisfied, Somewhat Satisfied, Neither Satisfied nor Dissatisfied, Somewhat Dissatisfied, or Very Dissatisfied? [SINGLE RESPONSE]

1.	Very dissatisfied
2.	Somewhat dissatisfied
3.	3. Neither satisfied nor dissatisfied
4.	Somewhat satisfied
5.	Very satisfied
98.	Don't Know

[ASK IF Q747= 1,2]

Q75. Why do you give that rating? _________

[ASK ALL]

Q76. How satisfied you are with Duke Energy's overall performance as your electricity supplier? [*INTERVIEWER NOTE: REPEAT SCALE IF NECESSARY: Please use a 0 to 10 scale where 0 means "very dissatisfied," 5 means "neither satisfied nor dissatisfied," and 10 means "very satisfied."*]

[SINGLE RESPONSE]

0.	0. Very dissatisfied
1.	1.
2.	2
3.	3
4.	4
5.	5. Neither satisfied nor dissatisfied
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Very satisfied
98.	Don't Know
99.	Refused

Q77. Would you say that your participation in Duke Energy Smart $aver Rebate Program has had a positive effect, a negative effect, or no effect on your overall satisfaction with Duke Energy?

1. Negative effect
2. No effect
3. Positive effect

-96. 98. I don't know

Demographics/Property Characteristics

Finally, we will ask you some questions about yourself and the residence where the rebated work was done.

[ASK ALL]

Q78. Do you live at this residence where the work was performed?

1. Yes

2. No

[ASK IF Q78=2]

Q79. Are you a property manager or an owner of the residence where the work was performed?

1. Owner
2. Property manager
-96. 96. Other, please specify: [OPEN-ENDED RESPONSE]

[ASK IF Q78=1]

Q80. Do you own or rent this residence?

[SINGLE RESPONSE]

1. Own
2. Rent
-96. 98. I don't know
-97.

[ASK IF Q80=2]

Q81. Do you pay your own electric bill or is it included in your rent?

[Single RESPONSE] [*DO NOT READ*]

1. Pay own bill
2. Included in rent
-96. 98. I don't know
-97.

[ASK ALL]

Q82. Approximately when was this residence first built?

[SINGLE RESPONSE]

1. Before 1960
2. 1960-1969
3. 1970-1979
4. 1980-1989
5. 1990-1999
6. 2000-2009
7. 2010-2019

8. 2020-2021
98. I don't know
-96.

Q83. What would you estimate the residence square footage to be: [*READ LIST*]

[SINGLE RESPONSE]

1. less than 1,000 sq ft
2. 1,001-2,000 sq ft
3. 2,001-3,000 sq ft
4. 3,001-4,000 sq ft
5. 4,001-5,000 sq ft
6. Greater than 5,000 sq ft
-96. 98. Don't know

[ASK ALL]

Q84. What is the fuel source of the primary heating system at the residence?

[SINGLE RESPONSE]

1. Electricity
2. Natural Gas (not propane)
3. Liquid propane gas
4. Fuel Oil
5. Wood
6. Or something else, please specify: [Open-ended response]

[Do not read list]

-96. 98. I don't know

Q85. ASK IF AIR SOURCE HEAT PUMP OR GEOTHERMAL HEAT PUMP WAS NOT INSTALLED] What type of system do you use to heat your home? Please select all that apply. [Multiple response allowed]

1. Heat pump
2. Electric baseboard heaters
3. Natural gas furnace
4. Plug in space heaters
5. Cadet wall heaters
96. Other, please specify: [[OPEN-ENDED RESPONSE]
98. I don't know

[ASK IF CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP, OR GEOTHERMAL HEAT PUMP WAS NOT INSTALLED]

Q86. What type of system do you use to cool your home? Please select all that apply. [Multiple response allowed]

1. Central air conditioner

2. Heat pump
3. Room/window air conditioner
4. Evaporative/swamp cooler
5. I do not have any air conditioning in my home
96. Other, please specify: [[OPEN-ENDED RESPONSE]
98. Don't know

[ASK ALL]

Q87. The following are a list of income ranges. Please identify the range that includes your annual household income.

[SINGLE RESPONSE]

1. Less than $15,000
2. $15,000 to less than $25,000
3. $25,000 to less than $35,000
4. $35,000 to less than $50,000
5. $50,000 to less than $75,000
6. $75,000 to less than $100,000
7. $100,000 to less than $150,000
8. $150,000 to less than $200,000
6. $200,000 or more
98. Don't know

99. Prefer not to say

Q88. In what year were you born?

1. [NUMERIC RESPONSE – FIELD WIDTH =4, 1900-2003]

-96.
-97. 99. Prefer not to say
-98.

Q89. 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
-96. 98 Don't know
-97. 99. Prefer not to say

Q90. Do you feel the COVID-19 pandemic, or government or organizational responses to it, presented any challenges to you regarding your participation in the Smart $aver program? If so, what were these challenges, and how do you think they might best be addressed moving forward?

1 Yes: [OPEN-ENDED RESPONSE]
2 No
-96. 98 Don't know

[ASK ALL]

Q91. In closing, do you have any other suggestions on how to improve Duke Energy's Smart $aver Program?

1. [YES, RECORD VERBATIM] ________
2. No
-96. 98. Don't know

CLOSE:

On behalf of Duke Energy Indiana, thank you for your time in completing this survey. If you were one of the first 100 customers to complete the survey, you will receive a $5 gift card!

Have a great day!

Trade Ally Survey

Landing Page (Web)

Thank you for taking this survey! The survey covers your involvement in energy efficiency offerings available through Duke Energy and your experience and satisfaction with the Smart $aver program.

Interviewer Instructions / Introduction (Phone)

Hi, I'm ____ calling from Resource Innovations on behalf of Duke Energy Kentucky. May I speak with whomever is most knowledgeable about the rebated [MEASURE LIST] projects that your firm has done through the Duke Energy Smart $aver rebate program?

[*If needed:*] I need to speak with someone who is knowledgeable about the sales and installation process – which is typically an installer or a salesperson.

[*Once appropriate contact is on phone:*]

We want to get some feedback on how the Duke Energy Smart $aver program is working for your firm. This is your chance to tell us what is working well, what isn't, and how Duke Energy can improve the program to better serve you and your customers. Is this a good time to talk?

[*If needed:*]

- The survey takes about 10-15 minutes, depending on how much you have to say.
- If now isn't a good time, when could I call you back?

Please note that this call may be monitored or recorded for quality assurance purposes. Rest assured, your answers will be confidential and not tied to you or your firm.

Building information and screening

What residential project types does your firm primarily focus on: new construction homes, existing homes, or both?

3. Existing homes
4. New construction projects
5. Both

-97. 98. Don't know
-98.

How many locations does your company have?

6. One
7. Two
8. Three
9. Four
10. Five
11. More than five: Specify: __________
98. Don't Know

For the questions in this survey, we would like to focus primarily on the Duke Energy Kentucky territory. Are you able to answer questions regarding the work associated with this area?

12. Yes [CONTINUE]
13. No [*Ask to forward survey link to co-worker that can*]
98. Don't know [*Ask to forward survey link to co-worker that can]*

Sources of Program Awareness

Q1. How did you originally hear about Duke Energy Kentucky Smart $aver rebate offerings?

1. Word-of-mouth (co-worker, another contractor)
2. Duke Energy website
3. Duke Energy program representative
4. TV/Radio/Newspaper/Billboard Ad
5. Event (home show, workshop, etc.)

96. Other, please specify:_______________

-96. 98. Don't know

Q2. How do you stay engaged with the Smart $aver program? [Allow multiple answers]

1. Newsletters or other program marketing
2. Trade Ally portal
3. Coordination with program staff
4. Program website
5. Other, specify:___________
6. None
7. Don't know

Nonparticipant Spillover

The next set of questions ask about the work your company did specifically during the time period from May 1st, 2020, to April 30th, 2021.

[START LOOP – LOOP THROUGH TOP THREE MOST INSTALLED MEASURE TYPES THAT TRADE ALLY INSTALLED during May 1st, 2020, to April 30th, 2021.]

Q3. Our records show your company performed [**MEASURE TYPE**] between May 1st 2020 to April 20, 2021. Is this correct?

1. Yes [continue to Q4]
2. No [Ask Q3 again with next measure type]

Q4. During this time period, approximately how many **[MEASURE]s** did your company install at ALL locations (in and outside of Duke Energy Kentucky territory combined)?

1. [Integer response]

Q5. Of these [pipe in answer from Q4] installations, about what percentage were completed <u>within</u> Duke Kentucky territory?

1. [Record % response]

Q6. During this time period, of all the [Q4 integer x Q5%] **[MEASURE]** projects that your company completed in Duke Kentucky territory, about what percentage would have qualified for a Smart $aver rebate?

1. [Record % response]

Q7. Of all these [Q4 integer x Q5% x Q6%] Duke rebate-qualified [MEASURE] projects, about what percent did you actually apply for Smart $aver rebates?

[Record % response]

Q8. For the roughly [Q4 x (100% - Q5%)] [MEASURE]s installed outside of Duke territory, about what percentage would you say would have qualified for Duke Incentives?

1. [Record % response]

Q9. [Ask only if Q8 >0%] Of these [MEASURES] installed outside of Duke's territory but would have qualified for a Duke incentive, what percentage did receive an incentive from another utility?

1. [Record % response]

Q10. For those Duke territory and rebate-qualified projects where you did not apply for Smart $aver rebates,

1. What are the reasons that this happens? _______________
2. And what could Duke Energy do to address these issues? _____________

Q11. During this time period, for completed and Duke rebated [**MEASURE**] projects, about what percentage of your customers specifically requested the **[MEASURE]** on their own and were not influenced by your recommendation?

1. [*Record percent*]

Q12. Using a 0 to 10 scale, where 0 is "not at all influential" and 10 is "extremely influential," how much influence has the Duke Smart $aver program had on your business practice of recommending rebate-qualifying [**MEASURE**]s to your customers?

[SINGLE RESPONSE]

0. Not at all influential
1.
2.
3.
4.

5.
6.
7.
8.
9.
10. Extremely influential

Q13. During this time period, for completed and rebated [**MEASURE**] projects, about what percentage of your customers were replacing working equipment early versus replacing a non-functioning item?

1. Early replacement of functioning equipment [*Record percent*]
2. Replacement of non-functioning equipment [*Record percent*]

Q14. During this time period, for completed and rebated [**MEASURE**] projects, about what was the average age of the units you replaced?

1. Average age:

[END LOOP]

Program Influence and Effects on TAs

Q15. During the time period of May 1st, 2020, to April 30th, 2021, how often did your customers ask about the Duke Energy rebates before you've had the chance to bring them up?

1. Never
2. Rarely
3. Occasionally
4. Frequently
5. Always
98. Don't know

[BASE: TRADE ALLIES THAT INSTALLED AIR SOURCE HEAT PUMPS, CENTRAL AIR CONDITIONERS, GEOTHERMAL HEAT PUMPS, VARIABLE SPEED POOL PUMPS, OR HEAT PUMP WATER HEATERS]

Q16. Thinking back to before you were involved in the Smart $aver program, how often did you recommend higher efficiency equipment that uses less energy than standard models to your customers? Would you say none of the time, some of the time, most of the time, or every time?

[SINGLE RESPONSE]

1. None of the time
2. Some of the time
3. Most of the time
4. Every time

-96. 97. Not applicable – I've been involved with the Duke program since starting in the industry/this company
-97. 98. Don't know

-99. [BASE: TRADE ALLIES THAT INSTALLED AIR SOURCE HEAT PUMPS, CENTRAL AIR CONDITIONERS, GEOTHERMAL HEAT PUMPS, VARIABLE SPEED POOL PUMPS, OR HEAT PUMP WATER HEATERS]
Q17. And what about now? How often did you recommend higher efficiency equipment that uses less energy than standard models to your customers

[SINGLE RESPONSE.]

1. None of the time
2. Some of the time
3. Most of the time
4. Every time
98. Don't know

-97.
-98.
Q18. Would you say your knowledge of energy efficient products and services has increased, decreased, or stayed about the same since you became involved with the Smart $aver program?

[SINGLE RESPONSE]

1. Increased
2. Decreased
3. Stayed about the same
-96. 98. Don't know

-97.
-98. [ASK IF Q18=1]
Q19. Using a 0 to 10 scale, where 0 is "not at all influential" and 10 is "extremely influential," how much influence has the Smart $aver program had on your increased knowledge of energy efficient products and services?

[SINGLE RESPONSE]
0. Not at all influential

1.
2.
3.
4.
5.
6.
7.
8.
9.
10. Extremely influential
-96. 98. Don't know

-97.

Q20. How have your equipment stocking practices changed, if at all, after participating in the Smart $aver program?

1. [OPEN-ENDED RESPONSE]
2. 98. Don't know

Challenges and Suggestions for Improvement

Q21. What energy efficient products, technologies, or services do you feel should be added to the Duke Energy rebate program? [MULTIPLE RESPONSE, Randomize Order]

1. Modulating furnaces
2. Heat recovery ventilation (HRV) systems
3. Boilers
4. Furnaces equipped with electronically commutated motors (ECMs)
5. Mini-split heat pumps
6. Multi-split heat pumps
7. Tankless water heaters
8. Humidifiers
9. Air handlers
10. Windows
11. Doors
12. No others should be added

-96. 96. Other, please specify: [OPEN-ENDED RESPONSE]
-97. 98. Don't know
-98.
-99.

An enhanced Rebate Application Entry and Tracking platform was launched on March 1st, 2021. Please answer the next set of questions about your experience *before* this new platform.

-100.

Q22. From May 1st, 2020, to April 30th, 2021, have you experienced problems or frustrations with the rebate application process?

1. Never
2. Rarely
3. Occasionally
4. Frequently
5. Always

98. Don't know

-97.
-98.
-99.

-100. [ASK IF Q22=2-5]

Q23. What types of problems or frustrations did you experience with the rebate application process?

1. [*Record response*]
98. Don't know

[ASK IF Q22=2-5]

Q24. Overall, have these problems with the rebate application process persisted or gotten better over time?

1. Persisted
2. Gotten somewhat better, or
3. Have been completely resolved at this point

-96. 98. Don't know

Q25. Now, thinking about the enhanced Rebate Application Entry and Tracking platform was launched on March 1st, 2021, have you had any challenges with this platform?

1. Yes
2. No
98. Don't know

Q26. [Q26=1] What challenges did you experience, and do you have any suggestions on how Duke Energy can further improve this platform?

1. [Record response]
98. Don't know

Q27. Do you have any suggestions on how Duke Energy can improve the rebate application process?

1. [*Record response*]
98. Don't know

Q28. Do you have any suggestions on how Duke Energy can improve the project inspection process?

1. [*Record response*]
98. Don't know

Q29. Do you feel there other processes not described thus far that are critical to your program participation experience, and if so, do you have any suggestions on how Duke Energy can improve them?

1. [*Record response*]
98. Don't know

Satisfaction

Thanks for your feedback so far, next are some questions about your satisfaction with the Smart $aver program.

Q30. Please rate the extent to which you are satisfied with the following aspects of the program using a 0 to 10 scale where 0 means "very dissatisfied," 5 means "neither satisfied nor dissatisfied," and 10 means "very satisfied." How satisfied are you with:

A	Program training offered by Duke Energy
B	Your Duke Energy Trade Ally Representative
C	The program website for customers
D	The trade ally portal application tracking system
E	The marketing of the program
F	The incentive application submission process
G	The selection of eligible equipment and services
H	The overall program

[SINGLE RESPONSE ON EACH A-H ITEM]

0.	0. Very dissatisfied
1.	1.
2.	2
3.	3
4.	4
5.	5. Neither satisfied nor dissatisfied
6.	6.
7.	7.
8.	8.
9.	9.

10.	10. Very satisfied
97.	N/A
98.	Don't Know
99.	Refused

[PROGRAMMER'S NOTE: REPEAT Q30 FOR EACH STATEMENT FROM Q29 WHERE Q29<5]

Q31. Please explain why you were dissatisfied with [**INSERT STATEMENT FROM Q29 A-H**]:

1. [*Record response*]
98. Don't know

Wrap-up

Q32. Do you have any other feedback you would like to provide about the Smart $aver Program?

1. [*Record response*]

CLOSE:

Thank you for your time in completing this survey.

Your responses have been recorded.

Have a great day!

Appendix E Participant Demographics

	DEK	
Home type	**%**	**n**
Single-family detached	81%	44
Manufactured or mobile home	0%	0
Row house or townhouse or condo	9%	5
Apartment or condo 4 units or more	6%	3
Other	4%	2
Home size	**%**	**n**
Less than 1,000 square feet	2%	1
1,001 to under 2,000 square feet	48%	26
2,001 to under 3,000 square feet	33%	18
3,001 to under 4,000 square feet	7%	4
4,001 to under 5,000 square feet	4%	2
Greater than 5,000	0%	0
I don't know	6%	3
Ownership Status	**%**	**n**
Own	100%	54
Rent	0%	0
Fuel source type	**%**	**n**
Electric	39%	21
Natural Gas	59%	32
Other	2%	1
Year residence was built	**%**	**n**
Before 1960	15%	8
1960-1969	11%	6
1970-1979	9%	5
1980-1989	17%	9
1990-1999	17%	9
2000-2009	28%	15
2010-2019	4%	2
2020-2021	0%	0
I don't know	0%	0
Household Income	**%**	**n**
Under $15,000	0%	0
15 to under $25,000	0%	0
25 to under $35,000	2%	1
35 to under $50,000	13%	7

	DEK	
50 to under $75,000	17%	9
75 to under $100,000	20%	11
100,000 to under $150,000	17%	9
150 to under $200,000	6%	3
$200,000 or more	11%	6
I don't know	0%	0
Prefer not to say	15%	8
Education Level	**%**	**n**
Less than high school	0%	0
Some high school	0%	0
High school graduate or equivalent (such as GED)	15%	8
Trade or technical school	9%	5
Some college (including Associate degree)	15%	8
College degree (Bachelor's degree)	31%	17
Some graduate school	6%	3
Graduate degree, professional degree	17%	9
Doctorate	6%	3
I don't know	0%	0
Prefer not to say	2%	1

EM&V Report for the Duke Energy Multifamily Energy Efficiency Program

Prepared for:

Duke Energy Kentucky

FINAL

January 30, 2024

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1. Evaluation Summary

1.1 Program Summary

The Multifamily Energy Efficiency Program is a direct install program offering efficient lighting and water products free of charge to Duke Energy customers in the multifamily sector. The program is delivered through coordination between Duke Energy (or Franklin Energy, the program implementation contractor) and property managers or owners at qualifying multifamily sites. The program consists of the following lighting and water measures.

- **Lighting Measures[1]:** Light-emitting diode (LED) bulbs installed in permanent fixtures, including A-line, candelabra and globe lights.
- **Water Measures:** Low flow bathroom and kitchen faucet aerators, water-saving showerheads, and water heater pipe insulation wrap are installed to reduce electric energy used for water heating.

All direct installations are overseen by Franklin Energy. Third party quality control inspections are completed on twenty percent of properties in any given month. The quantities of units that are inspected at each property are dependent upon the property size. Overall, at year end, at least five percent of all completed units must be inspected.

1.2 Evaluation Objectives and Methods

Guidehouse's evaluation included an independent assessment of program impacts and performance for participation that occurred in the Duke Energy Kentucky (DEK) jurisdiction between August 1, 2019 and December 31, 2022[2]. For this Evaluation, Measurement, and Verification (EM&V) effort, Guidehouse used an engineering-based approach to calculate program impacts, similar to previous evaluation cycles with some differences pertaining to data collection activities. Guidehouse conducted onsite field verification as part of the evaluation effort for this program to gather the information necessary to confirm program measure implementation and to inform the engineering algorithms used to estimate program impacts. The sampling procedure was updated to reflect the current mix of program measures, facility characteristics and data collection activities. 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
- **Net-to-Gross evaluation:** To assess the net-to-gross ratio

[1] With the U.S. Department of Energy (DOE) expanding the definition of general service lamps and finalizing new, more stringent efficiency requirements (45 lumens per Watt) for these lamps effective, respectively, on July 8 and July 25, 2022, the program does not plan to claim to any savings from lighting measure installations during this evaluation period.

[2] The program suspended operations in March 2020 through September 2021 in response to the COVID-19 pandemic and hence the program tracking data did not include any participation during this period.

By performing both impact and process components of the EM&V effort, Guidehouse 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.

1.3 Evaluation Parameters and Sample Period

To accomplish the evaluation objectives, Guidehouse performed an engineering review of measure savings algorithms, onsite field verification to assess installed quantities and measure characteristics, as well as surveys with tenants and property managers to assess satisfaction, decision-making processes and the net-to-gross ratio. The evaluated parameters are summarized in Table 1-1. For onsite field verification, the target sampling confidence and precision was 90 percent ± 10 percent and the achieved was 90 percent ± 16.8 percent.

Table 1-1. Evaluated Parameters

Evaluated Parameter	Description	Details
Efficiency Characteristics	Inputs and assumptions used to estimate energy and demand savings	1. Aerator flow rates 2. Showerhead flow rates 3. Water temperature
In-Service Rates	The percentage of program measures in use as compared to reported	1. Aerator, and showerhead quantities 2. Water heater pipe insulation length
Satisfaction	Customer satisfaction	1. Satisfaction with program 2. Satisfaction with measures 3. Satisfaction with contractor
Free Ridership	Fraction of reported savings that would have occurred, even in the absence of the program	1. Property manager surveys
Spillover	Additional, non-reported savings that occurred as a result of participation in the program	1. Property manager surveys 2. Tenant phone surveys

Source: Guidehouse

This evaluation covers participation from August 1, 2019 through December 31, 2022 for all measures. The program suspended operations in March 2020 through September 2021 in response to the COVID-19 pandemic and hence the program tracking data did not include any participation during this period. Thus, the evaluation effectively covers participation from August 1, 2019 through March 30, 2020 and September 1, 2021 through December 31, 2022. Table 1-2 shows the start and end dates of Guidehouse's EM&V data collection activities for this evaluation.

Table 1-2. EM&V Activity Period Start and End Dates

Activity	Start Date	End Date
Onsite Field Verification	7/12/2023	7/12/2023
Tenant Phone Surveys	4/25/2023	4/28/2023
Property Manager Surveys	4/25/2023	7/21/2023

Source: Guidehouse

1.4 Program Level Findings

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

For the evaluation period covered by this report, there were a total of 312 housing units at 4 participating properties. The program-level evaluation findings are presented in Table 1-3 and Table 1-4. Guidehouse 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.

Guidehouse found the net-to-gross (NTG) ratio to be 0.98, meaning that for every 100 kWh of reported energy savings, 98 kWh can be attributed directly to the program. Guidehouse calculated the net energy and demand impacts by multiplying the gross energy and demand impacts by the NTG ratio. These findings will be discussed in greater detail throughout this report.

Table 1-3. Program Claimed and Evaluated Gross Energy and Demand Impacts

DEK Gross Impacts	Claimed	Evaluated	Realization Rate
Energy Savings (MWh)	138	134	97%
Summer Peak Demand Savings (kW)	8.3	8.0	96%
Winter Peak Demand Savings (kW)	8.3	8.0	96%

Source: Guidehouse analysis, values subject to rounding.

Table 1-4. Program Evaluated Net Energy and Demand Impacts

DEK Net Impacts	Evaluated
Energy Savings (MWh)	132
Summer Peak Demand Savings (kW)	7.8
Winter Peak Demand Savings (kW)	7.8

Source: Guidehouse analysis, values subject to rounding.

1.5 Evaluation Considerations and Recommendations

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

1. Guidehouse recommends that Duke Energy should adopt the per unit ex post energy and demand impacts from this evaluation and use them going forward.
2. Duke Energy should consider requiring quality assessment and quality control (QA/QC) activities for the program be conducted in-person rather than over the phone. This will

result in increased rigor for inspections and will allow for consistent confirmation of installed measures with early identification of any issues that can be corrected for in subsequent tracking data reports.

3. Duke Energy should continue tracking additional existing energy efficiency opportunities (not offered through this program) at participating properties and consider channeling them through other applicable programs that offer those measures by sharing relevant leads internally.
4. Guidehouse recommends that Duke Energy continue to ensure that all participating tenant units are consistently provided with a handout that includes a summary of all the equipment replaced at their unit through the program along with any other relevant leave behinds. This will be especially important once the smart thermostat measure is added as a program offering for this jurisdiction, since the measure specific leave behind will help the tenants easily set up and use their new thermostat.
5. Guidehouse recommends that Franklin Energy include an identifier in the tracking data to help distinguish between the length of pipe wrap on hot and cold water pipes installed as part of the water heater pipe insulation measure.

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 property owner.

Duke Energy's Multifamily Energy Efficiency Program provides energy efficient lighting and water equipment at no cost to Duke Energy customers in the multifamily sector. The program is delivered through coordination with property managers/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 the following measures.

- **Lighting Measures:** Light-emitting diode (LED) bulbs installed in permanent fixtures, including A-line, candelabra, and globe lights.

- **Water Measures:** Low flow bathroom and kitchen faucet aerators, water-saving showerheads, and water heater pipe insulation wrap installed to reduce energy used for electric water heating.

2.2 Implementation

Franklin Energy is the implementation contractor for the program and coordinates recruiting and measure installation. Recruiting methods include primary outreach by energy advisors to identify properties, property managers, or property management companies likely to participate.

When the energy advisors have identified properties with an interest in the program, Franklin Energy then sends an outreach team 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.

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 program installation crew requires a representative from the property management team (the property manager or a facilities or maintenance personnel) to escort them around the property and allow access to the tenant units during installation and hence the installations are highly reliant on and must be scheduled based on the availability of the staff at the property. Once scheduled, the installation crew performs the work 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 Guidehouse for evaluation purposes.

Franklin Energy uses internal quality assurance (QA) and quality control (QC) procedures to ensure consistent measure installation. During installation, a Franklin Energy supervisor may accompany installation crews to ensure quality work. Post installation, an independent dedicated QA/QC team, conducts inspections on a least five percent of total 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 addresses the discrepancies, and subsequently updates the tracking data to reflect the QC findings. Franklin Energy then presents the tracking data to Duke Energy, and Duke Energy subsequently provides the data to Guidehouse for EM&V.

3. Evaluation Research Objectives and Methods

3.1 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. Evaluation objectives include the following:

1. **Impact evaluation:**
    a. Verify deemed savings estimates through review of measure assumptions and calculations.
    b. Perform onsite field verification of measure installations and collect data for use in an engineering analysis.
    c. Estimate the gross and net energy and peak demand savings (both summer and winter) by measure via engineering analysis.

2. **Net-to-Gross Analysis:**
    a. Assess the Net-to-Gross ratio by addressing free-ridership via property manager phone or online surveys and spillover via property manager and tenant surveys.

3. **Process evaluation:**
    a. Conduct phone interviews with program management and implementation contractor(s) to collect data for use in process analysis.
    b. Administer property manager phone or online surveys[3] to collect data for use in process analysis. Evaluate the strengths and weaknesses of current program processes and customer perceptions, with special consideration for effects of the COVID-19 pandemic.
    c. Administer tenant survey via phone to a sample of tenants in participating multifamily units to understand tenant program satisfaction, spillover, and COVID-19 impacts.

3.2 Evaluation Methods

Guidehouse'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) and to collect data to inform the engineering algorithms used to estimate program impacts
3. Net-to-gross (NTG) analysis (discussed in Section 5).

[3] The same survey was used to assess Net-to-Gross impacts as well.

3.2.1 Overview of Impact Methodology

3.2.1.1 Detailed Review of Ex Ante Deemed Savings

Guidehouse reviewed the ex-ante savings and supporting documentation used to estimate ex ante program impacts. For all measures, Duke Energy indicated that the deemed energy and demand impacts for this program are equivalent to the verified impacts from the most recent EM&V report, which was completed by Guidehouse in 2019.[4] The deemed ex ante savings for water measures are shown in Table 3-1 below.

Table 3-1. Deemed Ex Ante Savings for Water Measures

Measure	Unit Basis	Annual Gross Energy Savings (kWh)	Summer Coincident Demand Savings (kW)	Winter Coincident Demand Savings (kW)
Bathroom Aerator – 1.0 GPM	Per aerator	34.27	0.0030	0.0030
Kitchen Aerator – 1.0 GPM	Per aerator	138.62	0.0091	0.0091
Showerhead – 1.5 GPM	Per showerhead	307.15	0.0136	0.0136
Water Heater Pipe Insulation	Per linear foot	17.54	0.0020	0.0020

Source: Duke Energy Multifamily EMV Report DEK December 26, 2019 – Table 17 and Table 18

The deemed ex ante savings for the water measures are calculated using the following algorithms from the 2015 Indiana Technical Reference Manual (TRM) for energy and coincident demand savings.

Equation 1. Energy Savings Algorithms for Aerator Measures

$$kWh\ Savings = ISR * (GPM_{BASE} - GPM_{LOW}) * MPD * \frac{PH}{FH} * DR * 8.3 * (T_{MIX} - T_{IN}) * \frac{365}{RE * 3{,}412}$$

Equation 2. Energy Savings Algorithms for Showerhead Measure

$$kWh\ Savings = ISR * (GPM_{BASE} - GPM_{LOW}) * MS * SPD * \frac{PH}{SH} * 8.3 * (T_{MIX} - T_{IN}) * \frac{365}{RE \times 3{,}412}$$

Equation 3. Demand Savings Algorithms for Aerator and Showerhead Measures

$$kW\ Savings = ISR * (GPM_{BASE} - GPM_{LOW}) * 60 * DR * 8.3 * \frac{(T_{MIX} - T_{IN})}{RE * 3{,}412} * CF$$

[4] Duke Energy Multifamily EMV Report DEK, December 26, 2019.

Equation 4. Energy Savings Algorithms for Water Heater Pipe Insulation Measure

$$kWh\ Savings = ISR * \left(\frac{1}{R_{EXIST}} - \frac{1}{R_{NEW}}\right) * \frac{L * C * \Delta T * 8760}{\eta_{DHW} * 3412}$$

Equation 5. Demand Savings Algorithms for Water Heater Pipe Insulation Measure

$$kW\ Savings = \frac{kWh\ Savings}{8760}$$

Where the parameters are defined as:

ISR – In-Service rate
GPM_{BASE} – Gallons per minute of baseline faucet aerator or showerhead
GPM_{LOW} – Gallons per minute of low-flow faucet aerator or showerhead
MPD – Average minutes of faucet user per person per day
PH – Average number of people per household
FH – Average faucets per household
365 – Days faucet or showerhead used per year
DR – Percentage of water flowing down drain
8.3 – Specific weight of water in pounds per gallon multiplied by the specific heat of water $(1.0\frac{Btu}{lb°F})$
T_{MIX} – Mixed water temperature exiting faucet
T_{IN} – Cold water temperature entering the DWH system
RE – Recovery efficiency of electric hot water heater
3412 – Constant to convert Btu to kWh
Hours – Average number of hours per year spent using faucet or showerhead
CF – Coincidence factor
MS – Average minutes per shower event
SPH – Average number of shower events per person per day
SH – Average number of showerheads per household
R_{EXIST} – Pipe heat loss coefficient (R-value) of existing uninsulated piping
R_{NEW} – Pipe heat loss coefficient (R-value) of existing pipe plus installed insulation
L – Feet of pipe from water heating source covered by pipe wrap
C – Circumference of pipe in feet
ΔT – Average temperature difference between water in pipe and ambient air temperature
8760 – Hours per year
η_{DHW} – Recovery efficiency of electric hot water heater

The impact parameters used in the calculation of deemed ex ante savings for the bathroom faucet aerator, kitchen faucet aerator and low flow showerhead measures are shown in Table 3-2, while the parameters for the water heater pipe wrap measure are shown in Table 3-3.

Table 3-2. Impact Parameters Used in the Deemed Ex Ante Savings from Prior Evaluation – Aerator and Showerhead Measures

Parameter	Bath Aerator – 1.0 GPM	Kitchen Aerator – 1.0 GPM	Showerhead – 1.5 GPM	Source
ISR	0.931	0.949	0.974	Guidehouse (then Navigant) field verification and phone surveys
GPM_{BASE}	2.00	2.20	2.50	Data Provided by Duke Energy from Franklin Energy Sample
GPM_{LOW}	1.00	1.00	1.50	Guidehouse field verification[a]
MPD	1.60	4.50	NA	2015 Indiana TRM
PH	1.83	1.83	1.83	2015 Indiana TRM
FH	1.29	1.00	NA	Guidehouse field verification
DR	0.70	0.50	1.00	2015 Indiana TRM
T_{MIX}	86.00	93.00	101.00	2015 Indiana TRM
T_{IN}	60.36	60.36	60.36	Building America Benchmark annual mains temperature for Cincinnati
MS	NA	NA	7.80	2015 Indiana TRM
SPD	NA	NA	0.60	2015 Indiana TRM
SH	NA	NA	1.00	Guidehouse field verification
RE	0.98	0.98	0.98	2015 Indiana TRM
Summer CF	0.0012	0.0033	0.0023	2015 Indiana TRM
Winter CF	0.0012	0.0033	0.0023	2015 Indiana TRM

a. Guidehouse 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.

Source: Duke Energy Multifamily EMV Report DEK December 26, 2019 – Table 16

Table 3-3. Impact Parameters Used in the Deemed Ex Ante Savings from Prior Evaluation – Water Heater Pipe Insulation Measure

Parameter	Pipe Wrap	Source
ISR	0.944	Guidehouse field verification and phone surveys
R_{EXIST}	1.00	2015 Indiana TRM

Parameter	Pipe Wrap	Source
R_{NEW}	3.00	2015 Indiana TRM
L	1	Savings are calculated per linear foot
C	0.16	Assumed as average of 0.5" and 0.75" diameter pipe
ΔT	65	2015 Indiana TRM
η_{DHW}	0.98	2015 Indiana TRM

Source: Duke Energy Multifamily EMV Report DEK December 26, 2019 – Section 4.3.3

3.2.1.2 Onsite Field Verification

Guidehouse conducted onsite field verification at 19 tenant units across two properties. Field verification efforts were designed to evaluate the consistency of measure characteristics with the program tracking database and to assess measure parameters that can be used to verify inputs and assumptions used to estimate energy and demand savings for the individual water measures in the program.

Table 3-4 shows a summary of the parameters assessed by Guidehouse during field verification.

Table 3-4. Parameters Evaluated During Field Verification

Parameter	Faucet Aerators	Showerheads	Water Heater Pipe Insulation
Installed quantity	x	x	x
Flow rates (GPM)	x	x	
Water heating system characteristics	x	x	x
Pipe length			x
Pipe diameter			x
Water temperature	x		
Measure location	x	x	
Baseline information (where available)	x	x	x

Source: Guidehouse analysis

Table 3-5 shows the target number of program measures in the sample to achieve a 90/10 confidence and precision target at the program level. Guidehouse developed these targets based on prior experience evaluating this program. The target completes indicate the minimum number of measures that Guidehouse planned to assess via the onsite field verification. A total of 19 tenant units were inspected, which represented 77 program measures. Table 3-5 also shows the distribution of the target and achieved representation for each measure.

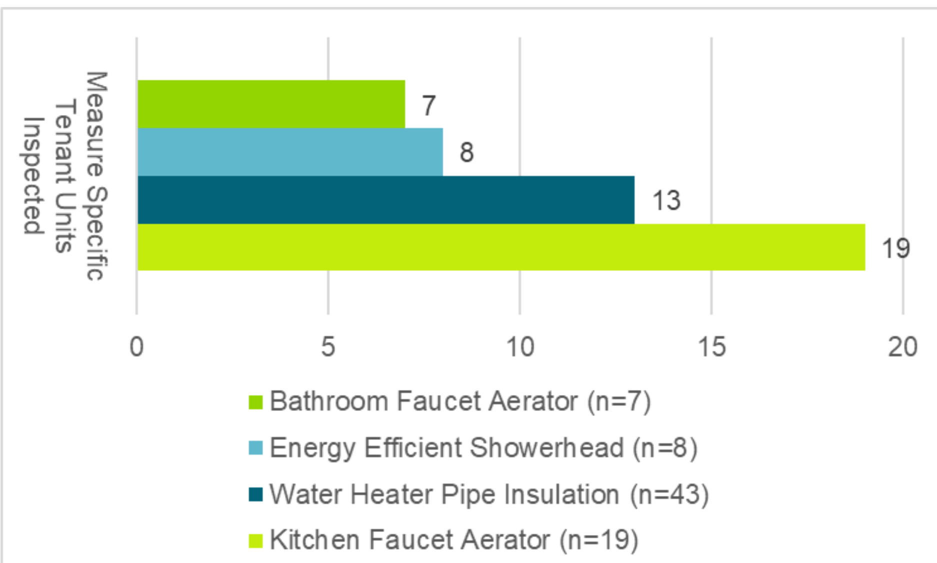
Table 3-5. Field Verification – Target Completes and Completes Achieved

Measure	Unit Basis	Total Count Tracking Data	Target Measures in Sample	Number of Housing Units in Sample	Number of Measures Reported in Sample
Bath Aerator	Aerator	110	20	7	7
Kitchen Aerator	Aerator	277	20	19	19
Showerhead – 1.5 GPM	Showerhead	257	20	8	8
Water Heater Pipe Insulation	Linear Feet	981	30	13	43
Total		**1,625**	**100**	**19**	**77**

Source: Guidehouse analysis

Figure 1 shows the distribution of completed onsite field verification by program measure. The magnitude of each bar indicates the number of inspected tenant units for each measure, and the values in parenthesis indicate the number of measures represented by the inspected units. If a tenant unit received multiple measures, all measures at the site were inspected as part of the field verification.

Figure 1. Field Verification – Measure Level Summary



Source: Guidehouse analysis

3.2.2 Overview of Net-to-Gross Methodology

As indicated in the evaluation plan, Guidehouse used a survey-based, self-report methodology to estimate free ridership and spillover for the program. A self-report approach is outlined in the

Universal Methods Protocol (UMP) as an acceptable NTG methodology. Guidehouse primarily targeted property managers for the NTG surveys because they are the decision makers for participation in the program.[5] Guidehouse also incorporated supplemental data gathered during tenant phone surveys into the analysis.

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

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

Equation 6. Net-to-Gross Algorithm

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

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.

3.2.2.2 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

[5] Guidehouse 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.

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.[6] Guidehouse then calculated a weighted average from each respondent based on their share of sample energy

[6] Scores were calculated by the following formulas:

- Likelihood: The overall likelihood score is calculated by multiplying the scores for the likelihood that the participant would have installed the same energy efficient equipment and the likelihood that the participant would have installed the same quantity of the same measures without the program's financial and technical assistance. 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, what is the likelihood that you would have installed the same equipment without the program?"
- Prior Planning: If participants stated they had considered installing energy efficient equipment prior to program participation, then the prior planning score is their answer to the following question: "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." The overall prior planning score was then calculated as a weighted average of their response to this question for both the lighting and water equipment.
- Program Importance: This score was calculated by taking the response to the following question "Please rate your agreement with the following statement: My decision to install energy efficiency equipment at my property was largely

savings and divided by 10 to convert the scores into a free ridership percentage. Next, a timing multiplier was applied to the average of the three scores to reflect the fact that respondents indicating that their energy efficiency actions would not have occurred until far into the future may be overestimating their level of free ridership. Participants were asked when they would have installed the equipment without the program. Respondents who indicated that they would not have installed the equipment for at least two years were not considered free riders and received a timing multiplier of 0.[7] 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.

3.2.2.3 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 Guidehouse estimated the energy spillover savings on a case-by-case basis.

It is important to note that although free ridership questions were only asked of property managers, Guidehouse surveyed both property managers and tenants for spillover.[8]

3.2.2.4 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.

motivated by Duke Energy's program” on a scale of 0-10 and subtracting from 10 (i.e., the higher the program importance, the lower the influence on free ridership).

[7] Guidehouse 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.

[8] 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 Guidehouse 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.

- The program as a whole, by taking a weighted average of the individual results based on each respondent's share of reported energy savings.

3.2.2.5 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. Guidehouse completed two property manager surveys. This sample represents about forty percent of the total reported energy savings, as shown in Table 3-6.

Table 3-6. Property Manager Sample Representation

Measure Category	Program Total Reported Energy Savings (kWh)	Sample Total Energy Savings (kWh)	% Share of Program
Bathroom Aerator	3,769	2,604	69%
Kitchen Aerator	38,399	19,269	50%
Showerhead	78,939	27,951	35%
Water Heater Pipe Insulation	17,208	7,279	42%
Total	**138,314**	**57,104**	**41%**

Source: Guidehouse analysis, values subject to rounding

3.2.3 Overview of Process Methodology

3.2.3.1 Tenant Surveys

Guidehouse conducted phone surveys with 7 residential tenants to assess program satisfaction. The surveys contained several questions to assess satisfaction with program participation, satisfaction with new equipment, questions to assess measures removed by the tenant after participation and tenant spillover. Also included in the survey were questions to assess the impacts of COVID-19 on energy consumption at tenant units.

3.2.3.2 Property Manager Surveys

Guidehouse completed surveys with property managers for two of the four participating properties. The completed surveys represented over 700 measures or 41 percent of the program reported energy savings. The survey included a number of questions to assess participation experience and satisfaction, satisfaction with new equipment, as well as questions to assess free ridership and spillover. Also included in the survey were questions to assess the impacts of COVID-19 on different aspects of property management activities including energy use.

3.2.3.3 Interviews with Duke Energy Program Manager and Franklin Energy

Guidehouse interviewed Duke Energy's Program Manager and the Franklin Energy implementation staff to discuss program goals and any relevant changes to delivery or offerings since the previous evaluation.

3.2.3.4 Documentation Review

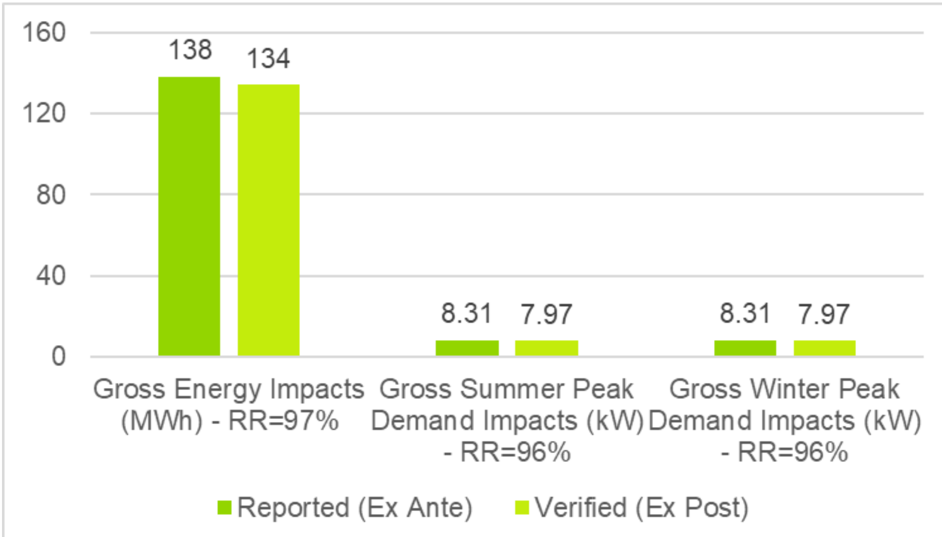
Guidehouse requested program documentation and tracking data to conduct a review of current processes. The program tracking data was sufficient to identify the measure characteristics and quantities of installed measures for each tenant at the participating properties.

4. Impact Evaluation

4.1 Impact Results

Figure 2 shows the program-level results for gross energy and demand savings for DEK. Guidehouse estimates gross realization rates of 97%, 96% and 96% for energy, summer coincident demand, and winter coincident demand, respectively.

Figure 2. Reported and Verified Program-Level Impacts



Source: Guidehouse analysis

Table 4-1 shows a comparison of gross and net impact findings. The evaluation team calculated the gross impact results in Table 4-1 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 0.98. The NTG methodology and results are discussed in detail in Section 3.2.2 and Section 5 of this report respectively.

Table 4-1. Summary of Program Impacts

	Energy (kWh)	Summer Coincident Demand (kW)	Winter Coincident Demand (kW)
Verified Gross Impacts	134,179	7.97	7.97
Verified Net Impacts	131,818	7.83	7.83

Source: Guidehouse analysis, values subject to rounding.

A summary of each measure's contribution to program energy savings and realization rate between reported and verified savings is shown in Table 4-2. By dividing the total verified savings by the total reported savings in the tracking data, Guidehouse calculated a gross realization rate of 97 percent for energy savings at the program level. This realization rate includes adjustments to the estimated savings for each measure discussed in the remainder of this report.

Table 4-2. Distribution of Program Gross Energy Savings by Measure

Measure	Measure Count from Tracking Data	Total Ex Ante Savings from Tracking Data (kWh)	Share of Total Savings from Tracking Data	Total Verified Ex Post Gross Savings (kWh)	Realization Rate
Showerhead – 1.5 GPM	257	78,939	57%	74,780	95%
Kitchen Aerator – 1.0 GPM	277	38,399	28%	38,276	100%
Water Heater Pipe Insulation	981	17,208	12%	16,149	94%
Bath Aerator – 1.0 GPM	110	3,769	3%	4,973	132%
Total	**1,625**	**138,314**	**100%**	**134,179**	**97%**

Source: Guidehouse analysis, values subject to rounding.

The results for gross summer coincident demand by measure are shown in Table 4-3.

Table 4-3. Distribution of Program Summer Coincident Demand Savings by Measure

Measure	Total Ex Ante Savings from Tracking Data (kW)	Share of Total Savings from Tracking Data	Total Verified Ex Post Gross Savings (kW)	Realization Rate
Showerhead – 1.5 GPM	3.48	42%	3.66	105%
Kitchen Aerator – 1.0 GPM	2.53	30%	2.16	85%
Water Heater Pipe Insulation	1.96	24%	1.84	94%
Bath Aerator – 1.0 GPM	0.33	4%	0.31	95%
Total	**8.31**	**100%**	**7.97**	**96%**

Source: Guidehouse analysis, values subject to rounding.

The results for gross winter coincident demand by measure are shown in Table 4-4.

Table 4-4. Distribution of Program Winter Coincident Demand Savings by Measure

Measure	Total Ex Ante Savings from Tracking Data (kW)	Share of Total Savings from Tracking Data	Total Verified Ex Post Gross Savings (kW)	Realization Rate
Showerhead – 1.5 GPM	3.48	42%	3.66	105%
Kitchen Aerator – 1.0 GPM	2.53	30%	2.16	85%
Water Heater Pipe Insulation	1.96	24%	1.84	94%
Bath Aerator – 1.0 GPM	0.33	4%	0.31	95%
Total	**8.31**	**100%**	**7.97**	**96%**

Source: Guidehouse analysis, values subject to rounding.

4.2 Impact Evaluation Findings

4.2.1 Water Flow Regulation Measures

Guidehouse updated certain impact parameters for the aerator measures based on review of the information available and data collected for this evaluation period. Guidehouse used these updated impact parameters as shown in Table 4-5 with Equation 1 and Equation 3 from Section 3.2.1.1 to determine the verified energy and demand impacts respectively.

Table 4-5. Impact Parameters Used for Calculating Verified Impacts – Aerator Measures

Parameter	Source	Bath Aerator – 1.0 GPM	Kitchen Aerator – 1.0 GPM
ISR	Onsite field verification	0.857	0.789
GPM_{BASE}	Data provided by Duke Energy from Franklin Energy sample for the previous evaluation[a]	2.00	2.20
GPM_{LOW}	Duke Energy tracking data and specification sheets	1.00	1.00
MPD	2015 Indiana TRM	1.60	4.50
PH	Tenant survey responses (DEK and DEI)	2.13	2.13
FH	Duke Energy tracking data	1.09	1.00
DR	2015 Indiana TRM	0.70	0.50
T_{MIX}	2015 Indiana TRM	86.00	93.00

Parameter	Source	Bath Aerator – 1.0 GPM	Kitchen Aerator – 1.0 GPM
T_{IN}	Building America Benchmark annual mains temperature for Cincinnati Northern Kentucky Airport, Kentucky	59.47	59.47
RE	2015 Indiana TRM	0.98	0.98
Summer CF	2015 Indiana TRM	0.0012	0.0033
Winter CF	2015 Indiana TRM	0.0012	0.0033
Gross Energy Savings per Aerator (kWh)		**45.21**	**138.18**
Gross Summer Coincident Demand Savings per Aerator (kW)		**0.0028**	**0.0078**
Gross Winter Coincident Demand Savings per Aerator (kW)		**0.0028**	**0.0078**

a. Duke Energy Multifamily EMV Report DEK, December 26, 2019 – Table 16.

Source: Guidehouse analysis, values subject to rounding

Guidehouse also updated certain impact parameters for the showerhead measure based on review of the information available and data collected for this evaluation period. Guidehouse used these updated impact parameters as shown in Table 4-6 with Equation 2 and Equation 3 from Section 3.2.1.1 to determine the verified energy and demand impacts respectively.

Table 4-6. Impact Parameters Used for Calculating Verified Impacts – Showerhead Measure

Parameter	Source	Showerhead – 1.5 GPM
ISR	Onsite field verification	1.000
GPM_{BASE}	Data provided by Duke Energy from Franklin Energy sample for the previous evaluation[a]	2.50
GPM_{LOW}	Duke Energy tracking data and specification sheets	1.50
MS	2015 Indiana TRM	7.80
SPD	2015 Indiana TRM	0.60
PH	Tenant survey responses (DEK and DEI)	2.13
SH	Duke Energy tracking data	1.29
T_{MIX}	2015 Indiana TRM	101.00
T_{IN}	Building America Benchmark annual mains temperature for Cincinnati Northern Kentucky Airport, Kentucky	59.47

Parameter	Source	Showerhead – 1.5 GPM
RE	2015 Indiana TRM	0.98
Summer CF	2015 Indiana TRM	0.0023
Winter CF	2015 Indiana TRM	0.0023
Gross Energy Savings per Showerhead (kWh)		**290.97**
Gross Summer Coincident Demand Savings per Showerhead (kW)		**0.0142**
Gross Winter Coincident Demand Savings per Showerhead (kW)		**0.0142**

a. Duke Energy Multifamily EMV Report DEK, December 26, 2019 – Table 16.

Source: Guidehouse analysis, values subject to rounding

4.2.1.1 In-Service Rate

Guidehouse used the reported program quantities in the tracking database and the quantities verified during the onsite field verification to be still installed and functioning, to determine measure specific in-service rates for this evaluation period as shown in Table 4-7.

Table 4-7. Water Flow Regulation Measures – ISR

Measure	Units Inspected	Tracking Data Quantity	Verified Quantity	In-Service Rate (ISR)
Bath Aerator – 1.0 GPM	7	7	6	85.7%
Kitchen Aerator – 1.0 GPM	19	19	15	78.9%
Showerhead – 1.5 GPM	8	8	8	100.0%

Source: Guidehouse analysis

4.2.1.2 Baseline Flow Rate (GPM)

Duke Energy provided Guidehouse with the information for the equipment removed during the retrofit process. This data was collected by Franklin Energy from a sample of participant sites (data was collected at 4 out of the 6 total participating properties that received lighting and/or water measures during this evaluation period). However, the dataset did not include any flow rate data from aerators or showerheads removed during the retrofit process. In the absence of any data to update the baseline flow rate, Guidehouse continued to use the baseline flow rate values from the previous evaluation for this jurisdiction for these measures.

4.2.1.3 Average Number of People per Household (PH)

Guidehouse used the responses to the question “How many people live in your home?” from the tenant survey fielded as part of the process evaluation to inform a value for this parameter. A summary of the tenant responses to this question is shown in Table 4-8. To make up for the limited data due to low number of tenant survey completes for this evaluation period, Guidehouse supplemented the responses to this question with the data from the most recent evaluation of this program in the Indiana jurisdiction (DEI)[9]. Guidehouse used this combined dataset to determine the average number of people per household parameter as shown in Table 4-9.

Table 4-8. Water Flow Regulation Measures – PH (DEK Only)

Survey Response	Total Respondents	Assumed Number of People
1	4	1
2	0	2
3	2	3
4 or more	1	4
Weighted Average	**7**	**2.00**

Source: Guidehouse analysis

Table 4-9. Water Flow Regulation Measures – PH (DEK and DEI)

Survey Response	Total Respondents	Assumed Number of People
1	29	1
2	26	2
3	14	3
4 or more	13	4
Weighted Average	**82**	**2.13**

Source: Guidehouse analysis

4.2.1.4 Faucets per Household (FH) and Showerheads per Household (SH)

Guidehouse updated the faucets per household parameter for the aerator measures and the showerhead per household parameter for the showerhead measures using the tracking data as shown in Table 4-10. This assumes that Franklin Energy attempted to replace every faucet and showerhead in the housing unit during installation.

Table 4-10. Water Flow Regulation Measures – FH/SH

Measure	Quantity Installed	Number of Housing Units*	Aerators/Showerheads per Home
Bath Aerator – 1.0 GPM	101	110	1.09
Kitchen Aerator – 1.0 GPM	277	277	1.00
Showerhead – 1.5 GPM	199	257	1.29

* The number of housing units are determined as the distinct count of Electric Account Number.

Source: Guidehouse analysis

[9] Multifamily Energy Efficiency Program EM&V Report_DEI_9-5-2023 – Table 4-15

4.2.1.5 Cold Water Temperature Entering the DHW System (T_{IN})

Guidehouse used the annual mains temperature for Cincinnati Northern Kentucky Airport, Kentucky from the Building America Benchmark to inform the T_{IN} parameter used in the impact calculations for the aerator and showerhead measures. Guidehouse determined the Cincinnati Northern Kentucky Airport, Kentucky as the closest Building America Benchmark station to the properties that installed water flow regulation measures during this evaluation period.

4.2.2 Water Heater Pipe Insulation Measure

Guidehouse updated the in-service rate and R-value of the insulation for the water heater pipe insulation measure based on review of the information available and data collected for this evaluation period. Guidehouse used these updated impact parameters as shown in Table 4-11 with Equation 4 and Equation 5 from Section 3.2.1.1 to determine the verified energy and demand impacts respectively.

Table 4-11. Impact Parameters Used for Calculating Verified Impacts – Water Heater Pipe Insulation Measure

Parameter	Source	Pipe Wrap
ISR	Onsite field verification	0.767
R_{EXIST}	2015 Indiana TRM	1.00
R_{NEW}	Specification sheet	4.35
L	Savings are calculated per linear foot	1.00
C	Assumed as average of 0.5” and 0.75” diameter pipe	0.16
ΔT	2015 Indiana TRM	65.00
η_{DHW}	2015 Indiana TRM	0.98
Gross Energy Savings per Linear Foot (kWh)		**16.46**
Gross Summer Coincident Demand Savings per Linear Foot (kW)		**0.0019**
Gross Winter Coincident Demand Savings per Linear Foot (kW)		**0.0019**

Source: Guidehouse analysis, values subject to rounding

4.2.2.1 In-Service Rate

Guidehouse used the reported program quantities in the tracking database and the quantities verified during the onsite field verification, to determine the in-service rate for this measure as shown in Table 4-12.

Table 4-12. Water Heater Pipe Insulation Measure – ISR

Measure	Units Inspected	Tracking Data Quantity	Verified Quantity	In-Service Rate (ISR)
Water Heater Pipe Insulation	13	43	33	76.7%

Source: Guidehouse analysis

Through the onsite field verification, Guidehouse found that some of the water heater pipe wrap was installed on the cold water inlet pipe to the water heater. 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.[10] Guidehouse measured the length of pipe wrap installed on cold water pipes to be 3 feet or less and therefore made no further adjustments to the ISR.

4.2.2.2 R-value of Installed Insulation

Guidehouse updated the R-value of the installed insulation using specification sheet provided by Franklin Energy for this measure as shown in Table 4-13.

Table 4-13. Water Heater Pipe Insulation Measure – R-Value of Installed Insulation

Model #	Dimensions	R-Value
PI010	1/2” Wall for 1/2” Pipe	3.54
PI011	1/2” Wall for 3/4” Pipe	3.15
R-Value of Installed Insulation*		**3.35**

*Assumed as average of 0.5” and 0.75” diameter pipe

Source: Guidehouse analysis

[10] https://www.energy.gov/energysaver/do-it-yourself-savings-project-insulate-hot-water-pipes

5. Net-To-Gross Analysis

Guidehouse conducted an NTG analysis to estimate the share of program savings that can be attributed to participation in or influence from the program. Table 5-1 shows the results of Guidehouse's NTG analysis. Guidehouse 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 our previous evaluations of this program. Guidehouse chose to present a program-level NTG ratio rather than measure level due to the difficulty in estimating spillover by measure. Guidehouse believes it is more appropriate to present the NTG ratio in aggregate.

Table 5-1. NTG Results

Parameter	Value
Estimated Free Ridership	1.76%
Estimated Spillover	0.00%
Estimated NTG	0.9824

Source: Guidehouse analysis, values subject to rounding

5.1 Results of Free Ridership, Spillover and Net-to-Gross

5.1.1 Free Ridership Results

As described in Section 3.2.2.2, surveyed participants responded to a series of questions intended to elicit explicit estimates of free ridership, as well as ratings of program influence. Guidehouse estimated free ridership to be 1.76 percent. A representative for 2 out of the 4 participating properties completed the property manager survey.

Below are summaries by scoring component.

Prior Planning: The property manager representative for both properties reported that prior to participating in the Duke Energy program, they had considered installing energy efficient, water equipment (low flow toilets and showerheads) in tenant units at their facility. However, their plans at either properties were not very far along. They had neither identified an installation contractor and energy efficient equipment nor identified and secured financing to install the project (less than or equal to 3 on a scale of 0 to 10).

Program Importance: Respondents stated that the program was very important in having the measures installed. Both properties indicated at least some aspect of the Duke Energy program was very important (greater than or equal to 9 on a scale of 0 to 10) in influencing respondent decision to retrofit their properties. The average response for how important any one aspect of the Duke Energy program was in influencing respondent decision to retrofit the properties was 9.5 on a scale of 0 to 10.

Likelihood: Respondents were asked about the likelihood that they would have installed the same energy efficient (same quantity and same efficiency) equipment in the tenant units at their property in the absence of the program and its financial and technical assistance. The property manager representative indicated that both properties “may have” installed the same energy efficient water equipment even without the program however they were “not at all likely” to have completed the same upgrade achieving the same level of energy savings at the same time as this project through the program.

Timing: Both properties indicated that they may have completed some of the energy efficiency upgrades in the absence of the program. One of them indicated they would have done so within a year of the time of the program, while the other property indicated they likely would have completed some of the upgrades between 1-2 years after the program in the absence of it.

In summary, respondents indicated that the program was very important in their decisions to have the energy efficient measures installed. Both properties had considered installing energy efficient water equipment in tenant units prior to participating in the program though they were not very far along in their planning, and the free ridership estimates account for those responses.

5.1.2 Spillover Results

None of the property managers or the tenants indicated that they installed any additional energy efficient equipment at their facility or in their home respectively since receiving the equipment through the Duke Multifamily Energy Efficiency Program. As a result, Guidehouse calculated no spillover for this evaluation period.

6. Process Evaluation

Guidehouse 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 seven program participants and detailed surveys with a property manager representative for two properties. The property manager and tenant surveys were also used to inform the NTG analysis as discussed previously.

6.1 Key Findings

- Some of the key challenges generally associated with delivering energy efficiency programs to non-owner-occupied multifamily housing facilities include lack of financial capital for upfront costs, multiple decision makers, limited resources to manage retrofits, time and complexity associated with disrupting tenants. The Multifamily program appears to be effectively addressing these challenges.
- Majority of the tenants were satisfied with the program. On a scale of 0 to 10, where 0 indicates “not satisfied at all” and 10 indicates “extremely satisfied”:
    - About 57 percent of participants indicated 8-10 for satisfaction with the overall program.
    - About 86 percent of participants indicated 8-10 for satisfaction with Duke Energy.
- Tenants generally appear to be satisfied with the water equipment offered as part of the program. However, tenant satisfaction was lowest with the kitchen faucet aerator measure.
- Fifty seven percent of the tenants reported that they noticed savings on their energy bills since the installation of the measures.
- The property manager representative for both properties that completed the survey, indicated that they chose to participate in the program to primarily reduce maintenance costs and save tenants money on their utility bill.
- The property managers were highly satisfied with the quality of installation team’s work, communication with the program representatives and scheduling and timeliness of the installation team. On a scale of 0 to 10, where 0 indicates “not satisfied at all” and 10 indicates “extremely satisfied”:
    - Both properties indicated their satisfaction with the overall program to be a 10.
    - The average satisfaction with Duke Energy was reported to be 9.5.

6.2 Tenant Surveys

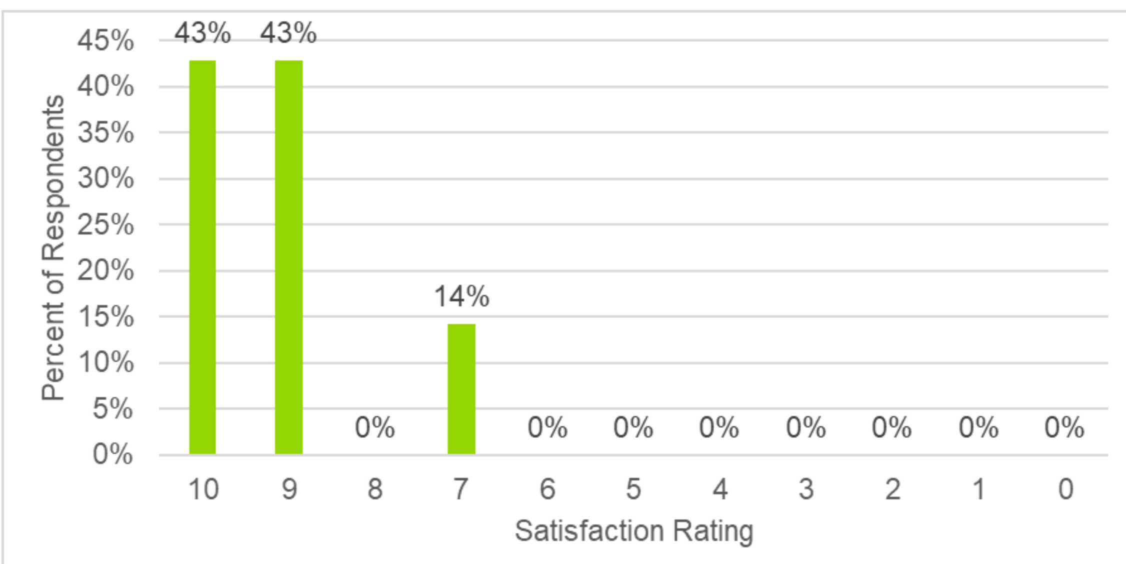
Guidehouse completed phone surveys with seven residential tenants that received energy efficient equipment through the program. This section presents details of the survey responses. Overall, tenants indicated that their experience with the program was favorable. Some key findings from the tenant phone surveys are listed below:

Survey results showed that majority of the tenants rated high satisfaction with the program. On a scale of 0 to 10, where 0 indicates “Not at all satisfied” and 10 indicates “Extremely satisfied,” 57 percent of the 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 7.0 out of 10. The two tenants who ranked their overall satisfaction low, noted low satisfaction with the energy efficient water equipment installed through the program and any savings on their electric bill since the equipment was installed. Survey results also show a high tenant satisfaction with Duke Energy as shown in Figure 4 with an average overall tenant satisfaction rating with Duke Energy of 9.1 out of 10.

Figure 3. Tenant Satisfaction with Duke Energy Multifamily Energy Efficiency Program (n=7)

Source: Guidehouse analysis

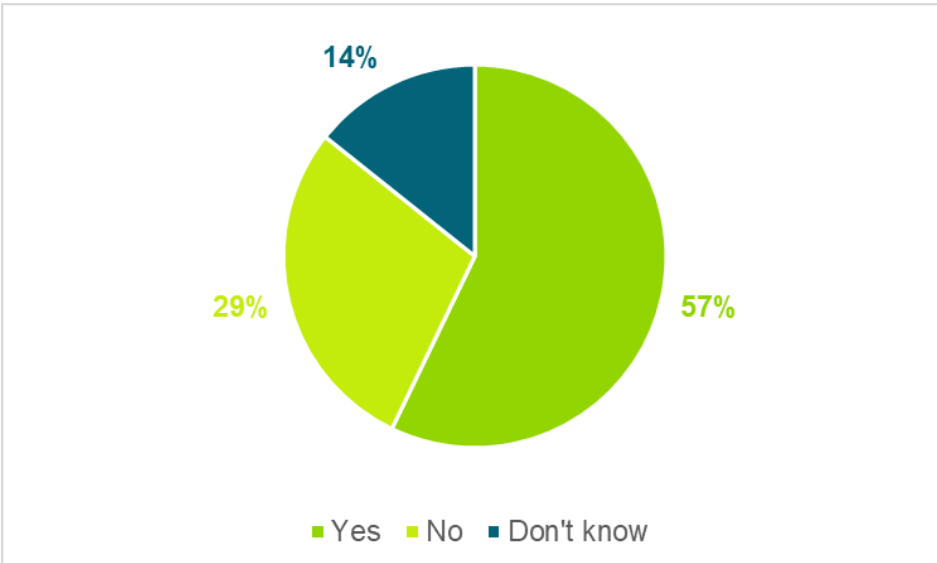
Figure 4. Tenant Satisfaction with Duke Energy (n=7)



Source: Guidehouse analysis

As shown in Figure 5, 57 percent of tenants noticed a decrease in their energy bills after the new measures were installed, one respondent was unsure if they are saving energy, while 29 percent of tenants did not notice a decrease in their utility bills.

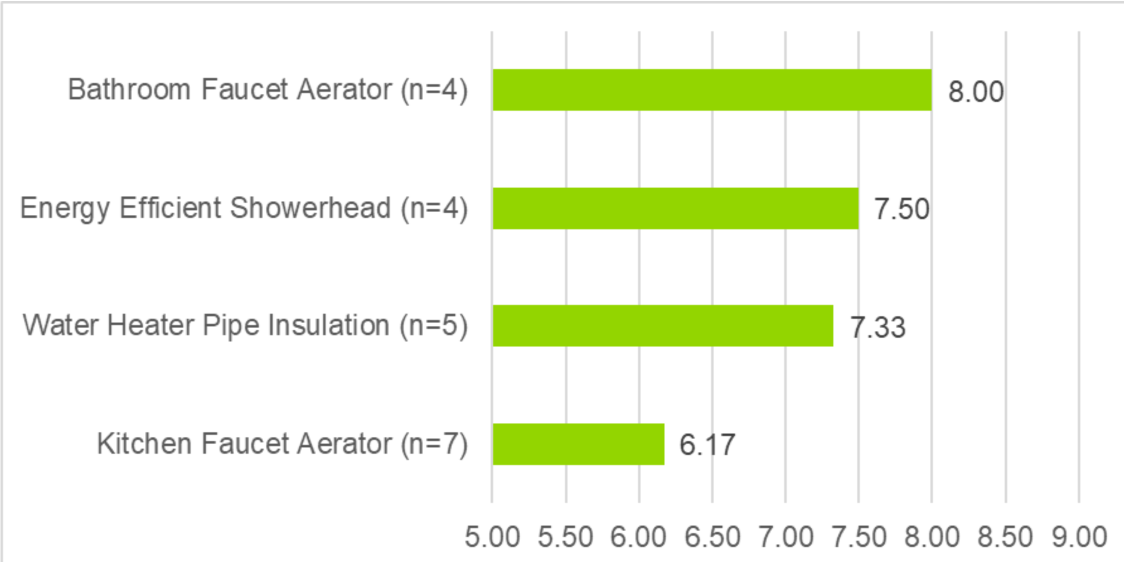
Figure 5. Tenants Who Noticed a Decrease in Their Energy Bill After Installing Program Measures (n=7)



Source: Guidehouse analysis

While most tenants were fairly satisfied with the measures, some were not. Guidehouse asked the participants to rate their satisfaction for each measure installed in their home. The bathroom faucet aerator measure had the highest average satisfaction rating, while the kitchen faucet aerator measure had a relatively lower average satisfaction rating, as shown in Figure 6. For tenants who received the kitchen faucet aerator, low satisfaction ratings were likely tied to the aerator spraying around and the need to replace the aerator after installation.

Figure 6. Tenant Satisfaction with Program Measures

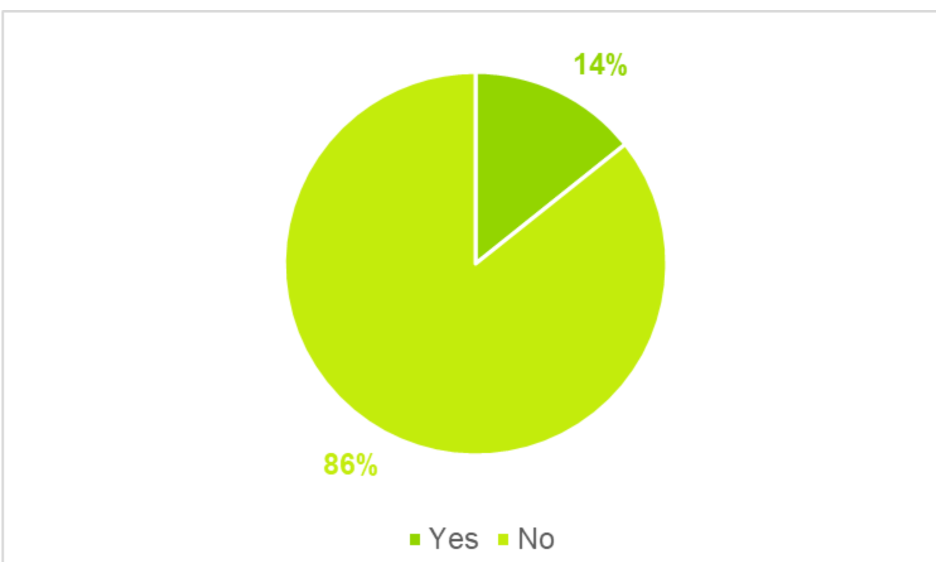


Source: Guidehouse analysis

None of the survey respondents indicated that they purchased additional energy efficiency equipment that they did not receive a rebate for as a result of their particpation in the program. As a result, Guidehouse calculated no tenant spillover savings for this evaluation period for use in the NTG analysis.

Only one of the tenants indicated that emergence of COVID-19 has changed how they use energy in their home as shown in Figure 7. They indicated they were now using more energy but for less money due to increased efficiency from the installation of program measures and that there were no additional tools or resources that Duke Energy could provide to help them with the energy use at their home.

Figure 7. Tenants Who Indicated a Change in Their Energy Use Due to COVID-19 (n=7)



Source: Guidehouse analysis

6.2.1 Participant Suggestions

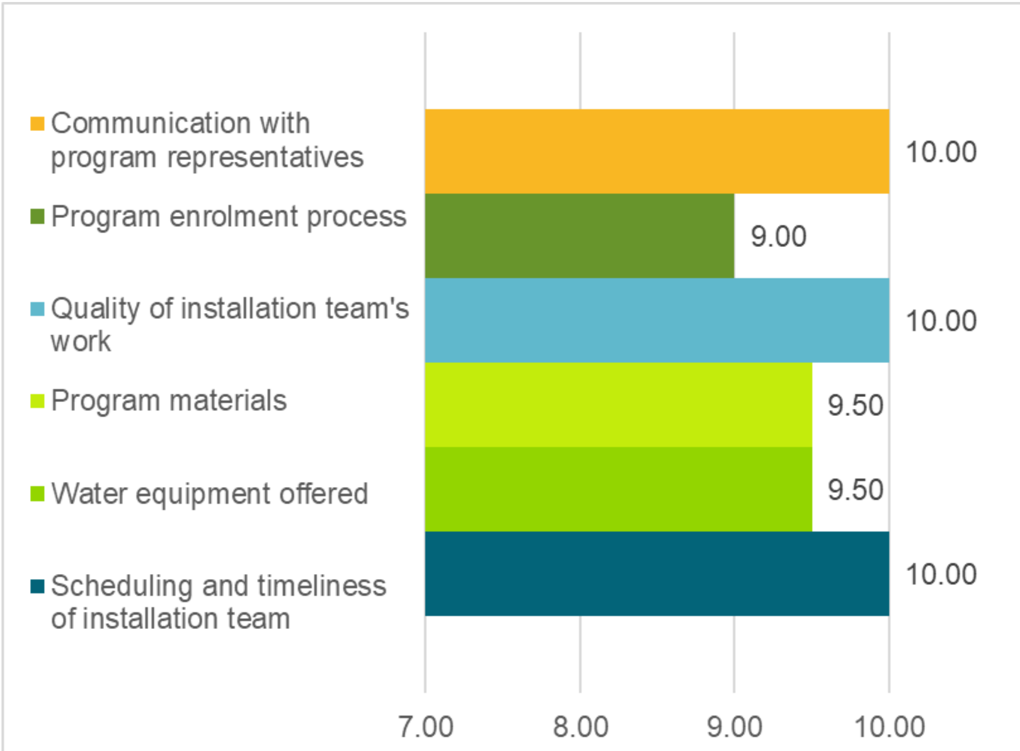
Guidehouse included a question in the tenant satisfaction survey that allowed respondents to offer suggestions for improving the program. Three of the seven respondents offered suggestions such as, offering light bulbs through the program and helping them save more on water usage.

6.3 Property Manager Interviews

Guidehouse completed surveys with a representative for two of the four participating properties. This section presents details of the survey responses. Overall, the respondent indicated that their experience with the program was very favorable. Some key findings from the property manager surveys are listed below:

- The respondent indicated that the desire to reduce maintenance costs and save tenants money on their utility bill, were the most important factors in their decision to install energy efficient equipment through the program in the tenant units at their property.
- Both properties first learned about the Multfamily Energy Efficiency Program from their Duke business energy advisor or account representative and the decision to participate in the program was driven by the owner of the property management company rather than the individual property.
- The satisfaction with the overall program experience for both properties was very high with an average rating of 10 on a scale of 0 to 10, where 10 indicates “extremely satisfied” and 0 indicates “not at all satisfied”.
- On a scale of 0 to 10, where 10 indicates “extremely satisfied” and 0 indicates “not at all satisfied”, the average rating from property managers for tenant satisfaction with the new water equipment available through the program was 9.5.
- The respondent expressed highest satisfaction with the quality of installation team’s work, communication with the program representatives and scheduling and timeliness of the installation team as shown in Figure 8. They provided comments indicating that the program representatives were professional, friendly, knowledgeable, understanding of the process to give notices to enter tenant units and great to work with.

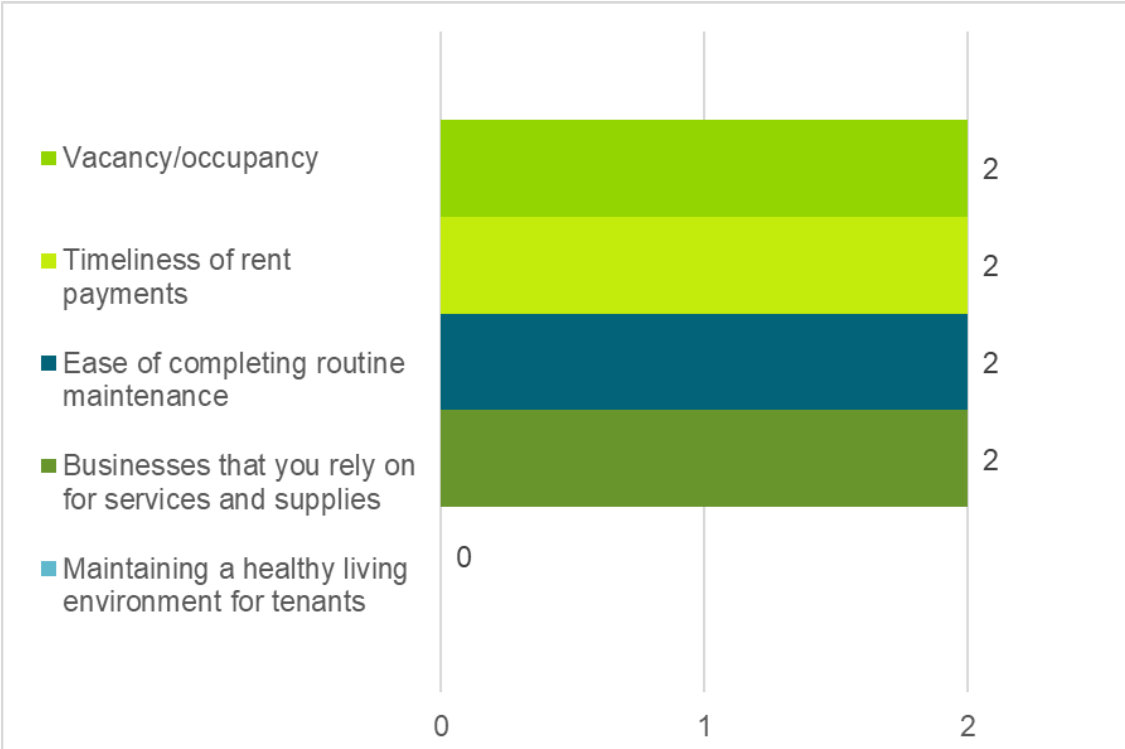
Figure 8. Property Manager Satisfaction with Program Aspects (n=2)



Source: Guidehouse analysis

- None of the two properties installed any additional energy efficient equipment as a result of their experience participating in the program. As such, Guidehouse calculated no property level spillover savings for this evaluation period for use in the NTG analysis.
- The property manager responses to impacts of COVID-19 on various property management aspects are shown in Figure 9. The respondent also indicated that the tenants at both properties are now using energy differently due to COVID-19 with most of them having learned to be more energy efficient.

Figure 9. Property Managers That Answered in the Affirmative to the Following COVID-19 Impacts (n=2)

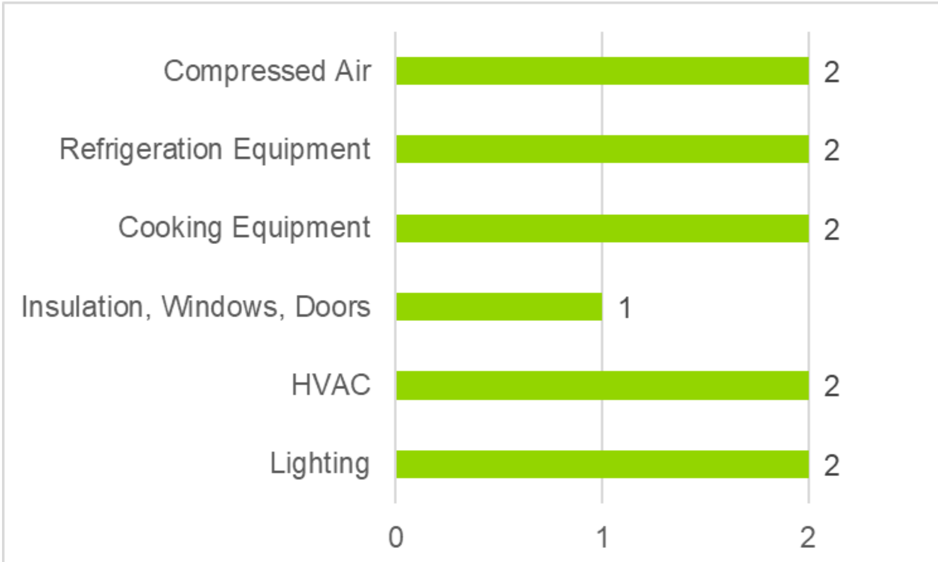


Source: Guidehouse analysis

- Vacancy/occupancy – The property manager indicated that some units have been left in very bad condition and require more expensive and time-consuming repairs and that units are no longer in good condition when returned to them
- Timeliness of rent payments – The property manager mentioned that the renters were used to the government programs that helped them pay rent and having to start paying rent on their own has been difficult for some.
- Ease of completing routine maintenance – The property manager indicated that people were more abusive to general items during the pandemic resulting in more frequent repairs and that tenants no longer like to allow entry to their units.
- Businesses that you rely on for services and supplies – The property manager indicated that supplies are now limited and that they have a hard time getting everyday supplies, especially paint.

- The respondent recommended offering thermostats that are easy to program through the Multifamily Energy Efficiency Program.
- The respondent also indicated that both properties are planning future updates or renovations at their facility with the following systems shown in Figure 10 that use or impact electricity usage expected to be updated.

Figure 10. Program Manager That Answered in the Affirmative to Updating the Following Systems (n=2)



Source: Guidehouse analysis

6.4 Interviews with Duke Energy Program Manager and Franklin Energy Implementation Staff

6.4.1 Interview with Duke Energy's Program Manager

Guidehouse interviewed Duke Energy's Program Manager to discuss program goals and any relevant changes to delivery or offerings since the previous evaluation. Duke Energy indicated that the program had suspended operations between March 2020 and July 2021 in response to the COVID-19 pandemic. Program participation resumed in August 2021 with the major goal being to get the program back up and running as safely as possible followed by stabilizing staffing and ramping up installations to maximize savings and hit program goals.

Duke Energy identified implementation team staffing as a persistent issue and one of the major barriers to program participation with significant turnover especially since the onset of COVID-19. As the program installation team is highly reliant on the property management team to escort them around the property during installation, the lack of resources and availability of the staff (property manager or maintenance team) at the properties was identified as one of the other barriers along with COVID-19. The program team expects some of the COVID-19 related issues to slowly improve as restrictions begin to relax.

Duke Energy noted that Franklin Energy currently handles all aspects of program delivery and administration. They also employ a quality control and quality assurance (QA/QC) team to ensure consistent measure installation and inspections are required for at least five percent of total participating housing units each year. The QA/QC inspections are currently conducted over phone in the Kentucky jurisdiction; however, Franklin Energy is actively working to hire for this role in the Midwest to conduct these inspections and QC procedures in-person.

Duke Energy approves the marketing material that is distributed to customers but the primary program marketing and material development is handled by Franklin Energy. Offering more energy efficiency education for property managers and tenants has been identified as an effort to target. However, the impact of making tenants aware of other Duke Energy programs and encouraging them to participate in them may be limited due to the nature of tenant unit ownership (the apartment units are generally owned by the property and not the individual tenant). The program does not specifically target properties of a certain age, however, Duke Energy noted that the typical age of the properties participating in the program is at least 5-7 years, with older properties offering better retrofit opportunities due to the need for multiple measure updates.

Duke Energy identified reduced maintenance costs, longer measure life, and high quality of the energy equipment offered through the program as the primary motivators for property managers to participate in the program. Some other benefits of program participation include a enhanced selling point for future tenants by highlighting the energy efficient equipment at the property and higher retention rate for existing tenants. Some properties might also be able to take advantage of green financing initiatives when they reach a certain level of energy efficiency to support other capital improvements at their facility.

Duke Energy indicated that smart thermostats will be added to the program as a measure in the Kentucky jurisdiction and that they are continually looking to add more cost-effective energy efficient equipment. Leave behind materials are provided to all tenant units participating in the program indicating what equipment was replaced. Moving forward, smart thermostats will also include information on how to program them, and who to reach out to with questions.

6.4.2 Interview with Franklin Energy Implementation Staff

Guidehouse also interviewed program implementation staff from Franklin Energy. The implementation steps for this program include outreach conducted by the Energy Advisor, assessment to identify and quantify opportunity, scheduling, installation of the measures based on assessment (additional measures may be installed if applicable), quality control and assessment conducted within three-weeks of installation. Since program resumption after COVID-19 shutdown, the quality assessment for this evaluation was conducted virtually by calling the tenants and confirming installations.

The implementation staff from Franklin Energy indicated a lack of resources (staffing) as a significant issue for this program after resumption post COVID-19. Some of the other barriers to program participation as identified by Franklin Energy include lack of new leads, inability to distinguish multifamily properties from residential properties, higher cancellation rates after COVID-19, prevalence of energy efficient products on the market and lack of resources and availability of the staff (property manager or maintenance team) at the interested properties. Franklin Energy also noted that some properties express reluctance in the adoption of water saving measures due to the expectation that they will reduce water pressure. In those cases, the Energy Advisors worked with the property to demonstrate the energy efficient equipment, and this has helped increase adoption of water savings equipment offered through the program.

Consistent with the Duke Energy program manager, Franklin Energy also confirmed the primary motivators for property managers to participate in the program to be non-energy benefits such as attracting new tenants, reduced labor and maintenance costs, and improved marketing pitch as a sustainable property. All program marketing is directed mainly to the property managers and handled primarily by the Franklin Energy staff. Franklin Energy is currently working on trade show marketing and e-mail, social media, and call campaigns to promote the program and encourage participation.

The implementation team also collects anecdotal data from customers during installation to identify their energy efficient equipment needs and track missed opportunity products that program participants want. Subject matter experts at Franklin Energy also attend tradeshows and conduct market research to identify other potential products with a view to keep the program measure offerings fresh, relevant and to drive program interest and allure.

7. Conclusions and Recommendations

Guidehouse's findings suggest that Duke Energy's Multifamily Energy Efficiency Program is being delivered and tracked effectively in the DEK jurisdiction. Customer satisfaction is generally high, and the program measure installations appear to be tracked appropriately for most measures, however improvement opportunities exist and Guidehouse presents the following list of recommendations to help improve program delivery and impacts:

1. Guidehouse recommends that Duke Energy adopt the per-unit energy and demand impacts from this evaluation and use them going forward. The engineering analysis and data collection described in this report provide support for updating the estimated impacts for each program measure.
2. Duke Energy should consider requiring quality assessment and quality control (QA/QC) activities for the program be conducted in-person rather than over the phone. This will result in increased rigor for inspections and will allow for consistent confirmation of installed measures with early identification of any issues that can be corrected for in subsequent tracking data reports.
3. Duke Energy should continue tracking additional existing energy efficiency opportunities (not offered through this program) at participating properties and consider channeling them through other applicable programs that offer those measures by sharing relevant leads internally.
4. Guidehouse recommends that Duke Energy continue to ensure that all participating tenant units are consistently provided with a handout that includes a summary of all the equipment replaced at their unit through the program along with any other relevant leave behinds. This will be especially important once the smart thermostat measure is added as a program offering for this jurisdiction, since the measure specific leave behind will help the tenants easily set up and use their new thermostat.
5. Guidehouse recommends that Franklin Energy include an identifier in the tracking data to help distinguish between the length of pipe wrap on hot and cold water pipes installed as part of the water heater pipe insulation measure.

8. Summary Form

Multifamily Energy Efficiency Program

Completed EMV Fact Sheet

Description of program

Duke Energy's Multifamily Energy Efficiency Program provides energy efficient lighting and water 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, water heater pipe wrap

* With the U.S. DOE expanding the definition of general service lamps and finalizing new, more stringent efficiency requirements (45 lumens per Watt) for these lamps effective, respectively, on July 8 and July 25, 2022, the program does not plan to claim to any savings from lighting measure installations during this evaluation period.

Date:	January 30, 2024
Region:	Duke Energy Kentucky
Evaluation Period	8/1/19 – 12/31/22
Annual kWh Savings	134,179
Per Participant kWh Savings	430
Net-to-Gross Ratio	0.9824

Evaluation Methods

The evaluation team used engineering analysis and onsite field verification as the primary basis for estimating program impacts. Additionally, telephone surveys were conducted with tenants at multifamily housing units to assess customer satisfaction and spillover. Detailed surveys were conducted with property managers to assess their decision-making process, and ultimately to estimate a net-to-gross ratio.

Impact Evaluation Details

- **Onsite field verification was conducted at 19 housing units.** The evaluation team inspected program measures at 19 housing units across two properties covering 77 program measures 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 77 percent for water heater pipe wrap to 100 percent for water-saving showerheads.
- **Participants achieved an average of 430 kWh of energy savings per year.**

9. Measure Level Inputs for Duke Energy Analytics

Guidehouse used the findings from onsite field verification 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.

Multifamily Energy Efficiency Program DS

Appendix A. Tenant Survey Guide

DUKE ENERGY MULTIFAMILY ENERGY EFFICIENCY PROGRAM
TENANT SURVEY

SCREENING

INTRO. 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 faucet aerators, water heater pipe insulation or showerheads. Is this the **<SAMPLE_CONTACT_NAME>** residence? **[IF NOT AVAILABLE, SCHEDULE A CALLBACK].**

S1. Safety is always first at Duke Energy. Are you driving or for any other reason not able to safely take this call right now?

1. No **[Continue]**
2. Yes **[Thank and terminate, say: "I thank you for your time today. We'll call back again later."]**

This survey may take about 10 minutes of your time.

I am calling for your opinion about your experience with a Duke Energy Efficiency Program. We will keep all of your responses confidential. For quality purposes, this call may be monitored and recorded.

Our records show that your household received new energy efficient water equipment in **<MONTH> <YEAR>**. Your landlord or property manager organized your participation in this program, and a work crew or maintenance staff would have installed **<MEASURE>** in your home.

S2. Do you recall **<MEASURE>** being installed in your home?
1. Yes
2. No
98. Do not recall/Do not know
99. Refused

[Continue if S2 = 1, if S2 = 2, 99 then Terminate]

[Ask if S2 = 98]
S3. Is there someone else who may recall the **<MEASURE>** that were installed?
1. Yes
2. No

[If S3 = 1, ask to speak to that person and repeat introduction. If that person is not available, ask S3A. Terminate call with initial respondent.]

S3A. Could you share that person's name and how to reach them?
A. Name
B. Phone number
C. Best time to call

[If S2 = 2, 99 or S3 = 2, then Terminate Call.]

[Say for Terminations:]

I have been asked to survey people who are familiar with the energy efficient equipment installed as part of this Duke 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 S2 = 1, Continue]

GENERAL SATISFACTION

PS1. Using a scale of 0-10, where 0 means not at all satisfied, and 10 means extremely satisfied. Please rate your satisfaction with: **[RECORD 0-10, 98= Do Not Recall/Know, 99=Refused]**

A. The **<MEASURE>** equipment installed in general **[If needed: I'll ask more specific questions about the equipment soon]**
B. The installation process itself
C. Any savings on your electric bill since this equipment was installed
D. Any information left behind about the equipment and energy efficiency
E. This Energy Efficiency Program experience in general
F. Duke Energy in general

[Ask for each PS1 immediately after rating is offered if response is <8]

PS1A. Why did you offer that rating? **[Open End]**

PS2. Have you noticed any savings on your electric bill since the installation of **<MEASURE>** equipment?

1. Yes
2. No
98. Don't Know

PS3 Is there additional information you would like to receive from Duke Energy about energy efficiency?

1. Yes
2. No
98. Don't Know

[Ask PS3A if PS3 = 1]

PS3A What information would you like to receive? **[Open End]**

MEASURE SATISFACTION

Now I'd like to ask you a few questions about your experience with the energy efficient equipment installed through the Duke Energy Efficiency Program.

M1. Using the same 0-10 scale, where 0 means not at all satisfied, and 10 means extremely satisfied. Please rate your satisfaction with: **[RECORD 0-10, 98= Do Not Recall/Know, 99=Refused] [Ask for each measure listed only]**

A. Bathroom faucet aerators
B. Kitchen faucet aerators
C. Energy efficient showerhead
D. Water heater pipe insulation

M2. Have you removed any of the products that were installed through this Duke Energy program?

1. Yes
2. No

[Ask if M2 = 1, Else Skip to SO1]

M3. As I read through the equipment that was installed, please tell me which ones you removed. Did you remove…. **[Only ask about items installed. For each equipment type that was removed, ask how many were removed.]**

A. Bathroom faucet aerators **[If Yes, ask "How many were removed?" and record number]**
B. Kitchen faucet aerators **[If Yes, ask "How many were removed?" and record number]**
C. Energy efficient showerhead **[If Yes, ask "How many were removed?" and record number]**
D. Water heater pipe insulation **[If Yes, ask "How many were removed?" and record number]**

[Ask for Each Equipment Type from M3 that had 1 or more removed]

M4. Could you tell me why you removed the **[Equipment type from M3 with 1 or more removed]**? **[Open End]**

NTG SPILLOVER BATTERY

SO1. Did you install any additional energy-efficient equipment in your home since receiving the equipment through the Duke Energy Efficiency Program?

1. Yes
2. No **[Skip to PI1]**
98. Don't know **[Skip to PI1]**

SO2. Did you receive rebates, incentives, financing, or information for those projects from any other utility or government program?

1. Yes, from Duke Energy
2. Yes, from another utility or government
3. No
98. Don't know

[Ask If SO2 = 3, Else Skip to PI1]

SO3. How important was your experience with the Duke Energy program, on your decision to install additional energy efficient equipment without a rebate or incentive? **[0-10, where 0 means "Not at all Important" and 10 means "Extremely Important"]**

[Ask If SO3 > 5, Else Skip to PI1]

SO4. Please briefly describe how the Duke Energy program influenced your decision to incorporate additional energy efficient equipment that you did not receive an incentive or rebate for.

[Open End]

SO5. Why didn't you apply for or receive a program incentive for the additional energy efficient equipment?

[Open End]

Ask if SO3 > 5

SO6. Please estimate the type(s) and quantity of the energy efficient equipment you installed without benefit of a program rebate or incentive:

	Type of Energy Efficient Equipment (Describe as specifically as possible)	Quantity purchased without an incentive?
Equipment Type 1		
Equipment Type 2		
Equipment Type 3		
Equipment Type 4		
Equipment Type 5		
Equipment Type 6		

PROGRAM IMPROVEMENT

PI1. What do you think could be improved about this Duke Energy program?
[OPEN END, 98=Don't Know, 99=Refused]

PI2. How could the program help you be more energy efficient?
[OPEN END, 98=Don't Know, 99=Refused]

PI3. What additional products or measures would you like to see added to the program?
[OPEN END, 98=Don't Know, 99=Refused]

COVID-19

C1. Has the emergence of COVID-19 changed how you use energy in your home? **[If Needed: Are you home more or less often, using lights, computers, television more or less often, perhaps raising the heat or lowering the air conditioning?]**

1. Yes
2. No
3. Don't know

[Ask if C1=1, Else Skip to D1]

C2. Please describe how you are using energy in your home differently as a result of COVID-19.
[OPEN-END]

C3. Have you or anyone in your household started working from home as a result of COVID-19?
1. Yes, started working from home but now working in-person
2. Yes, started working from home and still continuing to work from home
3. No

C4. Thinking of how COVID-19 has changed your home energy use, are there any tools or resources that Duke Energy could provide to help you? **[OPEN END]**

DEMOGRAPHICS

We're almost done. I just have a few basic questions.

D1. How many bedrooms are in your home?
1. 0 (Studio)
2. 1
3. 2
4. 3
5. 4 or more

D2. How many bathrooms are in your home?

1. 0
2. 1
3. 2
4. 3
5. 4 or more

D3. How many people live in your home?

1. 1
2. 2
3. 3
4. 4 or more

SURVEY 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 B. Property Manager Survey Guide

DUKE ENERGY MULTIFAMILY ENERGY EFFICIENCY PROGRAM
PROPERTY MANAGER SURVEY

SCREENING

S1. Our records show that your property participated in the Duke Energy Multifamily Energy Efficiency Program in **<MONTH>** of **<YEAR>** and received free installation of energy efficient **<MEASURE>** in tenant units at **<FIRM>** at **<ADDRESS>**. Do you recall this project?

1. Yes
2. Yes, but at different address or year **[Open Ended]**
3. No

S2. What was your role at **<FIRM>** with respect to the decision to participate in the Duke Energy Multifamily Energy Efficiency program and install the **<MEASURE>** project in tenant units? **[Rotate 1-7. Multiple responses accepted.]**

1. I met with the Duke Energy representative and approved the project
2. I reviewed the project proposal and approved the project
3. I met with the Duke Energy representative, and recommended the project for approval
4. I managed the project
5. I manage maintenance staff accompanying the Duke Energy installation team
6. I coordinated the project

97. Other **[Open Ended]**

S3. Would you be able to answer questions related to your property's participation in this program?

1. Yes
2. No

[Ask if S1 = 3 or S3 = 2, Else Skip to DM1]

S4. Please share the name and contact information for another person at **<FIRM>** who was involved in the decision making to participate in the Duke Energy **<MEASURE>** project. **[Offer Do Not Know button to skip to Close.]**

A. Name
B. Contact Phone
C. Contact Email

[If presented S4, regardless of answer, Skip to Screen Close Page.]

Confirm Decision Maker

DM1. Our records indicate that about **<UNITS>** at **<FIRM>** received energy efficient equipment through the program. Is that correct?

1. Yes
2. No

97. Other **[Detail]**
98. Do not recall
99. Do not know

DM2. Our records show that the following equipment and quantity was installed in tenant units at **<FIRM>.** Does this seem accurate? **[1 = Yes, 2 = No, 98 = Do Not Recall, 99 = Do Not Know]** **[List ITEMs included for property, add QUANTITY]**

A. **<QUANTITY>** Bathroom faucet Aerator
B. **<QUANTITY>** Kitchen Faucet Aerator
C. **<QUANTITY>** Showerhead
D. **<QUANTITY>** Water Heater Pipe Insulation

[Ask if DM1 or DM2 ≠ 1]

DM3. Could you share who else is familiar with the installation of energy efficient equipment in tenant units for this project, and how to reach that person**? [Continue Survey with this Decision Maker after collecting additional contact information. Add new contact to sample and contact.]**

A. Name
B. Position
C. Email
D. Phone

PROGRAM AWARENESS

PA1 How did you learn about the Multifamily Energy Efficiency program?

1. My Duke Business Energy Advisor or Account Representative
2. Visit at my facility from Duke Energy representative
3. Social Media advertisement from Duke Energy
4. Email from Duke Energy
5. Mailing from Duke Energy

97. Other **[Detail]**
98. Do not recall

PA2 Why did you decide to participate in the program? **[Rotate. Allow multiple responses.]**

1. Receive free equipment from Duke Energy for tenant units
2. Receive free installation from Duke Energy in tenant units
3. Program materials from Duke Energy for your tenants
4. Recommendations from the Duke Energy representative
5. Prior participation in a Duke Energy program
6. Information from Duke Energy about energy efficiency or related cost savings
7. Improve the property for tenants
8. Save tenants money on their utility bill
9. Energy efficiency initiatives such as ENERGY STAR
10. Replace old equipment
11. Replace broken equipment
12. Receive more efficient equipment or the latest technology
13. Reduce maintenance costs
14. Because the program was sponsored by Duke Energy
15. To help protect the environment
16. To save energy
17. To improve tenant satisfaction
18. To attract new tenants
19. Part of a broader remodeling or renovation
20. Recommended by another contractors
21. Recommended by family, friend, or neighbor
22. Duke Energy Advertising
23. Advertising other than Duke Energy

97. Other **[Detail]**
98. Don't know

PA2A. What was the one primary reason for your decision to participate in the program? **[List options selected in PA2. Allow one response]**

GENERAL SATISFACTION

GS1. Now that you've completed your project, we'd like to know how satisfied you were with the program for your tenant units. Please rate your satisfaction in general with the Duke Energy Multifamily Energy Efficiency Program. **[0-10 scale, with 0 meaning "Not at all Satisfied," 10 meaning "Extremely Satisfied"]**

NTG FREE RIDERSHIP BATTERY

Program Importance Score

Now we'd like to move away from satisfaction and ask you about how ***important*** the Duke Energy Multifamily program was to implementing the energy efficiency improvements.

The following questions pertain to the upgrades that were completed through the program. As you answer these questions, please think about the **<MEASURE>** project that was installed in tenant units at **<FIRM>**.

PI1 Please rate the importance of several factors that may have contributed to your decision to install the **<MEASURE>** in tenant units through the Duke Energy Multifamily Energy Efficiency Program. **[0-10 scale, with 0 meaning "Not at all Important' and 10 meaning "Extremely Important", 98 meaning "Do Not Recall/Do Not Know"] [Rotate A-J]**

Program Factors
A. Free equipment from Duke Energy
B. Free installation from Duke Energy
C. Program materials from Duke Energy
D. Recommendations from the Duke Energy representative
E. Prior participation in a Duke Energy program
F. Information from Duke Energy about energy efficiency or related cost savings

Non-Program Factors
G. Improve the property for tenants
H. Save tenants money on their utility bill
I. Energy efficiency initiatives in Kentucky such as ENERGY STAR

Potential Program Factors
J. Other non-energy related benefits from installing the energy-efficient equipment, such as reduced maintenance, tenant comfort or ease of use?

[Ask PI1Ja if the score given to PI1J is the max (and only max) compared to scores given to PI1 A-F; Otherwise, Skip]

a. Did Duke Energy introduce you to the non-energy benefits of these improvements?
   1. They were mentioned by Duke Energy or its representative
   2. No
   98. Don't know
   99. Refused

[*NOTE: If PI1Ia = 1, PI1J is a Program Factor*]

Program Importance Score

PI2. Overall, how important was the program, including **<list program factors from PC1>6 >**in your decision to implement the **<MEASURE>** project, rather than a less efficient alternative? **[0-10 scale, with 0 defined as "Not at All Important" and 10 defined as "Extremely Important," 98 meaning "Do Not Recall/Do Not Know"]**

Counterfactual Plans

[Ask If MEASURE = Water equipment]

NPW1. Prior to participating in the Duke Energy program, had you considered installing energy efficient, water equipment in tenant units at **<FIRM>**?
1. Yes
2. No

[Ask if NPW1 = 1, Else Skip to CC1]

NPW2. Please briefly describe your plans to install the efficient, water equipment in tenant units prior to participating in the Duke Energy program. **[OPEN END]**

NPW3. Again, thinking back to before you participated in the Duke Energy program, please rate how far along your plans were to install energy efficient, water equipment in tenant units at **<FIRM>**. **[0-10 scale, where 0 means "No Established Plans" and 10 means "Complete Plans Established"]**
A. Installation contractor and equipment of the same efficiency identified
B. Financing identified and secured to install the energy efficiency project

Counterfactual Likelihood

L1. What is the likelihood that you would have installed the same energy-efficient **<MEASURE>** (same quantity and same efficiency) in tenant units without the program and its financial and technical assistance?
1. Definitely WOULD NOT have installed the same quantity of energy efficient **<MEASURE>**
2. MAY HAVE installed the same quantity of energy efficient **<MEASURE>**, even without the program
3. Definitely WOULD have installed the same quantity of energy efficient **<MEASURE>**

[Ask if NP3A or NP3B >0, Else Skip to T1]

L2. If the Duke Energy Multifamily Energy Efficiency Program had not been available, and you went ahead with this project on your own without the free products, installation, or technical assistance, what is the likelihood that you would have completed the same upgrade achieving the same level of energy savings at the same time as this project? Again, we are not asking about your satisfaction with the **<MEASURE>** project, but about the likelihood that you would have completed an upgrade of the same level of energy savings without the Duke Energy Multifamily Energy Efficiency Program. **[RECORD 0-10, 98=Don't Know, 99=Refused] [Define: where 0 means "Not at all Likely" and 10 means "Extremely Likely"]**

Timing Adjustment

T1. If the Duke Energy Multifamily Energy Efficiency Program and free installed equipment had not been available, when do you think you would have performed upgrades with the **same efficiency level** as completed through the program in your tenant units at **<ADDRESS>**?
1. At the same time as this Duke Energy project
2. Within 1 year
3. Between 1-2 years later
4. Between 2-3 years later

5. Between 3-4 years later
6. More than 4 years later
7. Would never have installed without the Program

Consistency Check

CC1. Please describe in your own words any importance that the Duke Energy Multifamily Energy Efficiency Program had on your decision to implement the **<MEASURE>** project at your facility. **[OPEN ENDED]**

NTG SPILLOVER BATTERY

Inside Spillover

Please think about any energy efficient equipment you might have installed at the same facility without benefit of the Duke Energy program as you answer these next few questions.

SOI1. Did you install any additional energy-efficient equipment or make any operational improvements to save energy since participating in the Duke Energy Multifamily Energy Efficiency Program?
1. Yes
2. No, we did not install anything additional **[SKIP to SOO1]**
98. Don't know **[SKIP to SOO1]**

SOI2. Did you receive rebates, incentives, financing, or information for those projects from any other utility or government program?
1. Yes, from Duke Energy
2. Yes, from another utility or government
3. No
98. Don't know

[Ask If SOI2 = 3, Else Skip to SOO1]

SOI3. How important was your participation in the Duke Energy Multifamily Energy Efficiency Program on your decision to install additional energy efficient equipment without a rebate or incentive? **[0-10, where 0 means "Not at all Important" and 10 means "Extremely Important"]**

[Ask If SOI3 > 6, Else Skip to SOO1]

SOI4. Please briefly describe how the Duke Energy program influenced your decision to incorporate additional energy efficient equipment that did not receive an incentive or rebate. **[Open Ended]**

SOI5. Why didn't you apply for or receive a program incentive for the additional energy efficient equipment? **[Open Ended]**

Ask if SO3 >6

SOI6. Please estimate the type(s) and quantity of the energy efficient equipment you installed without benefit of a program rebate or incentive:

	Type of Energy Efficient Equipment (Describe as specifically as possible)	How many did you install?	What did the project cost?
Equipment Type 1			
Equipment Type 2			
Equipment Type 3			
Equipment Type 4			

	Type of Energy Efficient Equipment (Describe as specifically as possible)	How many did you install?	What did the project cost?
Equipment Type 5			
Equipment Type 6			

SOI7. Please think only about the additional energy efficient equipment that did not receive a rebate or incentive. Would you estimate that the energy savings from this non-incented equipment is less, more or similar to the energy savings from the Duke Multifamily Energy Efficiency program equipment?

1. Less than the Multifamily project
2. Similar to the Multifamily project
3. More than the Multifamily project
98. Don't know

Outside Spillover

Please think about any energy efficient equipment you might have installed at *another facility* without benefit of the Duke Energy program as you answer these next few questions.

SOO1. Did you install any additional energy-efficient equipment or make any operational improvements to save energy outside of the Duke Energy Multifamily Energy Efficiency Program after participating in the program?

1. Yes
2. No, we did not install anything additional
98. Don't know

SOO2. Did you receive rebates, incentives, financing, or information for those projects from any other utility or government program?

1. Yes, from Duke Energy
2. Yes, from another utility or government
3. No
98. Don't know

[Ask If SOO2 = 3, ELSE Skip to S1]

SOO3. How important was your participation in the Duke Energy Multifamily Energy Efficiency Program on your decision to install additional energy efficient equipment without a rebate or incentive? **[0-10, where 0 means "Not at all Important" and 10 means "Extremely Important"]**

[Ask If SOO3 > 5, ELSE Skip to S1]

SOO4. Please briefly describe how the Duke Energy program influenced your decision to incorporate additional energy efficient equipment that did not receive an incentive or rebate. **[Open Ended]**

SOO5. Why didn't you apply for or receive a program incentive for the additional energy efficient equipment? **[Open Ended]**

Ask if SO3 > 5

SOO6. Please estimate the type(s) and quantity of the energy efficient equipment you installed without benefit of a program rebate or incentive:

	Type of Energy Efficient Equipment (Describe as specifically as possible)	How many did you install?	What was the project cost?
Equipment Type 1			
Equipment Type 2			
Equipment Type 3			
Equipment Type 4			
Equipment Type 5			
Equipment Type 6			

SOO7. Please think only about the additional energy efficient equipment that did not receive a rebate or incentive. Would you estimate that the energy savings from this non-incented equipment is less, more, or similar to the energy savings from the Duke Multifamily Energy Efficiency program equipment?

1. Less than the Multifamily project
2. Similar to the Multifamily project
3. More than the Multifamily project
98. Don't know

SOO8. Did your experience with the Duke Energy Multifamily project in any way influence you to incorporate energy efficient equipment <u>at other facilities</u> that did not receive program rebates, but are also served by Duke Energy? Include only facilities served by Duke Energy, but that did not participate in any Duke Energy Efficiency programs.

1. Yes
2. No
98. Don't Know

[Ask if SOO8 = 1]

SOO9. Please estimate the number of other facilities that were influenced to install energy efficient equipment but did not participate in the program.

1. ______ Number
98. Don't Know

SATISFACTION

Now that you've completed your project, please tell us about your experience with the program.

S1. Please rate your satisfaction with the following. **[0-10 scale, with 0 meaning "Not at all Satisfied," 10 meaning "Extremely Satisfied" and 99 meaning "Not Applicable"] [Rotate A-L]**

A. **[Ask if <Measure> = Water]** Water equipment available through the program
B. **[Ask if <Measure> = Water]** Water selections installed through the program
C. Program materials available to communicate with tenants about the program
D. Scheduling and timeliness of installation team
E. Quality of installation team's work
F. **[Ask if <Measure> = Water]** Your tenants' satisfaction with the water equipment
G. Program enrollment process
H. Overall experience with the program
I. Communication with program representatives

J. Duke Energy overall

[Ask for PS1A-G <7 AND ALL PS1H, I, K]

S1A. Please explain why you rated **[Insert Text]** as you did. **[Open Ended]**

S2. Please share any feedback from your tenants about their experience with the equipment or installation through this program. **[Open End]**

S3. Do you highlight energy efficiency to prospective tenants? **[0-10 scale, with 0 defined as "Do not mention at all" and 10 defined as "Top feature highlighted"]**

COVID-19 IMPACTS

The next set of questions are about how COVID-19 has impacted your property.

C1. Have you experienced any changes to any of the following at this property due to COVID-19? **[Select all that apply]**
1. Vacancy/occupancy
2. Timeliness of rent payments
3. Ease of completing routine maintenance
4. Maintaining a healthy living environment for your tenants (e.g., increased air filtration needs, cleaning
5. Businesses that you rely on for services and supplies

97. Other **[Open End]**

[Ask for each option selected in C1]

C2A-F Please briefly describe the change you are experiencing related to **[insert C1 1-97]** **[Open End]**

C3. Have the effects of COVID-19 changed how tenants use energy at your property?
1. Yes
2. No

[Ask if C3 = 1, Else Skip to PI1]

C4 How are tenants using energy differently at **<FIRM>** due to Covid-19? **[Open End]**

C5. Considering these changes due to COVID-19, what kind of energy efficiency tools or resources could Duke Energy provide to help you? **[OPEN END]**

PROGRAM IMPROVEMENT

PI1. What do you think could be improved about this program? **[OPEN END, 98=Don't Know, 99=Refused]**

PI2. What does the program do well? **[OPEN END, 98=Don't Know, 99=Refused]**

PI3. How could the program help you make more energy efficiency improvements to tenant units at your facility? **[OPEN END, 98=Don't Know, 99=Refused]**

PI4. What additional equipment should Duke Energy add to the program? **[OPEN END, 98=Don't Know, 99=Refused]**

PI5. How could the program reach other properties like yours to participate in an energy efficiency project? **[OPEN END, 98=Don't Know, 99=Refused]**

FIRMOGRAPHICS

You are almost done! The final few questions are about your property.

F1. How old is the property at <Address>? ______ years old **[Open End]**

F1A When was the last renovation to tenant units?

1. ______ years ago **[Open End]**
2. There have not been renovations to tenant units

F2. How many residential unit types does the property include:

A. Studio _____ **[Open End]**
B. One bedroom _____ **[Open End]**
C. Two bedrooms _____ **[Open End]**
D. Three or more bedrooms _____ **[Open End]**

F3. Prior to participating in the Duke Energy program, approximately what percentage of these units already had energy efficient water equipment installed?

A. Studio _____% **[Open End]**
B. One bedroom _____% **[Open End]**
C. Two bedrooms _____% **[Open End]**
D. Three or more bedrooms _____% **[Open End]**

F4A. How many properties do you manage? _____ **[Open End]**

F4B. Was the decision to participate in this program driven by the individual property or by the property management company?
1. Individual Property
2. Owner of Property Management Company
98. Don't Know

F5. Are you planning any future updates or renovations at your facility?
1. Yes
2. No
98. Don't Know
99. Refused

[Ask If F5=1, Else Skip]

F6A. What systems that use or impact electricity are you planning to update?
1. Lighting
2. HVAC
3. Insulation, Windows, Doors
4. Cooking equipment
5. Refrigeration equipment
6. Compressed Air
7. Motors
97. Other **[Record]**
98. Don't Know
99. Refused

SURVEY CLOSING

Screen Closing Page

Thank you for beginning this survey!

This survey is for property managers familiar with energy efficiency projects through Duke Energy's Multifamily Energy Efficiency Program during 2019, 2020, 2021 or 2022. Since you are not, these are all the questions we have at this time.

Thank you for your time today.

Survey Closing Page

Thank you for your time in completing this survey!

Your responses are very important to DUKE ENERGY, and the information you shared will help as we design future energy efficiency programs.

Gift cards for completed surveys will be emailed in 4 to 8 weeks from Tango.com.

Save Energy and Water Kit Program 2022-2023 Evaluation Report

Duke Energy Kentucky

Prepared by Danielle Côté-Schiff Kolp, Alex Opipari, Keegan Skoretz, Tanushree Chowdhury

Date: July 19, 2024

Table of Contents

1 Executive Summary

1.1 Program Summary

The Save Energy and Water Kit Program (SEWKP) is an energy efficiency program offered by Duke Energy that targets residential customers throughout the Kentucky (DEK) territory who have not yet adopted energy-efficient water devices. Energy savings are achieved through installation of energy-efficient aerators, showerheads, and water heater pipe insulation wrap, all of which are provided to participants free of charge through an email or direct mail campaign.

1.2 Evaluation Objectives and Results

This report presents the results and findings of evaluation activities for the DEK SEWKP conducted by the Resource Innovations (RI) evaluation team for the program period of February 1, 2022 through May 31, 2023.

1.2.1 Impact Evaluation

The impact evaluation was divided into two tasks: first to determine gross savings (or impacts) and second to determine net savings. Gross impacts are energy and demand savings estimated at a participant's home that are the direct result of the homeowner's installation of the measures 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, Table 1-3 and Table 1-4 present the summarized findings of the impact evaluation for the DEK jurisdiction. The only notable difference between Kit 1 and Kit 2 are the number of showerheads provided (one in Kit 1, and two in Kit 2). Note tables may not compute due to rounding.

Table 1-1: DEK Energy Savings per Kit

Kit Size	Population	Reported (kWh)	Gross Verified (kWh)	Realization Rate
Kit 1	1,383	265	335	127%
Kit 2	891	442	363	82%
Program Total	**2,274**	**334**	**346**	**104%**

Table 1-2: DEK Summer Demand Savings per Kit

Kit Size	Population	Reported (kW)	Gross Verified (kW)	Realization Rate
Kit 1	1,383	0.025	0.027	108%
Kit 2	891	0.040	0.032	81%
Program Total	**2,274**	**0.031**	**0.029**	**94%**

Table 1-3: DEK Winter Demand Savings per Kit

Kit Size	Population	Reported (kW)	Gross Verified (kW)	Realization Rate
Kit 1	1,383	0.033	0.036	109%
Kit 2	891	0.053	0.043	81%
Program Total	**2,274**	**0.041**	**0.039**	**95%**

Table 1-4: DEK Program Savings

Measurement	Population*	Reported	Realization Rate	Gross Verified	NTG	Net Verified
Energy (kWh)	2,274	759,814	104%	786,823	108.52%	853,833
Summer Demand (kW)		70	94%	66		72
Winter Demand (kW)		92	95%	88		95

*Reflects adjusted population due to 11.8% of survey respondents indicating that they did not receive a kit.

The proportion of gross verified savings by measure type for the DEK jurisdiction are presented in Figure 1-1. Per unit energy and demand savings for DEK measures are presented in Table 1-5, Table 1-6 and Table 1-7.

Figure 1-1: DEK Proportion of Program Gross Verified Savings by Measure

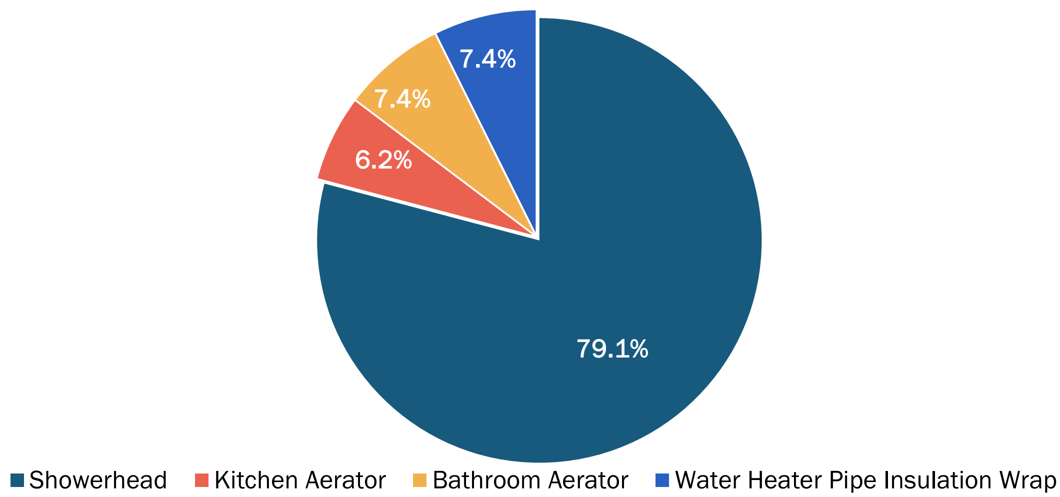


Table 1-5: DEK Measure Reported and Gross Verified Energy Savings Per Unit

Measure	Reported (kWh)	Gross Verified (kWh)	Realization Rate
Showerhead	177.5	187.8	106%
Kitchen Aerator	32.5	21.3	66%
Bathroom Aerator	9.6	12.7	133%
Water Heat Pipe Insulation Wrap*	5.9	4.2	72%

*Savings for water heater pipe insulation wrap is a per linear foot measurement

Table 1-6: DEK Measure Reported and Gross Verified Summer Demand Savings Per Unit

Measure	Reported (kW)	Gross Verified (kW)	Realization Rate
Showerhead	0.0149	0.0134	90%
Kitchen Aerator	0.0023	0.0030	132%
Bathroom Aerator	0.0018	0.0019	106%
Water Heat Pipe Insulation Wrap*	0.0007	0.0005	69%

*Savings for water heater pipe insulation wrap is a per linear foot measurement

Table 1-7: DEK Measure Reported and Gross Verified Winter Demand Savings Per Unit

Measure	Reported (kW)	Gross Verified (kW)	Realization Rate
Showerhead	0.0206	0.0185	90%
Kitchen Aerator	0.0030	0.0039	132%
Bathroom Aerator	0.0024	0.0025	105%
Water Heat Pipe Insulation Wrap*	0.0007	0.0005	69%

*Savings for water heater pipe insulation wrap is a per linear foot measurement

Table 1-8 provides the DEK measure level free ridership and spillover results, along with the corresponding net-to-gross (NTG) ratio.

Table 1-8: DEK Net-To-Gross Effects

Measure	Free Ridership	Spillover	NTG Ratio
Showerhead	12.52%	21.44%	108.92%
Kitchen Aerator	13.65%		107.79%
Bathroom Aerator	11.59%		109.85%
Water Heater Pipe Insulation Wrap	16.68%		104.76%
Program Total	**12.93%**	**21.44%**	**108.52%**

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 exploring participating household feedback and the extent to which the kits effectively motivate households to save energy.

The evaluation team initially conducted web surveys with households that received a kit and additionally supplemented those with phone surveys to ensure proper representation from respondents in each group, collecting a total of 159 responses. The team also conducted in-depth interviews with the Duke Program Team and the implementer for the program, AM Conservation.

1.2.2.1 Program Successes

The 2022-2023 DEK SEWKP evaluation found successes in the following areas:

- Pipe insulation in service rate increased to 42% compared to 30% in the 2018-2019 DEK evaluation.
- Pipe insulation had the highest satisfaction rating of any of the kit measures. Eighty-seven percent of respondents said they were very satisfied with the water heater pipe insulation and another 10% said they were moderately or somewhat satisfied (n=89).
- Most participants (92%) used the online ordering platform to request their kit. Additionally, nearly all (97%) of those respondents said it functioned properly, indicating that the online ordering platform is functioning as intended.
- Participants who watched the installation videos found them helpful, as well as the written instructions. Of the 9% of respondents who watched the online installation videos, 100% found them helpful. Of the 83% of respondents who read the instructions included with the kit, 83% found them helpful.
- Participants were largely satisfied with the program overall. Eighty-one percent of overall participants said they were very satisfied with the program (n=135). An additional 16% said they were moderately or somewhat satisfied with the program.

1.2.2.2 Program Challenges

The 2022-2023 DEK SEWKP evaluation found challenges in the following areas:

- The decreased percentage of electric water heaters in participant homes contributes to lower program savings.
- Kit size determination continues to present challenges. This includes respondents needs for specific numbers of measures not aligning with their household appliances including:
    - 66% of respondents who received only 1 showerhead reported that they have 2 or more showers.
    - 18% of respondents who received 2 showerheads reported that they only have 1 shower.
    - 39% of respondents who received 2 showerheads but only installed one said they did not need a second.
- 11.8% of participants are reporting that they did not receive a kit, leading to a decrease in program population.
- Most participants did not watch the installation videos. Ninety-one percent of overall respondents said they did not watch the installation videos (n=129), though those that did reported they were helpful, indicating potential need for higher awareness.

1.3 Evaluation Conclusions and Recommendations

The evaluation findings led to the following conclusions and recommendations for the program.

Conclusion 1: Most survey respondents (91%) said they did not watch the online installation videos, but all respondents that did watch the videos reported that they were very helpful. Also, 83% of respondents said they read the installation instructions that were included in the kit. Customers who did not read the instructions and did not watch the online installation videos were less likely to install showerheads and kitchen faucet aerators.

> **Recommendation:** The online ordering platform and postcard could provide an opportunity to mention the online installation videos. During the program implementation staff interview, AM Conservation staff noted that the installation videos were recently added directly to the e-commerce site.

> **Recommendation:** Review marketing strategies for the online installation videos and ensure customers are aware of this resource. The instructions included in the kit could also make mention of the online installation videos through a note or incorporation of a feature such as a QR code that is linked to the instruction video website. Future evaluations should assess awareness of the online installation videos through participant surveys.

Conclusion 2: The quantity of showerheads provided in kits do not always align with showers in the recipient homes, and some kits are being provided to homes that do not have an electric water heater. The in-service rate for showerhead 2, provided only in kit 2, is 18% for the DEK 2022-2023 population, while most respondents who did not install showerhead 2 indicate they do not need a second showerhead or do not have a second shower. The current approach for determining which households receive a second showerhead (Kit 2) is dependent upon home square footage data from a third-party data supplier and a threshold of 1,500 square feet set by Duke Energy, where homes containing 1,500 or more square feet of living space receive Kit 2. This methodology does not appear to be consistent with customer self-reported data, which is discussed in detail at the end of Section 5.1.2.8. Additionally, only 77% of survey respondents indicated that they have an electric water heater in their home. These factors both reduce the verified electricity savings attributable to the program.

> **Recommendation:** Incorporate a small set of questions within the online ordering platform and postcard to help verify key participant information. This can include asking participants how many showerheads they want to install, and the type of water heater in their home.

Recommendation: Consider claiming secondary impacts attributable to kit measures. The primary impacts that are typically included in the evaluation of kit measures estimate electricity savings at the water heater in participating homes. Mid-Atlantic TRM v10 provides algorithms to estimate impacts of kit measures for homes that have a natural gas water heater, that can be used in cost-effectiveness calculations for non-electricity savings. There are also secondary electricity impacts for most kit measures due to water savings. Reduced water consumption in homes can be used to estimate electricity savings at municipal water supply and wastewater treatment facilities, which are attributable to all program participants regardless of water heater type. These secondary impacts have been estimated for the DEK 2022-2023 SEWKP program, as outlined in Section 3.5.

Conclusion 3: A significant portion of survey respondents indicated that they did not receive a kit after ordering one. This included 9.0% of Kit 1 recipients and 15.9% of Kit 2 recipients, amounting to 11.8% of the total program population.

Recommendation: The evaluation team and Duke Energy should investigate potential causes of participants claiming they did not receive kits in future evaluations in all jurisdictions. This can be done by incorporating questions regarding kit delivery into IDIs with program implementers, and by adding follow up questions to participant surveys for participants who claim they did not receive a kit.

Conclusion 4: The overall in-service rate of water heater pipe insulation wrap has increased to 42% in the 2022-2023 DEK evaluation, with an in-service rate of 48% for unit 1 and 36% for unit 2, relative to an in-service rate of 30% in the 2018-2019 evaluation. Additionally, 87% of survey respondents indicated they were very satisfied with this measure. This observation is most likely attributed to the new foam insulation sections that are included in program kits, which replaced previously offered insulating pipe tape beginning in 2022.

Recommendation: The evaluation team recommends that Duke Energy continue to offer this type of water heater pipe insulation wrap to program participants. The increase to in-service rate has the potential to increase program savings, while high participant satisfaction with this measure suggests that it will continue to be popular among future program participants in DEK and other jurisdictions.

2 Introduction

2.1 Program Overview

The Save Energy and Water Kit Program (SEWKP) is an energy efficiency program offered by Duke Energy that targets residential customers throughout its Kentucky (DEK) territory who have not yet adopted energy-efficient water devices. Energy savings are achieved through the installation of energy-efficient aerators, showerheads, and water heater pipe insulation wrap, all of which are provided to participants free of charge through an email or direct mail campaign.

2.1.1 Energy Efficiency Kit Measures

Table 2-1 lists the kit contents included in the program. There are two kit sizes. The two kits are identical except for the quantity of showerheads included. Kit 1 includes one showerhead and Kit 2 includes two showerheads.

Table 2-1: Kit Measures and Quantity

Measure	Kit 1	Kit 2
Efficient Showerhead (1.5 GPM)	1	2
Bathroom Faucet Aerator (1.0 GPM)	2	2
Kitchen Faucet Aerator (1.5 GPM)	1	1
Water Heater Pipe Insulation Wrap (3' Foam Section)	2	2

The model of kitchen faucet aerator and water heater pipe insulation provided in the kits are different than those provided in previous program years. The kitchen faucet aerator provided to program year 2022-2023 participants is a 1.5 GPM model, while a 1.0 GPM model was provided previously. The water heater pipe insulation wrap provided to program year 2022-2023 participants is two sections of insulation foam intended for two 3-foot segments of water pipe. Participants in previous program years were provided with a roll of insulating pipe tape.

2.2 Program Implementation

2.2.1 Participant Identification and Recruitment

Duke Energy markets the program to single-family homeowners with electric water heaters who have not previously participated in SEWKP or any other programs with similar measures. Each home's energy consumption data is used to identify which homes likely have electric water heaters and should receive an invitation to participate. Further, Duke Energy assigns either Kit 1 or Kit 2 to each home based on household square footage data provided from a third-party data supplier. Homes with less than 1,500 square feet of living space receive Kit 1 and homes with 1,500 or more square feet of living space receive Kit 2. Customers receive either an email invitation to participate, if one is on file, or a business reply card (BRC) mailing if an email is not on file. Email invitations provide a link for the customer to join the program while BRCs include a detachable reply form for customers to mail back (postage is pre-paid). Customers also have the option to scan a bar code or QR code included on the BRC to enroll via the online platform. AM Conservation then ships the appropriate kit (1 or 2) to registered households.

2.2.2 Participation

The defined evaluation period was February 1, 2022 through May 31, 2023. During this time, the program recorded a total of 2,579 kit recipients in the DEK territory. Of the sampled participants, 9.0% of kit 1 respondents and 15.9% of kit 2 respondents stated they did not receive a kit; therefore, the DEK program population was reduced proportionally to 2,274 for the evaluation. Table 2-2 provides a summary of program population by kit size.

Table 2-2: DEK Program Population

Kit Size	Total Recorded Program Population	Percent of Sample That Did Not Receive Kit	Adjusted Evaluation Program Population
Kit 1	1,520	9.0%	1,383
Kit 2	1,059	15.9%	891
Program Total	**2,579**	**11.8%**	**2,274**

2.3 Key Research Objectives

The primary objective of the impact evaluation was to estimate the gross and net energy and demand savings resulting from program participation at both per kit and program level for the DEK territory. Key focus areas for the impact evaluation included the installation rate and resulting savings of each measure within the SEWKP kits.

The process evaluation objectives were to inform and assess opportunities for improving the design and delivery of SEWKP. The process evaluation also sought to assess kit recipient experiences by investigating the following:

- kit recipients' assessments of the program materials and SEWKP kits in terms of ease of use and quality of instructional content; and
- kit recipients' responses to the SEWKP kits and the extent to which the kits are effective in engaging families in energy and water conservation.

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 kit measures implemented in participants' homes;
- assess the rate of free riders from the participants' perspective and determine spillover effects; and
- 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 the DEK 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?
- Did customers use the provided informational materials? If so, were they satisfied with the materials? If not, why?

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 an evaluation work plan to describe the tasks and processes that will be followed to complete the evaluation;

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 the SEWKP through verification activities of a sample of 2022-2023 program participants.

The following two subsections provide a more detailed description of the impact and process evaluations.

2.4.1 Impact Evaluation

The impact evaluation was comprised of the following key steps, which are described in further detail in Section 3:

Participant surveys: As part of a joint data collection effort with the process portion of the evaluation, the impact evaluation conducted a web and phone-based survey of the participants. These surveys included questions pertaining to key savings parameters such as in-service rates and water heater fuel saturation. Table 2-3 below summarizes the number of surveys completed.

Estimate gross savings: Data collected via participant surveys were used as inputs to engineering algorithms to calculate gross verified energy and demand savings for each measure. The ratio of gross verified (ex post) savings to reported (ex ante) savings within the sample produced the realization rate for each measure. The realization rates were then applied to the program population's reported savings to yield program level gross verified savings estimates.

Estimate net savings: Net impacts reflect 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, which is applied as an adjustment factor to the gross verified 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 EM&V objectives for this research effort, the evaluation team reviewed program documents and conducted web and phone surveys with participating households who received a kit. The team also held in-depth interviews (IDIs) with Duke Energy program staff and the AM Conservation implementation team. Table 2-3 provides a summary of the activities the evaluation team conducted as part of the SEWKP process and impact evaluations.

Table 2-3. DEK SEWKP Summary of Evaluation Activities

Target Group	Population	Sample	Confidence /Precision	Method
Impact Activities				
DEK Kit 1 Participants	1,520	85	90% ± 8.7%	Web and Phone Surveys
DEK Kit 2 Participants	1,059	74	90% ± 9.2%	Web and Phone Surveys
Total Program Participants	**2,579**	**159**	**90% ± 6.3%**	**Web and Phone Surveys**
Process Activities				
DEK Kit 1 Participants	1,520	85	90% ± 8.7%	Web and Phone Surveys
DEK Kit 2 Participants	1,059	74	90% ± 9.2%	Web and Phone Surveys
Total Program Participants	**2,579**	**159**	**90% ± 6.3%**	**Web and Phone Surveys**
Duke Energy Program Staff	n/a	1	n/a	Phone IDI
Implementation Staff	n/a	1	n/a	Phone 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 February 2022 through May 2023. 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 installation of a measure included in the program-provided kit. Net impacts reflect 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.
- Estimate gross verified savings using primary data collected from participants and engineering savings algorithms.
- Compare the sample's reported savings to gross verified savings to calculate measure realization rates, then apply measure realization rates to the program's total reported savings.
- Apply attribution survey data to estimate net-to-gross ratios for each measure and net-verified savings for the program (described in Section 4).

3.2 Sampling Plan and Achievement

To provide representative results and meet program evaluation goals, a sampling plan was created to guide all evaluation activities. A random sample was created to target 90/10 confidence and precision at the program level assuming a coefficient of variation (Cv) equal to 0.5.

After reviewing the program database, the evaluation team identified a population of 2,579 DEK participants within the defined evaluation period. Based on this population, the evaluation team established sub-sample frames for web and phone-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 3-1 below, the evaluation completed 159 surveys among program participants between March 16 and April 5, 2024. This sample size resulted in a precision of ±6.3 at a 90% confidence interval.

Table 3-1: DEK Impact Sampling

Target Group	Population	Sample	Confidence /Precision	Method
DEK Kit 1 Participants	1,520	85	90% ± 8.7%	Web and Phone Surveys
DEK Kit 2 Participants	1,059	74	90% ± 9.2%	Web and Phone Surveys
Total Program Participants	**2,579**	**159**	**90% ± 6.3%**	**Web and Phone Surveys**

3.3 Description of Analysis

3.3.1 Web and Phone-Based Surveys

The evaluation team performed web and phone-based surveys to gather 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 3-2.

Table 3-2: Participant Data Collected and Used for Analysis

Measure	Data Collected	Data Use
Showerhead	Units Installed	In-Service Rate
	Units Later Removed	
	Hot Water Fuel Type	% Electric DHW
	Water Heater Type	Recovery Efficiency
	Frequency of Showers	Hot Water Consumption
	Duration of Showers	
Bathroom Faucet Aerator Kitchen Faucet Aerator	Units Installed	In-Service Rate
	Units Later Removed	
	Hot Water Fuel Type	% Electric DHW
	Water Heater Type	Recovery Efficiency
	Residents per Home	Hot Water Consumption
Water Heater Pipe Insulation Wrap	Units Installed	In-Service Rate
	Units Later Removed	
	Hot Water Fuel Type	% Electric DHW
	Water Heater Type	Recovery Efficiency
	Length of Insulation Installed	Pipe Length

3.3.2 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 surveys were completed for customers receiving one bathroom aerator each, and five customers reported to still have the aerator installed and operable, the ISR for this measure would be 5 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 3-3.

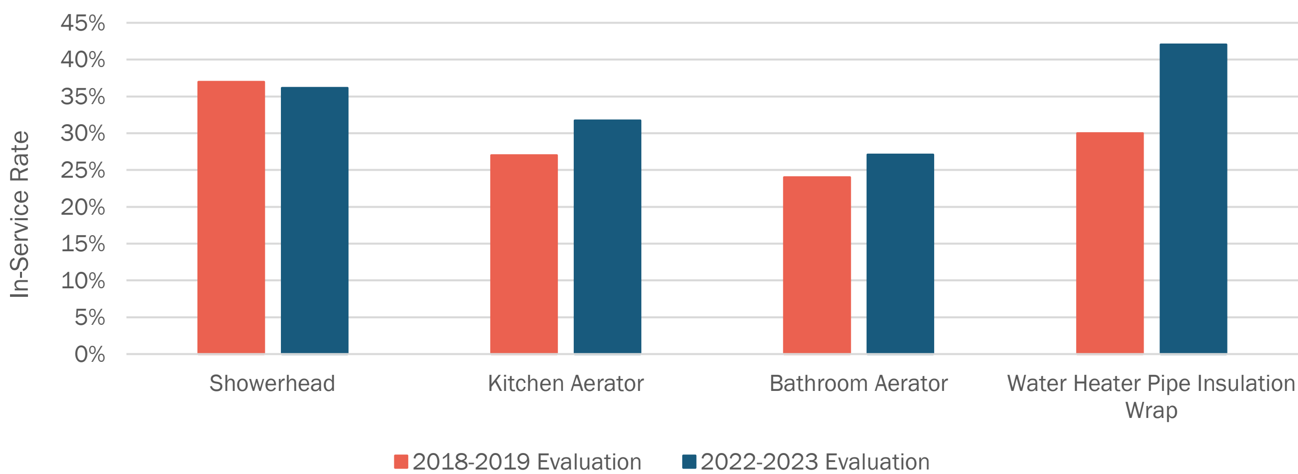
Table 3-3: DEK SEWKP Sample In-Service Rates

Measure	Unit 1	Unit 2	Total
Showerhead	45%	18%	36%
Kitchen Aerator	32%	N/A	32%
Bathroom Aerator	37%	18%	27%
Water Heater Pipe Insulation Wrap*	48%	36%	42%

*Quantity of water heater pipe insulation sections (not feet) in service.

As Figure 3-1 shows, in-service rates have varied in the Kentucky jurisdiction relative to the previous evaluation. In-service rates for showerheads decreased slightly, while in-service rates for other measures increased. The in-service rate for water heater pipe insulation wrap increased showed the largest increase, as 42% of distributed pipe insulation is in-service for 2022-2023 participants compared to 30% for 2018-2019 participants (note the last evaluation had pipe tape).[1]

Figure 3-1: DEK Historical Equipment In-Service Rates



3.3.3 Water Heater Type

The type of water heater in participant homes impacts the savings of all measures in the program kits. Natural gas water heaters do not use electricity to heat water, so there are no primary electricity savings due to water heating attributable to homes with natural gas water

[1] Save Energy and Water Kits 2018-2019 Evaluation Report, September 24th, 2020.

heaters that participate in the program. Savings for homes with electric resistance water heaters or heat pump water heaters are generated by reducing the amount of hot water consumed or by reducing heat lost through water pipes.

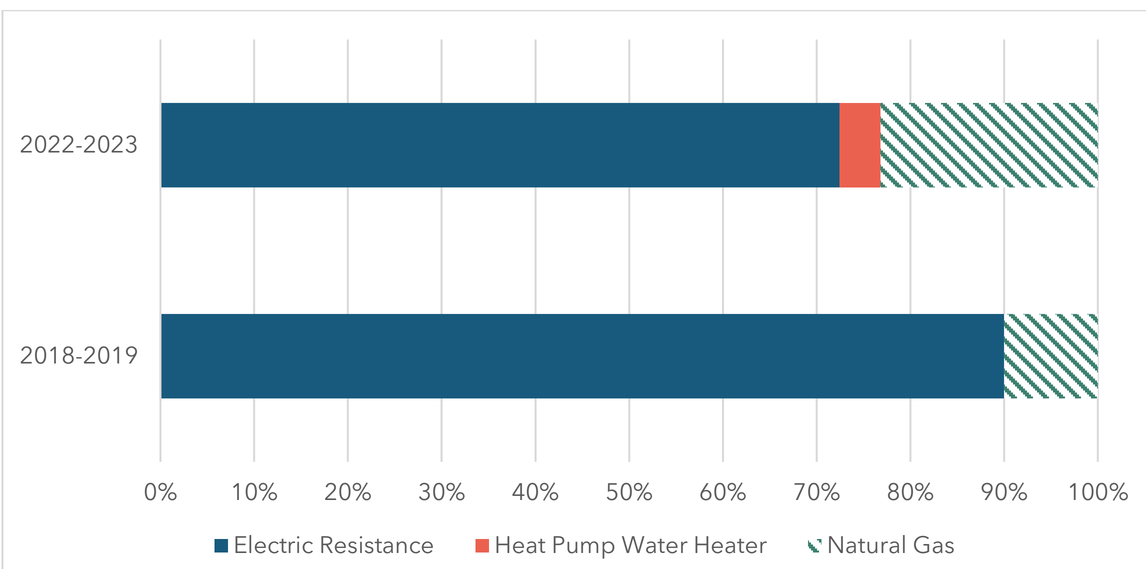
Heat pump water heaters are expected to generate less savings than electric resistance water heaters, as heat pump water heaters are more efficient. Water heater efficiency assumptions were sourced from the Mid-Atlantic TRM v10. Table 3-4 shows the assumed efficiency of each type of water heater, as well as the portion of each water type among sampled participant homes.

Table 3-4: DEK SEWKP Sample Water Heater Types and Assumed Efficiencies

Water Heater Type	Electric Recovery Efficiency (RE)	2024 Evaluation Sample Proportion
Natural Gas	N/A	23.2%
Electric Resistance	0.98	72.5%
Heat Pump Water Heater	2.0	4.3%

The portions of water heater types are also presented in Figure 3-2, alongside reported water heater types of program year 2018-2019 participants. It should be noted that the 2018-2019 evaluation collected data indicating water heater fuel type (electricity or natural gas) and did not distinguish heat pump water heaters.

Figure 3-2: DEK Historical Water Heater Types



3.3.4 Kit Measure Savings

The following section of this report provides a summary of the algorithms used to estimate energy and demand savings for each of the kit items. As much as possible, input parameters referenced program participant responses in the surveys. For inputs more technical in nature and which could not reliably be collected in participant surveys, the evaluation applied deemed values provided by the Mid-Atlantic TRM v10 for showerhead, kitchen aerator, and bathroom aerator measures, as well as deemed values from the Mid-Atlantic TRM v9 for the water heater pipe insulation wrap measure.[2] Input parameters are presented for each measure alongside those used in the 2020 evaluation for comparison. The 2020 evaluation relied on Indiana TRM v2.1 and Ohio TRM 2010 for technical inputs, so there is some variation in TRM sourced parameters that would otherwise be consistent between evaluations.

Verified savings were calculated individually for each measure and participant, then those savings were averaged to derive the measure level savings presented in the remainder of this section and in Section 3.4.

Verified savings were calculated individually for each measure and participant, then those savings were averaged.

Demand savings coincident factors (CF) for the summer and winter seasons were estimated to align with peak demand periods[3] for DEK using the study on residential domestic hot water use referenced by the Mid-Atlantic TRM.[4] This method considers the average hot water uses by fixture type (showerhead, faucet aerator) during the peak period along with the probability of the evaluated daily hours of use occurring within that time frame.

[2] The water heater pipe insulation wrap measure is absent from Mid-Atlantic TRM v10, so Mid-Atlantic TRM v9 was used as an alternate source.
[3] The Kentucky jurisdiction defines the demand peaks as 4pm to 5pm during July (Summer) and 7pm to 8pm during January (Winter).
[4] Aquacraft, DeOreo and Mayer, *The End Uses of Hot Water in Single Family Homes from Flow Trace Analysis*, July 2011

3.3.4.1 Showerheads

The Save Energy and Water Kit contained either one or two efficient showerheads, with the quantity depending on the kit received. Kit 1 participants received one showerhead while those qualifying for Kit 2 received two showerheads.

The algorithm provided by the Mid-Atlantic TRM v10 determines average showerhead savings by calculating the total shower use in the home across all showerheads in the numerator and dividing by the number of showerheads per home in the denominator. The survey instrument developed for this evaluation collected data that is relevant to *only* the showerheads replaced through the program. This was done by asking survey respondents to indicate the average minutes per shower and average showers per day specifically for each showerhead that was retrofitted using fixtures provided by the program. Energy and demand savings algorithms provided by Mid-Atlantic TRM v10 were therefore modified to make use of the data collected to present a more accurate estimation of savings from this measure.

Equation 3-1 and Equation 3-2 below outline the algorithms utilized to estimate savings accrued by the showerhead measure. The average parameters for the 2024 evaluation are shown in Table 3-5. For comparison, Table 3-5 also presents the algorithm input parameters from the 2020 evaluation.

Equation 3-1: Showerhead Energy Savings Algorithm

$$\Delta kWh = ISR \times ELEC \times \frac{(GPM_{base} - GPM_{low}) \times \left(\frac{Time}{Shower}\right)_{SH\ 1,2} \times \left(\frac{Showers}{Day}\right)_{SH\ 1,2} \times 365 \times 8.3 \frac{Btu}{gal \cdot {}^{\circ}\mathrm{F}} \times (T_{out} - T_{in})}{3412 \frac{Btu}{kWh} \times RE}$$

Equation 3-2: Showerhead Demand Savings Algorithm

$$\Delta kW = CF \times \frac{\Delta kWh}{HOU}$$

Where:

$$HOU = \frac{\left(\frac{Time}{Shower}\right)_{SH\ 1,2} \times \left(\frac{Showers}{Day}\right)_{SH\ 1,2}}{60} \times 365$$

Table 3-5: Average Parameters for Showerhead Savings Calculations

<table>
<tr><th>Parameter</th><th>2024 Evaluation Source</th><th>2024 Evaluation</th><th>2020 Evaluation</th></tr>
<tr><td>ISR (All)</td><td>Participant Survey</td><td>36%</td><td>37%</td></tr>
<tr><td>ISR (SH 1)</td><td>Participant Survey</td><td>45%</td><td>-</td></tr>
<tr><td>ISR (SH 2)</td><td>Participant Survey</td><td>18%</td><td>-</td></tr>
<tr><td>ELEC</td><td>Participant Survey</td><td>77%</td><td>90%</td></tr>
<tr><td>GPM_{base}</td><td>Federal Code Maximum</td><td>2.5</td><td>2.5</td></tr>
<tr><td>GPM_{low}</td><td>Program Provided Equipment</td><td>1.5</td><td>1.5</td></tr>
<tr><td>Time (SH 1)</td><td>Participant Survey</td><td>11.5</td><td rowspan="2">9.6</td></tr>
<tr><td>Time (SH 2)</td><td>Participant Survey</td><td>8.8</td></tr>
<tr><td>SPD (SH 1)</td><td>Participant Survey</td><td>1.48</td><td rowspan="2">1.43[5]</td></tr>
<tr><td>SPD (SH 2)</td><td>Participant Survey</td><td>0.57</td></tr>
<tr><td>365</td><td>Days Per Year</td><td>365</td><td>365</td></tr>
<tr><td>T_{out}</td><td>Mid-Atlantic TRM v10</td><td>105</td><td>101</td></tr>
<tr><td>T_{in}</td><td>Mid-Atlantic TRM v10</td><td>57.8</td><td>57.8</td></tr>
<tr><td>RE</td><td>Participant Survey</td><td>1.04</td><td>0.98</td></tr>
<tr><td>Summer CF</td><td>Mid-Atlantic TRM v10, adjusted</td><td>0.0081</td><td>0.0101</td></tr>
<tr><td>Winter CF</td><td>Mid-Atlantic TRM v10, adjusted</td><td>0.0111</td><td>0.0139</td></tr>
</table>

As Table 3-5 shows, the TRM deemed input parameters did not change between the two evaluations. Similarly, the overall in-service rate remained fairly constant. However, the electric water heater fuel saturation was found to be lower in the 2024 evaluation than in the 2020 evaluation. Water heater efficiency increased slightly due to inclusion of heat pump water heaters, which lowers savings.

Recall the number of showerheads provided to each participant is dependent on the size of the kit received; with Kit 1 providing a single showerhead and Kit 2 providing two showerheads. Since the evaluation demonstrated that equipment in-service rates drop as additional items are provided (i.e., a second showerhead) it is important to show the

[5] Calculated as showers per day per person (0.73) * people per home (2.6) / showerheads per home (1.33) presented in Save Energy and Water Kits 2018-2019 Evaluation Report, Table 3-6

difference in estimated savings between the first and second showerhead provided to a participant. Savings presented in Table 3-6 are the average of participant level verified savings of each showerhead within each "Item" category (i.e., Showerhead 1, Showerhead 2, or All Showerheads).

Table 3-6: Showerhead Gross Verified Savings Per Unit

Item	Program Population	ISR	Energy (kWh)	Summer Demand (kW)	Winter Demand (kW)
Showerhead 1	2,274	45%	262.8	0.0172	0.0237
Showerhead 2	891	18%	27.9	0.0054	0.0075
All Showerheads	3,165	36%	187.8	0.0134	0.0185

3.3.4.2 Faucet Aerators

All Save Energy and Water Kits contained one kitchen faucet aerator and two bathroom faucet aerators. Equation 3-3 and Equation 3-4 below outline the algorithms utilized to estimate savings accrued by the faucet aerator measures.

Equation 3-3: Faucet Aerator Energy Savings Algorithm

$$\Delta kWh = ISR \times ELEC \times \frac{(GPM_{base} \times Thr_{base} - GPM_{low} \times Thr_{low}) \times Time \times PH \times 365 \times DR \times 8.3 \times (T_{out} - T_{in})}{3412 \frac{Btu}{kWh} \times RE}$$

Equation 3-4: Faucet Aerator Demand Savings Algorithm

$$\Delta kW = CF \times \frac{\Delta kWh}{HOU}$$

Where:

$$HOU = \frac{PH \times Time}{60} \times 365$$

The average parameters for kitchen faucet aerators are shown in Table 3-7. As with Table 3-5 for showerheads measures, Table 3-7 presents the algorithm input parameters from the 2020 evaluation as well for comparison.

Table 3-7: Average Parameters for Kitchen Faucet Aerator Savings Calculations

Parameter	2024 Evaluation Source	2024 Evaluation	2020 Evaluation
ISR	Participant Survey	32%	27%
ELEC	Participant Survey	77%	90%
GPM_{base}	Federal Code Maximum	2.2	2.2
GPM_{low}	Program Provided Equipment	1.5	1.0
Thr_{base}	Mid-Atlantic TRM v10	0.83	-
Thr_{low}	Mid-Atlantic TRM v10	0.95	-
Time	Participant Survey	4.5	4.5
PH	Participant Survey	2.92	2.7
365	Days Per Year	365	365
DR	Mid-Atlantic TRM v10	50%	50%
T_{out}	Mid-Atlantic TRM v10	93	93
T_{in}	Mid-Atlantic TRM v10	57.8	57.8
RE	Participant Survey	1.04	0.98
Summer CF	Mid-Atlantic TRM v10, adjusted	0.011	0.0051
Winter CF	Mid-Atlantic TRM v10, adjusted	0.0147	0.0067

The TRM algorithm varied between evaluations, as the 2020 evaluation relied on the Indiana TRM. Table 3-7 shows that throttle was applied to the base and efficient case kitchen aerators for the 2024 evaluation, but this parameter is absent from the Indiana TRM methodology employed for the 2020 evaluation. Additionally, the kitchen aerator currently offered by the program is a 1.5 GPM model, instead of the 1.0 GPM model previously offered to program participants. The in-service rate found in the 2024 evaluation is higher than the 2020 evaluation, and participants per household increased slightly between the 2020 and 2024 evaluations. Electric water heater saturation was also found to have decreased between evaluations. Table 3-8 presents the gross verified savings per measure for kitchen aerators.

Table 3-8: Kitchen Faucet Aerator Gross Verified Savings Per Unit

Item	Program Population	ISR	Energy (kWh)	Summer Demand (kW)	Winter Demand (kW)
Kitchen Faucet Aerator	2,274	32%	21.3	0.0030	0.0039

The average parameters for bathroom faucet aerators are shown in Table 3-9, alongside the algorithm input parameters from the 2020 evaluation for comparison.

Table 3-9: Average Parameters for Bathroom Faucet Aerator Savings Calculations

Parameter	2024 Evaluation Source	2024 Evaluation	2020 Evaluation
ISR (All)	Participant Survey	27%	24%
ISR (1^{st})	Participant Survey	37%	-
ISR (2^{nd})	Participant Survey	18%	-
ELEC	Participant Survey	77%	90%
GPM_{base}	Federal Code Maximum	2.2	2.2
GPM_{low}	Program Provided Equipment	1.0	1.0
Thr_{base}	Mid-Atlantic TRM v10	0.83	-
Thr_{low}	Mid-Atlantic TRM v10	0.95	-
Time	Participant Survey	1.6	1.6
PH	Participant Survey	2.92	2.5
365	Days Per Year	365	365
DR	Mid-Atlantic TRM v10	70%	70%
T_{out}	Mid-Atlantic TRM v10	86	86
T_{in}	Mid-Atlantic TRM v10	57.8	57.8
RE	Participant Survey	1.04	0.98
Summer CF	Mid-Atlantic TRM v10, adjusted	0.0039	0.0023
Winter CF	Mid-Atlantic TRM v10, adjusted	0.0052	0.0031

Similar to kitchen faucet aerators, the TRM algorithm varied between evaluations as the 2020 evaluation relied on Indiana TRM. Table 3-9 shows that throttle parameters were not applied in the 2020 evaluation. Additionally, the Indiana TRM requires dividing savings by the number of faucets in the home, while Mid-Atlantic TRM does not. Overall in-service rates increased from the 2020 evaluation.

Both Kit 1 and Kit 2 include two bathroom aerators. Similar to the showerhead measure, it is important to show the difference in estimated savings between the first and second bathroom faucet aerator in a kit since the evaluation demonstrated that equipment in-service rates drop as additional items are provided (i.e. a second aerator). Table 3-10 presents the average participant level verified aerator savings for each "Item" category (i.e. Bathroom Aerator 1, Bathroom Aerator 2, or All Bathroom Aerators).

Table 3-10: Bathroom Faucet Aerator Gross Verified Savings Per Unit

Item	Program Population	ISR	Energy (kWh)	Summer Demand (kW)	Winter Demand (kW)
Bathroom Aerator 1	2,274	37%	17.6	0.0026	0.0034
Bathroom Aerator 2	2,274	18%	7.9	0.0013	0.0017
All Bathroom Aerators	4,548	27%	12.7	0.0019	0.0025

3.3.4.3 Water Heater Pipe Insulation Wrap

All participants received two sections of foam pipe insulation, and each section was 3-feet in length. This is different than the pipe insulation previously provided by the program, as participants before 2022 received a 15-foot roll of water heater pipe insulation wrap with their kit intended to cover 5 linear feet of pipe. To estimate the impacts resulting from the installation of the water heater pipe insulation wrap measure, the evaluation team followed Equation 3-5 and Equation 3-6 as given in Mid-Atlantic TRM v9.

Equation 3-5: Water Heater Pipe Insulation Wrap Energy Savings Algorithm

$$\Delta kWh = ISR \times ELEC \times \frac{\left(\frac{1}{R_{ex}} - \frac{1}{R_{new}}\right) \times L \times C \times \Delta T \times 8{,}760}{RE \times 3{,}412}$$

Equation 3-6: Water Heater Pipe Insulation Wrap Demand Savings Algorithm

$$\Delta kW = \frac{\Delta kWh}{8{,}760}$$

In the same format as showerheads and faucet aerators above, average parameters for both 2020 and 2024 evaluations are shown in Table 3-11.

Table 3-11: Average Parameters for Water Heater Pipe Insulation Wrap Savings Calculations

Parameter	2024 Evaluation Source	2024 Evaluation	2020 Evaluation
ISR (All)	Participant Survey	42%	30%
ISR (1^{st})	Participant Survey	48%	N/A
ISR (2^{nd})	Participant Survey	36%	N/A
ELEC	Participant Survey	77%	90%
R_{ex}	Mid-Atlantic TRM v9	1.00	1.00
R_{new}	Program Provided Equipment	4.66	3.00
L (Total)	Participant Survey	4.67	4.9
L (1^{st})	Participant Survey	2.37	N/A
L (2^{nd})	Participant Survey	2.29	N/A
C	Mid-Atlantic TRM v9, ½" pipe	0.13	0.20
ΔT	Mid-Atlantic TRM v9	65	65
8,760	Hours per Year	8,760	8,760
RE	Participant Survey	1.04	0.98
3,412	BTU per kWh	3,412	3,413

The primary difference between the 2024 and previous 2020 evaluation shown in Table 3-11 was in-service rate. The 2024 evaluation shows that 42% of pipe insulation sections were installed, compared to 30% of insulation tape rolls being used in the 2020 evaluation. However, this measure change also required an adjustment to the assumed pipe circumference (C) from TRMs. The previously offered pipe insulation tape could be applied to any size of pipe, so the evaluation assumed that participants had either ½ inch or ¾ inch pipes in their home. The new foam pipe insulation specifications show that it is designed for ½ inch pipe. Table 3-12 shows the average of participant level verified savings.

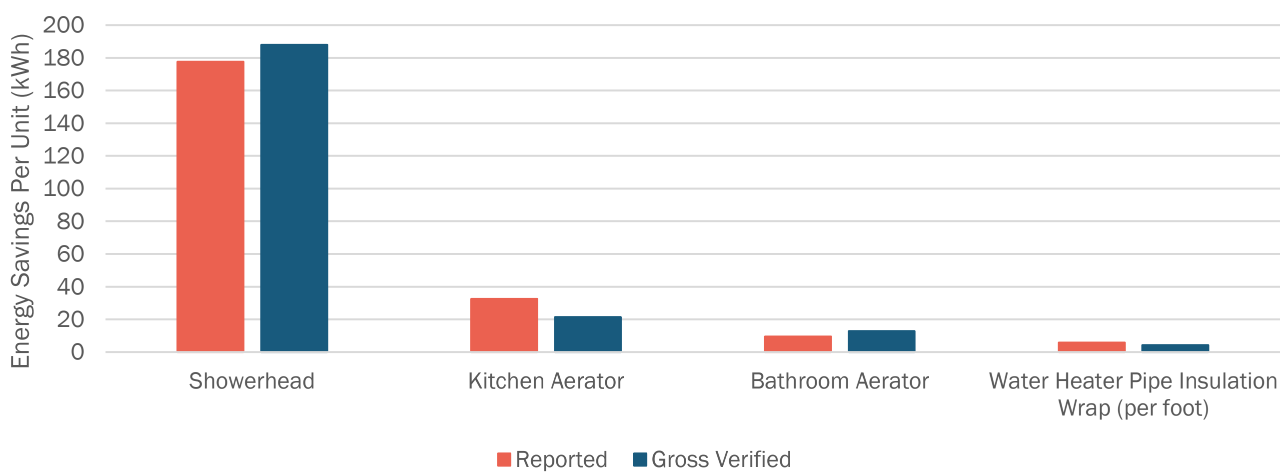
Table 3-12: Water Heater Pipe Insulation Wrap Gross Verified Savings Per Linear Foot

Item	Program Population	ISR	Energy (kWh)	Summer Demand (kW)	Winter Demand (kW)
Pipe Insulation 1	2,274	48%	4.9	0.0006	0.0006
Pipe Insulation 2	2,274	36%	3.6	0.0004	0.0004
All Pipe Insulation	4,548	42%	4.2	0.0005	0.0005

3.4 Results

Participant survey responses in DEK led to energy savings adjustments with a program energy realization rate of 104%. Figure 3-3 and Table 3-13 graphically and numerically compare the reported and gross verified energy savings by measure. Similarly, Table 3-14 and Table 3-15 present measure level reported and gross verified demand savings.

Figure 3-3: DEK Measure Reported and Gross Verified Energy Savings Per Unit



Energy realization rates varied significantly by measure. Changes to the measures provided in kits impacted energy realization rates for kitchen aerator and water heater pipe insulation wrap measures. In-service rates generally increased, but electric water heater saturation decreased. Demand realization rates also varied significantly, due to the same contributing factors. Measure specific differences are discussed above in Section 3.3.

Table 3-13: DEK Measure Reported and Gross Verified Energy Savings Per Unit

Measure	Reported (kWh)	Gross Verified (kWh)	Realization Rate
Showerhead	177.5	187.8	106%
Kitchen Aerator	32.5	21.3	66%
Bathroom Aerator	9.6	12.7	133%
Water Heat Pipe Insulation Wrap*	5.9	4.2	72%

*Savings for water heater pipe insulation wrap is a per linear foot measurement

Table 3-14: DEK Measure Reported and Gross Verified Summer Demand Savings Per Unit

Measure	Reported (kW)	Gross Verified (kW)	Realization Rate
Showerhead	0.0149	0.0134	90%
Kitchen Aerator	0.0023	0.0030	132%
Bathroom Aerator	0.0018	0.0019	106%
Water Heat Pipe Insulation Wrap*	0.0007	0.0005	69%

*Savings for water heater pipe insulation wrap is a per linear foot measurement

Table 3-15: DEK Measure Reported and Gross Verified Winter Demand Savings Per Unit

Measure	Reported (kW)	Gross Verified (kW)	Realization Rate
Showerhead	0.0206	0.0185	90%
Kitchen Aerator	0.0030	0.0039	132%
Bathroom Aerator	0.0024	0.0025	105%
Water Heat Pipe Insulation Wrap*	0.0007	0.0005	69%

*Savings for water heater pipe insulation wrap is a per linear foot measurement

Table 3-16, Table 3-17 and Table 3-18 present energy and demand savings by kit type. Realization rates for Kit 2 were lower than Kit 1 primarily due to a lower in-service rate for the second showerhead included in each kit. Note summary tables may not compute due to rounding.

Table 3-16: DEK Energy Savings per Kit

Kit Size	Population	Reported (kWh)	Gross Verified (kWh)	Realization Rate
Kit 1	1,383	265	335	127%
Kit 2	891	442	363	82%
Program Total	**2,274**	**334**	**346**	**104%**

Table 3-17: DEK Summer Demand Savings per Kit

Kit Size	Population	Reported (kW)	Gross Verified (kW)	Realization Rate
Kit 1	1,383	0.025	0.027	108%
Kit 2	891	0.040	0.032	81%
Program Total	**2,274**	**0.031**	**0.029**	**94%**

Table 3-18: DEK Winter Demand Savings per Kit

Kit Size	Population	Reported (kW)	Gross Verified (kW)	Realization Rate
Kit 1	1,383	0.033	0.036	109%
Kit 2	891	0.053	0.043	81%
Program Total	**2,274**	**0.041**	**0.039**	**95%**

Lastly, Table 3-19 presents the reported and gross verified energy and demand savings achieved by the program in the DEK territory during the evaluation period.

Table 3-19: DEK Program Savings

Measurement	Population	Reported	Gross Verified	Realization Rate
Energy (kWh)	2,274	759,814	786,823	104%
Summer Demand (kW)		70	66	94%
Winter Demand (kW)		92	88	95%

3.5 Secondary Impacts

Mid-Atlantic TRM v10 includes algorithms and assumptions for estimating secondary impacts attributable to each of the measures included in program kits. Secondary impacts include energy savings realized by municipal water infrastructure due to reduced water consumption, as well as fossil fuel savings attributable to participating homes that have a natural gas water heater. The following subsections describe each of these secondary impacts, as well as the expected program results if these secondary impacts are included in the analysis.

3.5.1 Secondary Electric Energy Impacts

Secondary electric energy impacts are estimated as a reduction in energy use at water supply and wastewater treatment facilities resulting from lower water use in homes. Mid-Atlantic TRM v10 provides algorithms for estimating water savings in hundreds of cubic feet (CCF) and provides deemed energy savings per unit of water savings. These savings are attributable to all showerheads and faucet aerators installed through the program, regardless of the type of water heaters in participating homes. There are no water savings associated with water heater pipe insulation wrap.

Mid-Atlantic TRM v10 lists a caveat to claiming these savings: "Please note that utilities' must be careful not to double count the monetary benefit of these savings within cost effectiveness testing if the avoided costs of water already include the associated electricity benefit."

The showerhead water savings algorithm was modified to make use of the data collected to present a more accurate estimation of savings, as previously discussed in Section 3.3.4.1. Equation 3-7 and Equation 3-8 show water savings algorithms for showerheads and faucet aerators, while deemed energy savings per water savings are shown in Equation 3-9.

Equation 3-7: Showerhead Water Savings Algorithm

$$\Delta CCF = ISR \times City \times \frac{(GPM_{base} - GPM_{low}) \times \left(\frac{Time}{Shower}\right)_{SH\ 1,2} \times \left(\frac{Showers}{Day}\right)_{SH\ 1,2} \times 365}{748\frac{Gallons}{CCF}}$$

Equation 3-8: Faucet Aerator Water Savings Algorithm

$$\Delta CCF = ISR \times City \times \frac{(GPM_{base} \times Thr_{base} - GPM_{low} \times Thr_{low}) \times Time \times PH \times 365 \times DR}{748\frac{Gallons}{CCF}}$$

Equation 3-9: Deemed Energy Savings per Water Savings

$$\Delta kWh = 2.07\frac{kWh}{CCF} \times \Delta CCF$$

All parameters for these equations are as given above in Table 3-5 for showerheads, Table 3-7 for kitchen faucet aerators, and Table 3-9 for bathroom faucet aerators, with the exception of the *City* parameter. This represents the portion of survey respondents that source their water from municipal sources. It was found that 97% of survey respondents source their water from their municipality (*City* = 0.97). Table 3-20 shows the average secondary energy savings per participant for each measure.

Table 3-20: DEK Gross Verified Secondary Energy Savings Per Unit

Item	Water (CCF)	Secondary Energy (kWh)
Showerhead 1	4.0182	8.3176
Showerhead 2	0.4664	0.9655
Kitchen Aerator	0.4190	0.8674
Bathroom Aerator 1	0.5024	1.0399
Bathroom Aerator 2	0.2259	0.4676

Inclusion of secondary energy impacts leads to increased electricity savings for showerheads, kitchen faucet aerator, and bathroom faucet aerators. The change in realization rate varies with each measure, due to differences in the amount of water saved and reported energy savings. Table 3-21 presents adjusted realization rates and gross verified energy savings for all measures, while Table 3-22 presents a comparison of adjusted realization rates and primary kit measure realization rates that were discussed in Section 3.4.

Table 3-21: DEK Measure Reported and Adjusted Gross Verified Energy Savings Per Unit

Measure	Reported (kWh)	Adjusted Gross Verified (kWh)	Adjusted Energy Realization Rate
Showerhead	177.5	193.79	109.18%
Kitchen Aerator	32.5	22.18	68.24%
Bathroom Aerator	9.6	13.50	140.66%
Water Heat Pipe Insulation Wrap*	5.9	4.24	71.93%

*Savings for water heater pipe insulation wrap is a per linear foot measurement

Table 3-22: DEK Measure Energy Realization Rate Adjustments

Measure	Primary Realization Rate	Adjusted Realization Rate	Realization Rate Change
Showerhead	105.82%	109.18%	+3.36%
Kitchen Aerator	65.57%	68.24%	+2.67%
Bathroom Aerator	132.81%	140.66%	+7.85%
Water Heat Pipe Insulation Wrap*	71.93%	71.93%	0.00%

Table 3-23 presents adjusted energy savings per kit due to the inclusion of secondary electricity savings. Similarly, Table 3-24 shows adjusted program savings.

Table 3-23: DEK Adjusted Energy Savings per Kit

Kit Size	Population	Reported (kWh)	Adjusted Gross Verified (kWh)	Adjusted Realization Rate
Kit 1	1,383	265	345.8	131%
Kit 2	891	442	374.7	85%
Program Total	**2,274**	**334**	**357.1**	**107%**

Table 3-24: DEK Program Adjusted Energy Savings

Measurement	Population	Reported	Adjusted Gross Verified	Adjusted Realization Rate
Energy (kWh)	2,274	759,814	811,996	107%

Table 3-25 shows a comparison of adjusted realization rates and primary realization rates that were discussed in Section 3.4. Inclusion of secondary electricity impacts increases the program energy realization rate by 3.31%.

Table 3-25: DEK Kit Energy Realization Rate Adjustments

Measure	Primary Realization Rate	Adjusted Realization Rate	Realization Rate Change*
Kit 1	127%	131%	+4.04%
Kit 2	82%	85%	+2.64%
Program Total	**104%**	**107%**	**+3.31%**

*Program total realization rate change may not compute due to rounding.

3.5.2 Fossil Fuel Impacts

Fossil fuel impacts are estimated as a reduction in fuel use for participating homes that have a fossil fuel water heater. The calculations are similar to those for participants with an electric water heater. Equation 3-10, Equation 3-11 and Equation 3-12 show fossil fuel impact algorithms for showerheads, faucet aerators, and water heater pipe insulation wrap, respectively.

Equation 3-10: Showerhead Fossil Fuel Savings Algorithm

$$\Delta MMBTU = ISR \times Gas \times \frac{(GPM_{base} - GPM_{low}) \times \left(\frac{Time}{Shower}\right)_{SH\,1,2} \times \left(\frac{Showers}{Day}\right)_{SH\,1,2} \times 365 \times 8.3\frac{Btu}{gal \cdot °\mathrm{F}} \times (T_{out} - T_{in})}{10^6 \times RE}$$

Equation 3-11: Faucet Aerator Fossil Fuel Savings Algorithm

$$\Delta MMBTU = ISR \times Gas \times \frac{(GPM_{base} \times Thr_{base} - GPM_{low} \times Thr_{low}) \times Time \times PH \times 365 \times DR \times 8.3 \times (T_{out} - T_{in})}{10^6 \times RE}$$

Equation 3-12: Water Heater Pipe Insulation Wrap Fossil Fuel Savings Algorithm

$$\Delta MMBTU = ISR \times Gas \times \frac{\left(\frac{1}{R_{ex}} - \frac{1}{R_{new}}\right) \times L \times C \times \Delta T \times 8{,}760}{10^6 \times RE}$$

All parameters for these equations are as given above in Table 3-5 for showerheads, Table 3-7 for kitchen faucet aerators, Table 3-9 for bathroom faucet aerators, and Table 3-11 for water heater pipe insulation wrap, with the exception of the *Gas* and *RE* parameters. *Gas* represents the portion of participant survey respondents that have a fossil fuel water heater installed in their home, which was found to be 23% (*Gas* = 0.23). *RE* represents the recovery efficiency of the water heater, which is listed as 80% for gas water heaters in Mid-Atlantic TRM v10 (*RE* = 0.80). Table 3-26 shows average gross verified fossil fuel savings per participant (average for all participants) for each measure.

Table 3-26: DEK Gross Verified Fossil Fuel Savings Per Unit

Item	Fossil Fuel Savings (MMBTU)
Showerhead 1	0.4758
Showerhead 2	0.0484
Kitchen Aerator	0.0232
Bathroom Aerator 1	0.0406
Bathroom Aerator 2	0.0170
Water Heat Pipe Insulation Wrap 1*	0.0060
Water Heat Pipe Insulation Wrap 2*	0.0040

*Savings for water heater pipe insulation wrap is a per linear foot measurement

Table 3-27 presents fossil fuel savings attributable to program participants that do not possess an electric water heater. Savings are shown at the kit level and program level for each kit type, as well as program total MMBTU savings.

Table 3-27: DEK Fossil Fuel Savings

Kit Size	Population	Gross Verified Savings per Kit (MMBTU)	Program Gross Verified Savings (MMBTU)
Kit 1	1,383	0.5866	811
Kit 2	891	0.6350	566
Program Total	**2,274**	**0.606**	**1,377**

4 Net-To-Gross

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).[6] 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 Equation 4-1 to calculate the NTG ratio.

Equation 4-1: Net-To-Gross Algorithm

$$NTG = 100\% - FR + SO$$

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 100%, with 0% being no free ridership and 100% 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), according to Equation 4-2.

Equation 4-2: Free Ridership Algorithm

$$FR = \frac{FRC + FRI}{2}$$

[6] 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*

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.

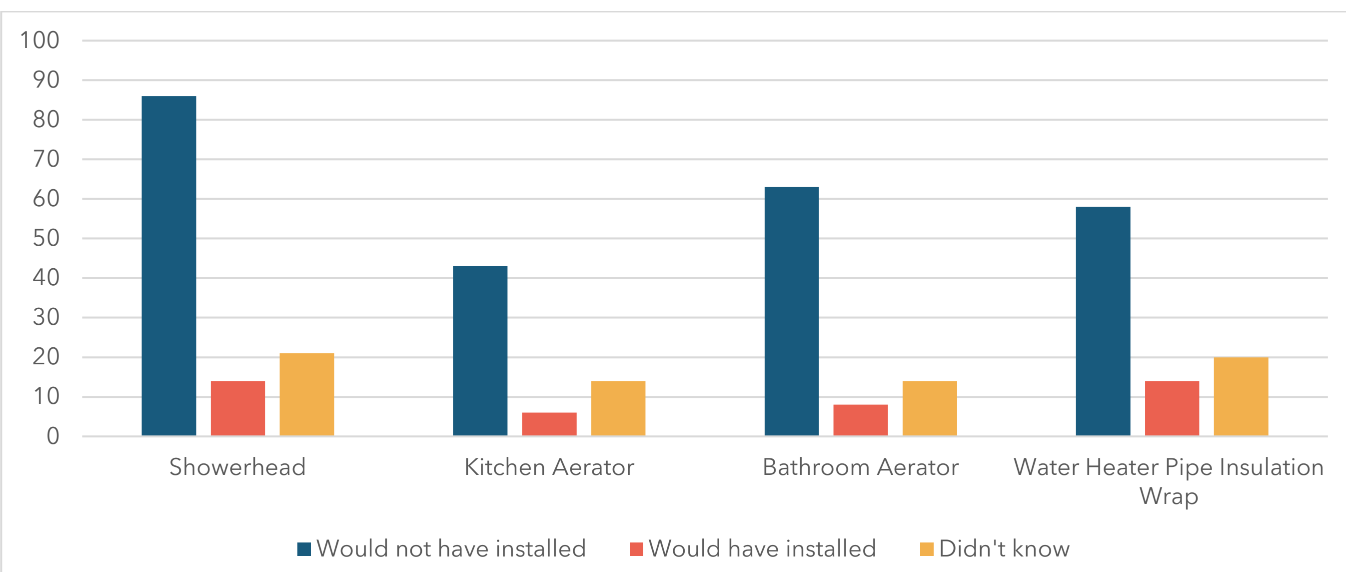
Specifically, the survey asked respondents which, if any, of the currently installed items they would have purchased and installed on their own within the next year if Duke Energy had not provided them. For respondents who installed more than one of a given measure (bathroom aerators or showerheads) 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 participant and each installed measure, the evaluation team assigned one of the FRC values:

- Would not have installed the measure on their own – no free ridership (0% FRC)
- Would have installed the measure on their own – full free ridership (100% FRC)
- Did not know if they would have installed the measure on their own – partial free ridership (50% FRC)

The responses for free ridership change are shown in Figure 4-1.

Figure 4-1. Free Ridership Change



The free ridership change values for each measure are averaged, and are shown in Table 4-1.

Table 4-1: Free Ridership Change by Measure

Measure	Count	Free Ridership Change
Showerhead	121	20.25%
Kitchen Aerator	63	20.63%
Bathroom Aerator	85	17.65%
Water Heater Pipe Insulation Wrap	92	26.09%

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 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.

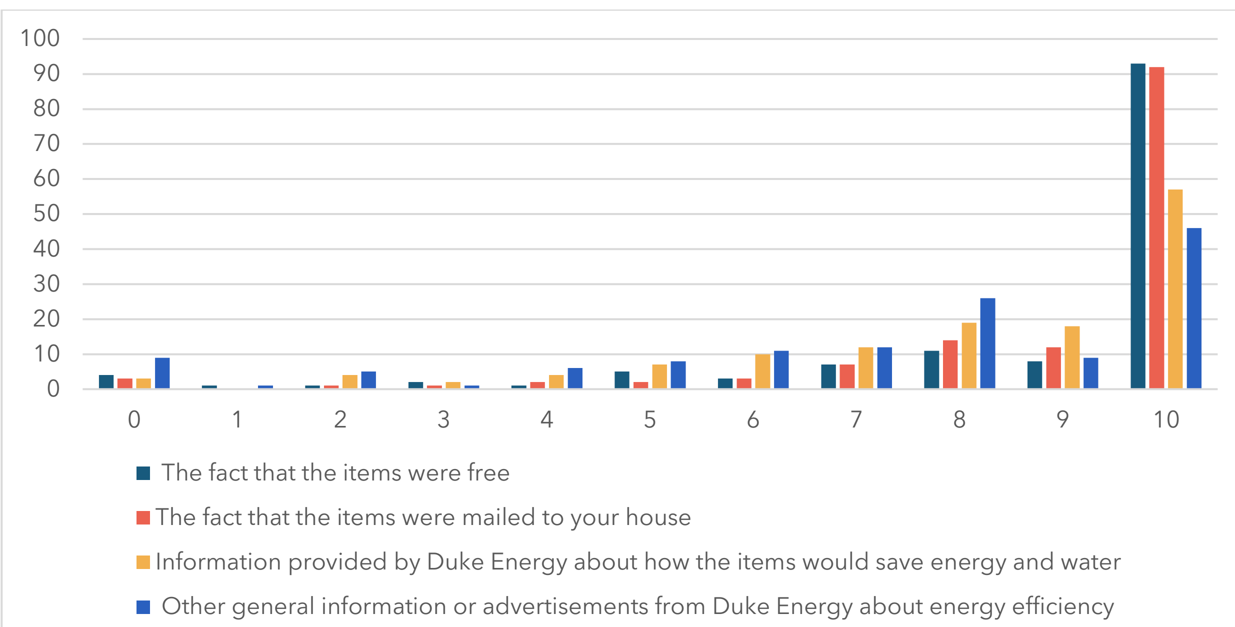
FRI is based on the highest-rated item in the FRI battery. The evaluation team assigned the FRI scores shown in Table 4-2, based on that rating.

Table 4-2: Free Ridership Influence Values

Highest Influence Rating	FRI Value
0	100%
1	90%
2	80%
3	70%
4	60%
5	50%
6	40%
7	30%
8	20%
9	10%
10	0%

The responses for free ridership influence are shown in Figure 4-2.

Figure 4-2. Free Ridership Influence



The free ridership influence values for each measure are shown in Table 4-3.

Table 4-3: Free Ridership Influence by Measure

Measure	Count	Free Ridership Influence
Showerhead	121	4.79%
Kitchen Aerator	63	6.67%
Bathroom Aerator	85	5.53%
Water Heater Pipe Insulation Wrap	92	7.28%

4.1.3 Total Free Ridership

The evaluation team calculated the total free ridership by measure by calculating the average between each measure's change and influence score, then savings weighting each result with the evaluated per unit savings for each unit installed by respondents to derive the overall total.

The evaluation team then estimated overall program level free ridership by calculating a savings-weighted mean of the measure-specific FR scores. The ridership calculated for each measure is presented in Table 4-4.

Table 4-4: Free Ridership by Measure

Measure	Response Count	Confidence Interval	Free Ridership
Showerhead	121	7.4%	12.52%
Kitchen Aerator	63	10.3%	13.65%
Bathroom Aerator	85	8.9%	11.59%
Water Heater Pipe Insulation Wrap	92	8.4%	16.68%

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 primarily on previous Duke Energy Smart$aver and other recent evaluations to be consistent across programs, which draw upon ENERGY STAR® calculators and algorithms and parameter assumptions listed in the Mid-Atlantic TRM v9 and v10. Spillover measures that were not represented in recent evaluations were sourced from Illinois TRM v12 assumptions.

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 shown in Equation 4-3.

Equation 4-3: Participant Measure Spillover Algorithm

$$PMSO = Deemed\ Measure\ Savings\ (kWh) \times Program\ Attributable\ Percentage$$

The evaluation team summed all PMSO savings values for the DEK jurisdiction, which are presented in Table 4-5.

Table 4-5: DEK Sample PMSO by Measure

Measure	Average Assigned Weight	Attributable Savings (kWh)
Window sealing	70%	2,136
Attic insulation	100%	2,043
LEDs	79%	1,649
Door sealing	74%	1,420
Smart thermostat	78%	1,251
Floor insulation	85%	831
Wall insulation	100%	798
Duct sealing or insulation	73%	556
Washer	93%	391
Installed low flow shower heads with pause functions	90%	308
Faucet	95%	115
Air conditioning	60%	108
Efficient Windows	75%	106
Dishwasher	80%	96
Dryer	100%	92
Aerators	100%	60
Refrigerator	57%	60
Stove	50%	12
Pipe insulation	40%	5
Total		**12,036**

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, as shown in Table 4-6.

Table 4-6: DEK Sample Gross Program Savings

Measure	Installed Count	Verified Sample Savings (kWh)
Showerhead	121	41,364
Kitchen Aerator	63	3,543
Bathroom Aerator	85	5,487
Water Heater Pipe Insulation Wrap	92	5,738
Total		**56,132**

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, as presented in Equation 4-4.

Equation 4-4: Program Spillover Algorithm

$$Program\ SO = \frac{\sum PMSO}{\sum Sample\ Gross\ Program\ Savings}$$

$$DEK\ SO = \frac{12{,}036}{56{,}132} = 21.44\%$$

These calculations produced a spillover estimate of 21.44% for the DEK program.

4.3 Net-To-Gross

Inserting the FR and SO estimates into Equation 4-1 produces a NTG value for each measure. Measure NTG values are shown below in Table 4-7.

Table 4-7: Net-To-Gross Results

Measure	Free Ridership	Spillover	Measure NTG	Program NTG
Showerhead	12.52%	21.44%	108.92%	108.52%
Kitchen Aerator	13.65%		107.79%	
Bathroom Aerator	11.59%		109.85%	
Water Heater Pipe Insulation Wrap	16.68%		104.76%	

The evaluation team applied this NTG ratio to program gross verified savings to calculate SEWKP kit net savings for DEK, as shown in Table 4-8.

Table 4-8: DEK Net Verified Program Savings

Measurement	Population	Gross Verified	NTG	Net Verified
Energy (kWh)	2,274	786,823	108.52%	853,833
Summer Demand (kW)		66		72
Winter Demand (kW)		88		95

5 Process Evaluation

The process evaluation is based on an interview with program staff and surveys with households who requested the Save Energy & Water kit during the program year. Table 5-1 shows the data collection activities.

Table 5-1. Summary of Process Evaluation Data Collection Activities

Target Group	Method	Sample Size	Precision and 90% Confidence
Duke Energy Program Staff	Phone in-depth interview	1	N/A
Program Implementation Staff	Phone in-depth interview	1	N/A
Households	Web/phone survey	Kit 1: 85 Kit 2: 74	Kit 1: 8.7% Kit 2: 9.2%

5.1 Process Evaluation Findings

5.1.1 Interviews with Key Contacts

The program staff interviews helped the evaluation team understand how the program operates, learn of perceived successes and challenges, and informed the design of the survey guides for program participants and implementers.

5.1.1.1 Program Staff

The program staff interview conducted by the evaluation team focused on program goals, program implementation, and communication strategies. According to the program staff the program has been performing well, and since transitioning to a new vendor, they have exceeded participation goals. They informed the evaluation team that the costs are aligned with the kit expenses, and while they're spending more overall, it's directly related to the kits. Although they continue to use direct mail and email, the program staff mentioned that efficient email marketing has contributed to cost-effectiveness. Overall, they are meeting or exceeding their goals for both costs and participation.

When the evaluation team enquired about communication with the implementation staff, the Duke Energy program staff expressed satisfaction. According to them, since partnering with the vendor, communication has been effective, with regular weekly calls. They also added that sometimes reporting complexity regarding tracking kits arises and they are working on refining the reporting processes. They reported that the program tracks kit data at the measure level. For every shipped kit, the vendor specifies individual components (such as pipe wrap and showerheads). According to the program staff this granularity helps them to ensure accurate reporting. They also added that they have launched a platform to provide insights into customer choices regarding upgrades (in future program years) or standard kits to allow customers to customize their selection.

Additionally, when asked about the effect of the pandemic on their program, the Duke Energy program staff mentioned that there have not been any lingering pandemic-related problems in 2022 or 2023, and the supply chain seems unaffected.

5.1.1.2 Program Implementation Staff

The Evaluation Team conducted an interview with key implementer staff from AM Conservation that are responsible for administering the Save Energy and Water Kit offering in the Kentucky territory. The primary objective of the interview was to gain deeper insights into various aspects of the program, including program goals, delivery processes, roles and responsibilities, communication with Duke Energy, and any barriers perceived during program implementation. Although the program implementer began conversations with Duke Energy in 2021, they were officially brought into the program in January 2022. The timeframe for this evaluation is February 1st, 2022, through May 31st, 2023. According to the implementation staff, since 2023 there has been a focus on driving customers to the E-commerce platform, where they can opt in for a kit.

According to the implementation team, Duke Energy manages its own marketing efforts (because it is an invitation only program), aiming to collect orders from interested customers through email campaigns and outreach. They added that while enrollment can be done online, all verification processes are managed by Duke. However, when it comes to tracking kits for processing and distribution, that responsibility lies with the AM Conservation team.

The implementation team reported that they usually ship kits twice a week through USPS. The program allows customers to opt in through two methods: email campaigns and business reply cards (BRC). According to the staff, BRCs are mainly used for hard-to-reach areas. They reported that in 2022 and 2023, the direct mail (BRC) campaign achieved an approximately 6% conversion rate, while the email campaign was at 7%. The implementation staff notes that compared to other mass marketing efforts, this program's conversion rates are notably higher.

The implementation team clarified that although they provide monthly reports on kit processing, the frequency of processing is contingent upon Duke's marketing activities. In other words, the team tailors their processing schedule based on the marketing initiatives undertaken by Duke. In terms of data tracking, the AM Conservation team stated that when a kit is processed and assigned a tracking number, they promptly report it back to Duke. They said this ensures accurate recording in Duke's participation database. The team noted that the system has been effective, tracking returns and maintaining an accurate count. Because they find that the current web service transfer between databases works well, they do not foresee any future change.

When the evaluation team inquired about the proportion of households that submitted a kit survey form but were ineligible to receive a kit, the staff from the implementation team mentioned that the likelihood of someone completing the survey but not participating is slim. This is because Duke specifically markets the program to eligible customers.

The implementation team reported that in their ongoing collaboration, the team maintains regular communication with Duke Energy. They have a standing weekly call, and some of the staff have additional weekly calls with key program staff on Duke's side. Additionally, they hold biweekly call center meetings. According to the team, these efforts are effective for program implementation and well-coordinated.

When asked about the feedback from the participants, the team reported that the program had received positive feedback. Participants expressed a desire to save money on their electric bills, as well as an appreciation for the water-saving benefits of the products, but the implementation team did note there are occasional cases where older individuals may need assistance with installation. In those instances, they proactively reach out to guide and support them. Overall, they felt the program has been well-received by participants.

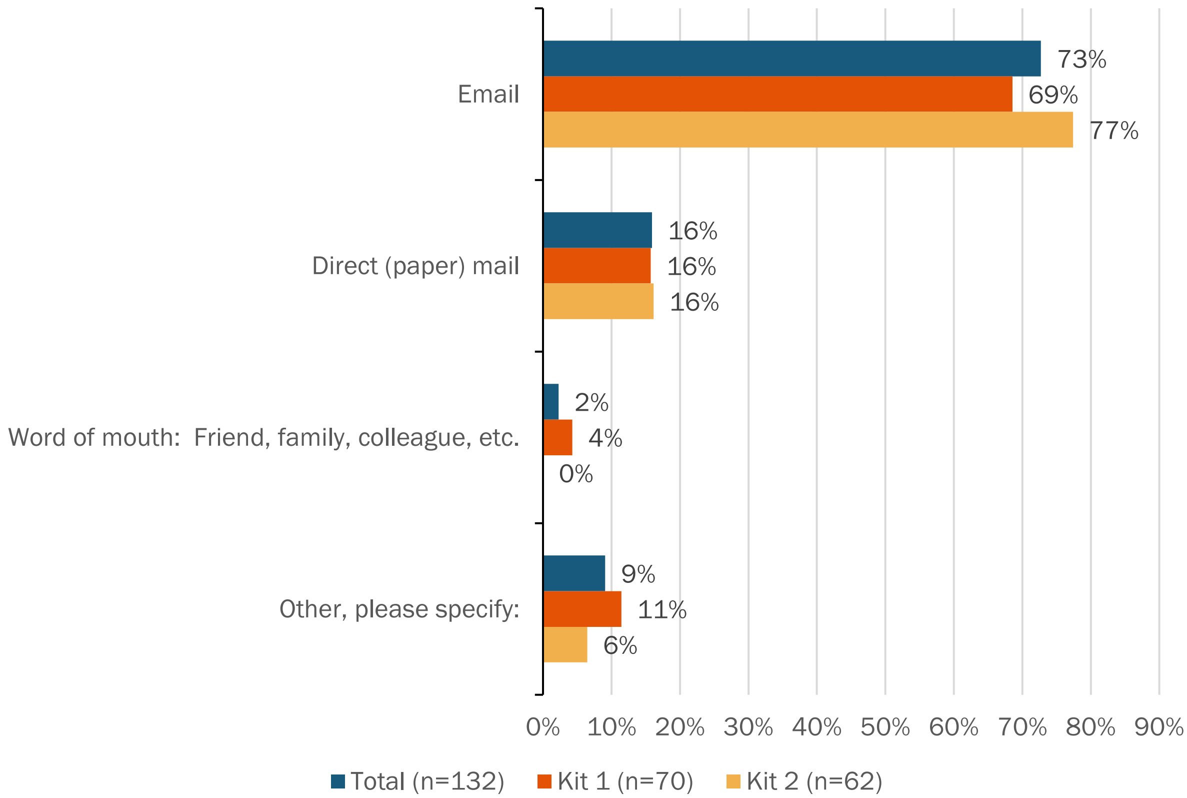
The implementation staff emphasized effective communication as a key strength of the program. They highlighted the importance of constant communication between team members on both the Duke Energy side and their own side, which contributes to the program's smooth operation. They also praised the high-quality products within the kit. According to them, customers expressed excitement about the offerings, and the current kit seems to resonate well with users. In their ongoing efforts to enhance the customer experience, the team collaborates with Duke Energy to ensure customers feel comfortable installing the products. They reported that recently, they have improved this by providing installation videos directly on the e-commerce site.

5.1.2 Participant Survey

5.1.2.1 Learning About the Program

Participants mainly learned about the program through email (69% of Kit 1 respondents; 77% of Kit 2 respondents), and fewer participants learned about the program through direct mail (16% of Kit 1 respondents; 16% of Kit 2 respondents) as seen in Figure 5-2. Participants also reported learning about the program by word-of-mouth (4% of Kit 1 respondents; 0% of Kit 2 respondents), however they would not be able to participate without an invitation from Duke Energy. Respondents also provided responses other than what was offered in the survey including learning about it through their energy bill and other online sources.

Figure 5-1: Participant Awareness Sources

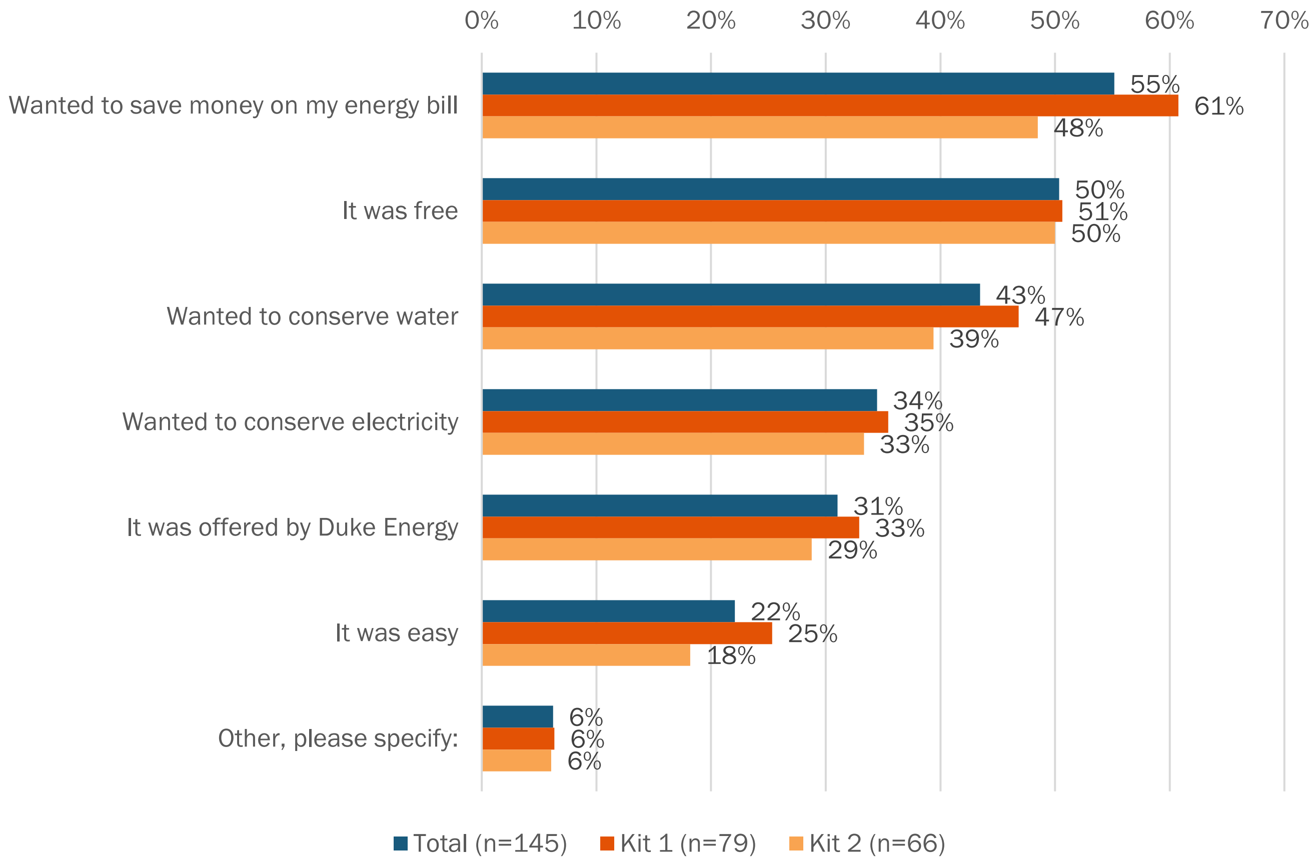


2022-2023 DEK SEWKP Evaluation: Participant Survey Question 3: "How did you learn about the Save Energy and Water Kit offering?" (n=132).

5.1.2.2 Motivation to Request Kits

Figure 5-3 shows participants were mainly motivated to request a free kit to save money on their energy bills (61% of Kit 1 respondents; 48% of Kit 2 respondents). Other motivations included that the kit was free (51% of Kit 1 respondents, 50% of Kit 2 respondents), wanting to conserve water (47% of Kit 1 respondents; 39% of Kit 2 respondents), and that respondents wanted to conserve electricity (35% of Kit 1 respondents; 33% of Kit 2 respondents).

Figure 5-2: Customer Motivation to Request a Kit

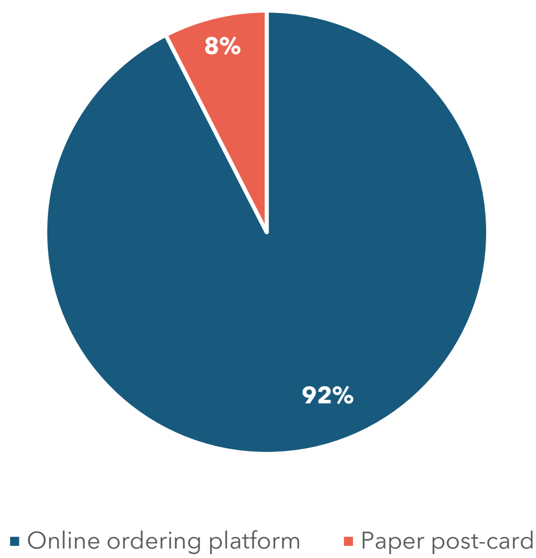


2022-2023 DEK SEWKP Evaluation: Participant Survey Question 4: "What motivated you to request a free Save Energy and Water Kit from Duke Energy?" Multiple responses allowed (n=145).

5.1.2.3 Invitations to Participate

The SEWKP is invite-only, meaning that program staff from Duke Energy must send out invitations to eligible participants to participate in the program. The direct mail is a Business Reply Card (BRC) with pre-paid postage for participants to request a kit through the program implementer. The email communication leads participants to the online ordering platform to request their free kit. Ninety-two percent of survey respondents used the online ordering platform to request their kit, as seen in Figure 5-4, and almost all respondents (97%) reported that the platform functioned properly. Only 8% of respondents used the BRC to request their kit.

Figure 5-3: Enrollment Method Reported by Survey Respondents

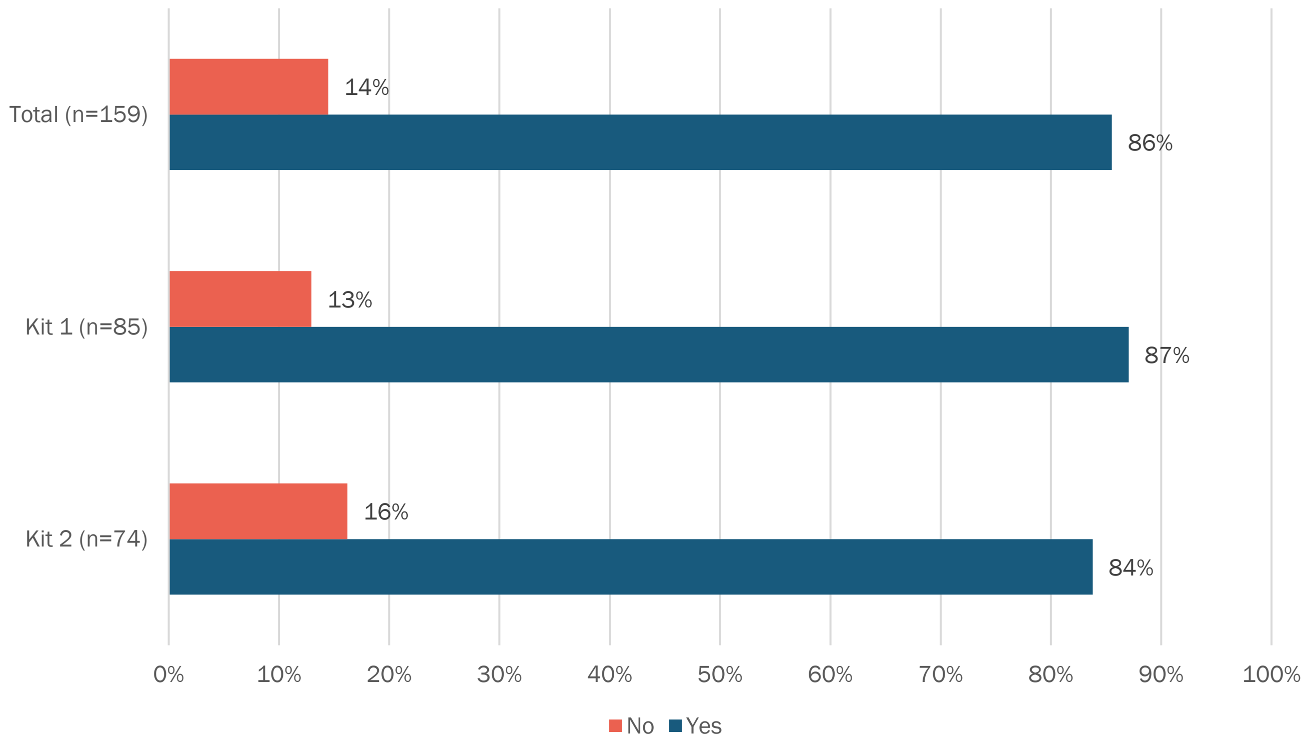


2022-2023 DEK SEWKP Evaluation: Participant Survey Question 5: "Did you order the kit through the website or using the paper post-card?" (n=146).

5.1.2.4 Participant Installation and Uninstallation Rates

Most kit recipients (87% of Kit 1 respondents; 84% of Kit 2 respondents) installed at least one measure from the kit. Figure 5-5 shows this breakdown among respondents overall as well as by kit type.

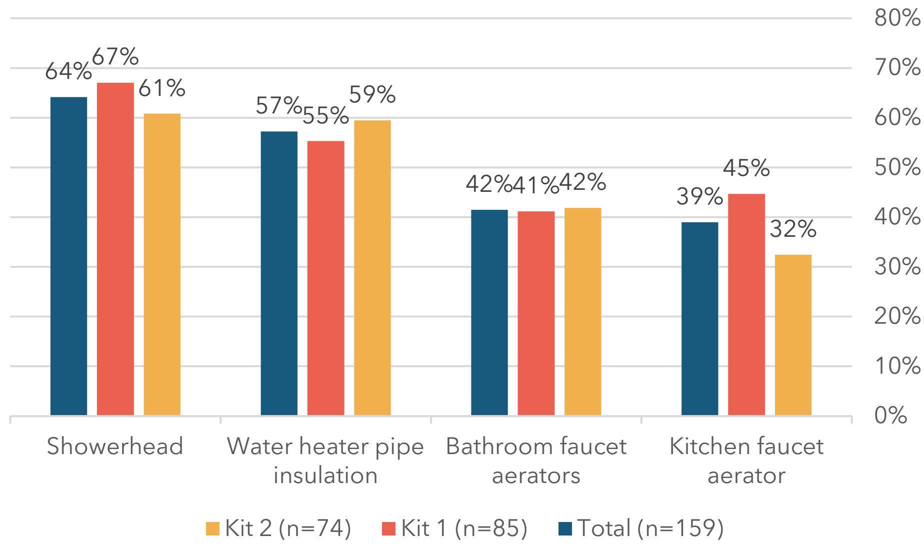
Figure 5-4: Respondent Installation of Items in Their Kit



2022-2023 DEK SEWKP Evaluation: Participant Survey Question 8: "Have you or anyone else **installed** any of those items in your home, even if they were taken out later?" (n=159).

As shown in Figure 5-6, showerheads were the most commonly installed measure with 64% of respondents overall reporting they installed at least one. Additionally, 57% of respondents indicated they initially installed at least one section of water heat pipe insulation, 42% said they installed at least one bathroom faucet aerator and 39% said they installed the kitchen faucet aerator.

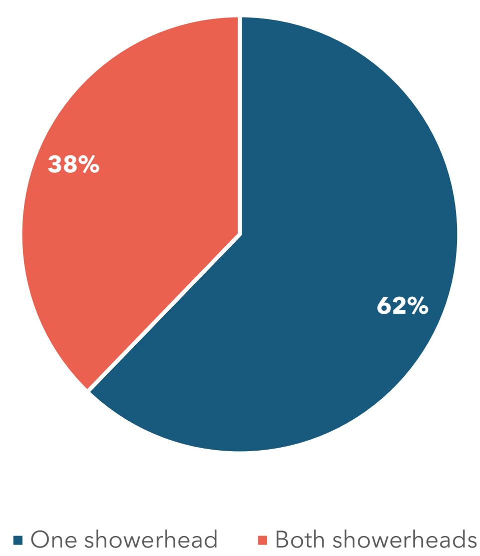
Figure 5-5: Respondent Initial Installation Rates



2022-2023 DEK SEWKP Evaluation: Participant Survey Question 15: "Which of the items were installed, even if they were taken out later?" Multiple responses allowed (n=159).

When looking at installation of showerheads among Kit 2 recipients, the evaluation team noted that respondents were more likely to install only one showerhead. As shown in Figure 5-7, of the respondents who received Kit 2 and indicated they installed showerheads, only 38% said they installed both.

Figure 5-6: Kit 2 Recipient Showerhead Installation



2022-2023 DEK SEWKP Evaluation: Participant Survey Question 16: "Your kit contained two showerheads. How many of the showerheads from the kit were installed in your home, even if one or both were taken out later?" (n=45).

Additionally, the evaluation team asked respondents who only installed one showerhead what their reasons were for not installing the second. As shown in Table 5-2, the most common reason was that respondents said they did not need a second showerhead, followed by respondents saying they do not have a second shower.

Table 5-2: Reasons for Not Installing the Second Showerhead

Reasons for not installing the second showerhead (n=28)	
I do not need a second showerhead	39%
I do not have a second shower	32%
I did not like the color/finish	7%
I did not like the water spray pattern	4%
Other, please specify:	18%

2022-2023 DEK SEWKP Evaluation: Participant Survey Question 17: "What was the **primary** reason the second showerhead was not installed?" (n=28).

When looking at installation of bathroom faucet aerators among respondents, the evaluation team found that 50% of respondents overall installed both aerators, though there was some difference between kit sizes. Table 5-3 shows the full breakdown of responses from respondents overall as well as by kit size, among those who indicated they installed at least one aerator.

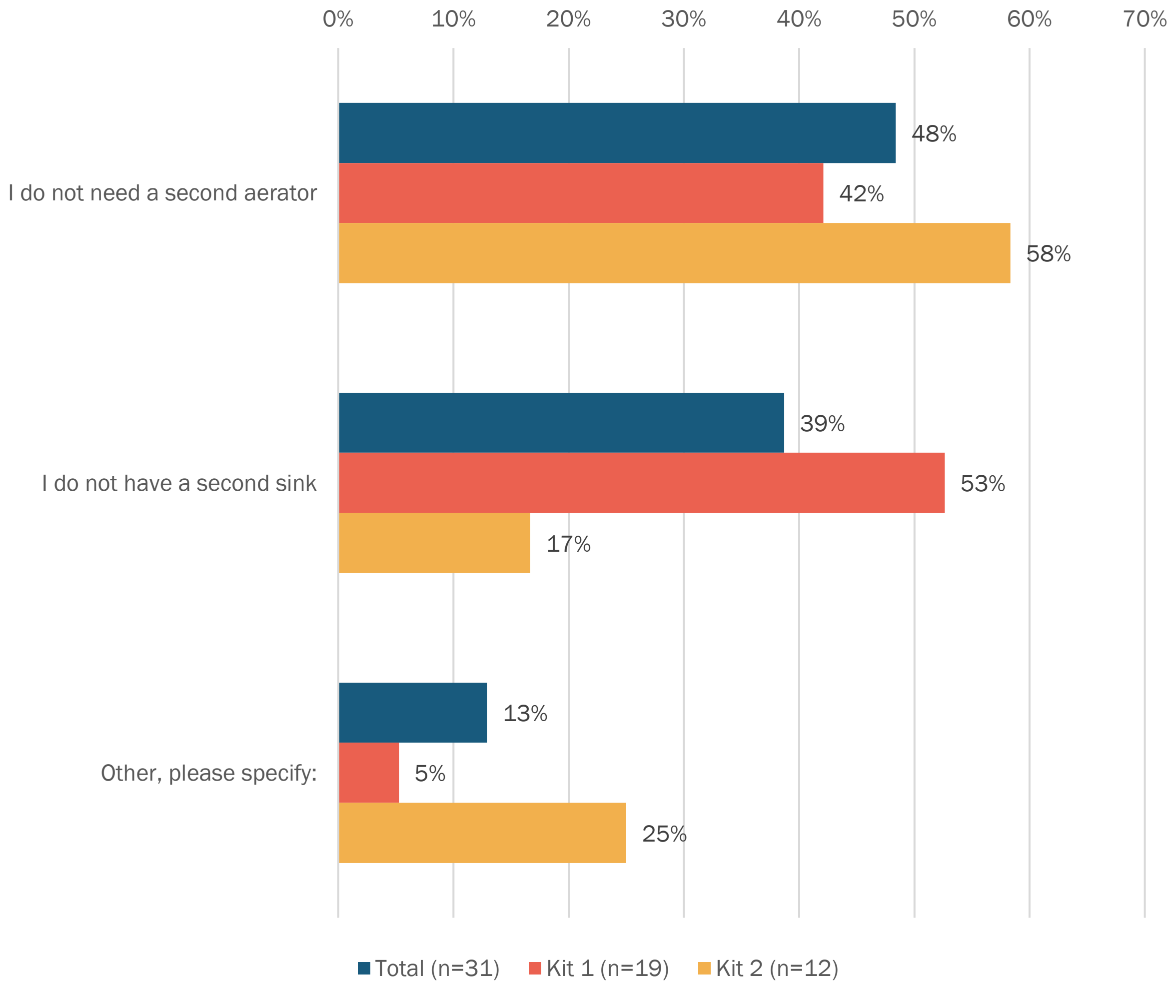
Table 5-3: Bathroom Aerator Installation

Number of Bathroom faucet aerators	Total (n=62)	Kit 1 (n=33)	Kit 2 (n=29)
One	**50%**	**58%**	41%
Two	**50%**	42%	**59%**

2022-2023 DEK SEWKP Evaluation: Participant Survey Question 19: "How many of the bathroom faucet aerators from the kit were installed in your home, even if one or more were taken out later?" (n=62).

Similarly, the evaluation team asked respondents who only installed one bathroom faucet aerator what their reasons were for not installing the second. As shown in Figure 5-8, the most common reason was that respondents said they did not need a second aerator, followed by respondents saying they do not have a second sink.

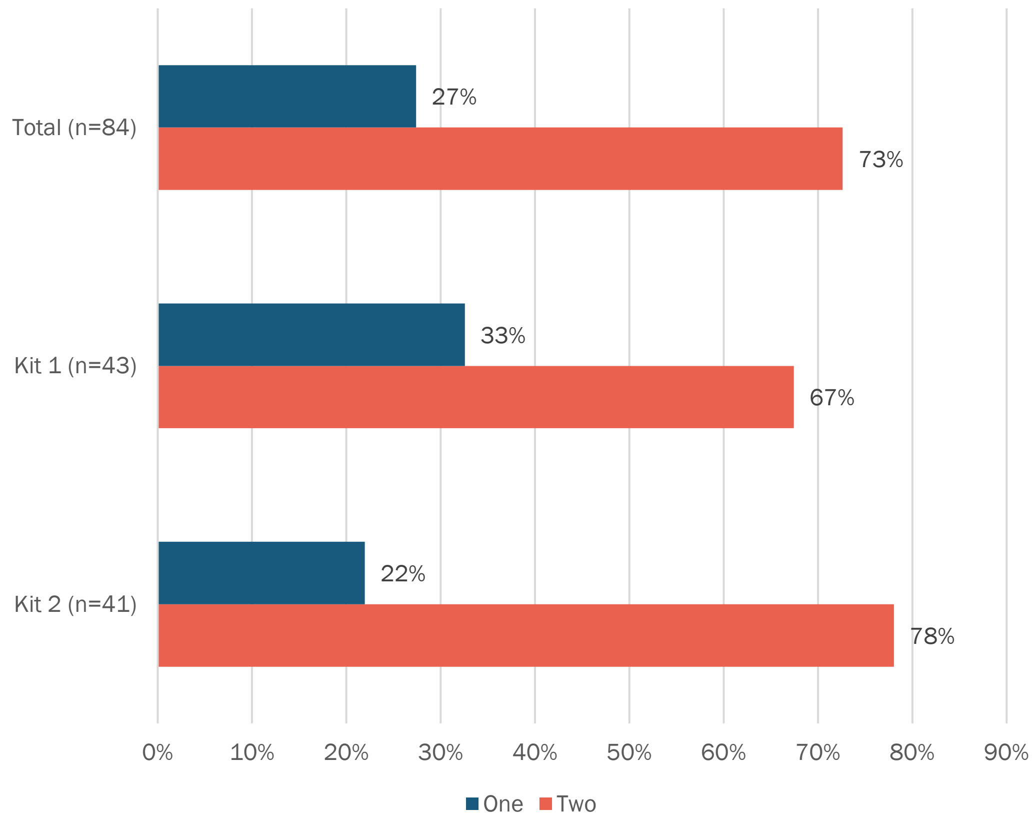
Figure 5-7: Reasons For Not Installing the Second Bathroom Faucet Aerator



2022-2023 DEK SEWKP Evaluation: Participant Survey Question 20: "What was the primary reason the second aerator was not installed?" (n=31).

In addition, the evaluation team found that most respondents who installed water heater pipe insulation installed both sections. This was the case for respondents across both kit types, as shown in Figure 5-9.

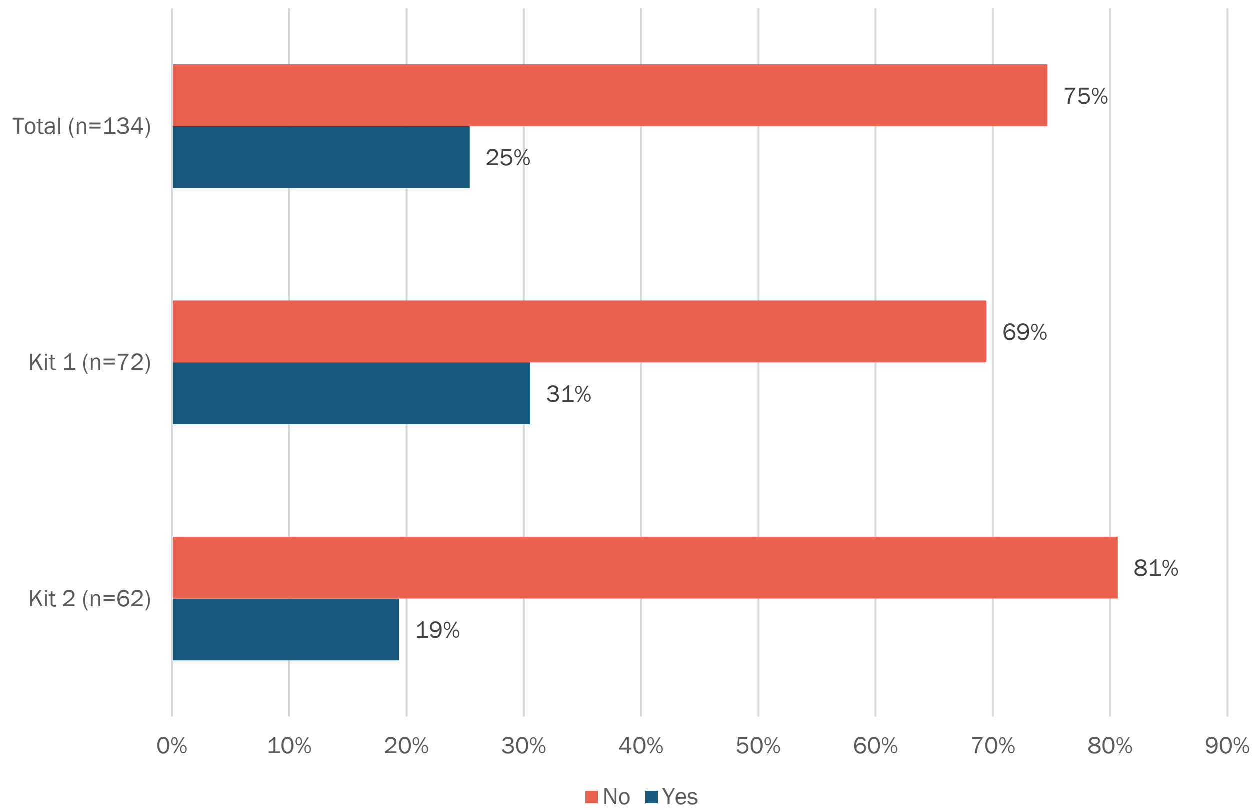
Figure 5-8: Installation of Water Heater Pipe Insulation Sections



2022-2023 DEK SEWKP Evaluation: Participant Survey Question 22: "Of the two water heater pipe insulation sections, how many were installed in your home?" (n=84).

Most respondents who installed measures also reported that they did not uninstall any measures later on. As shown in Figure 5-10, 75% of respondents overall reported they did not uninstall any measures.

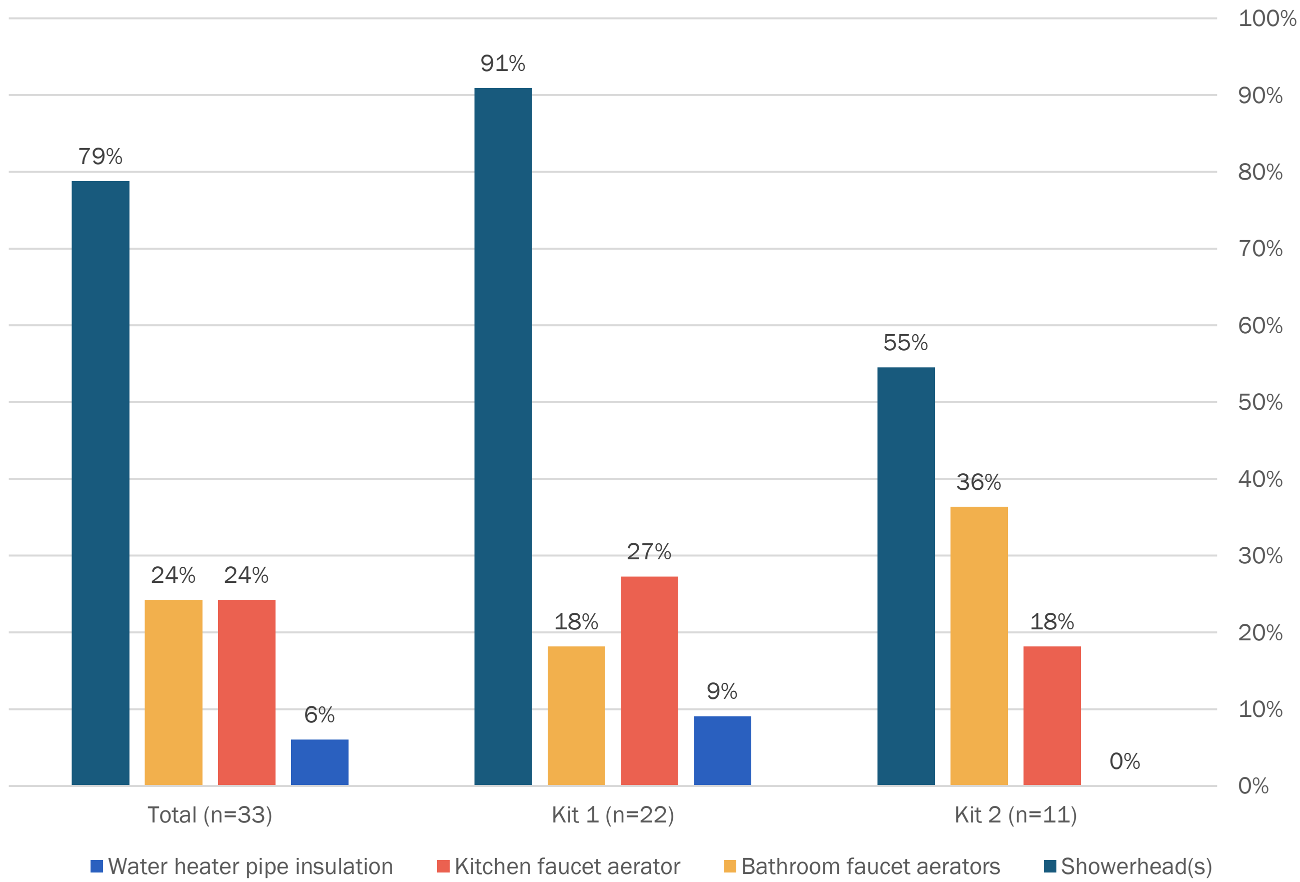
Figure 5-9: Respondent Uninstallation of Items in Their Kit



2022-2023 DEK SEWKP Evaluation: Participant Survey Question 25: "Have you (or anyone in your home) uninstalled any of the items from the kit that you had previously installed?" (n=134).

When looking at rates of uninstallation by measure, the evaluation team found that showerheads were the most uninstalled measure while water heater pipe insulation was the least uninstalled measure. Figure 5-11 shows the full breakdown of these results among respondents overall as well as kit type.

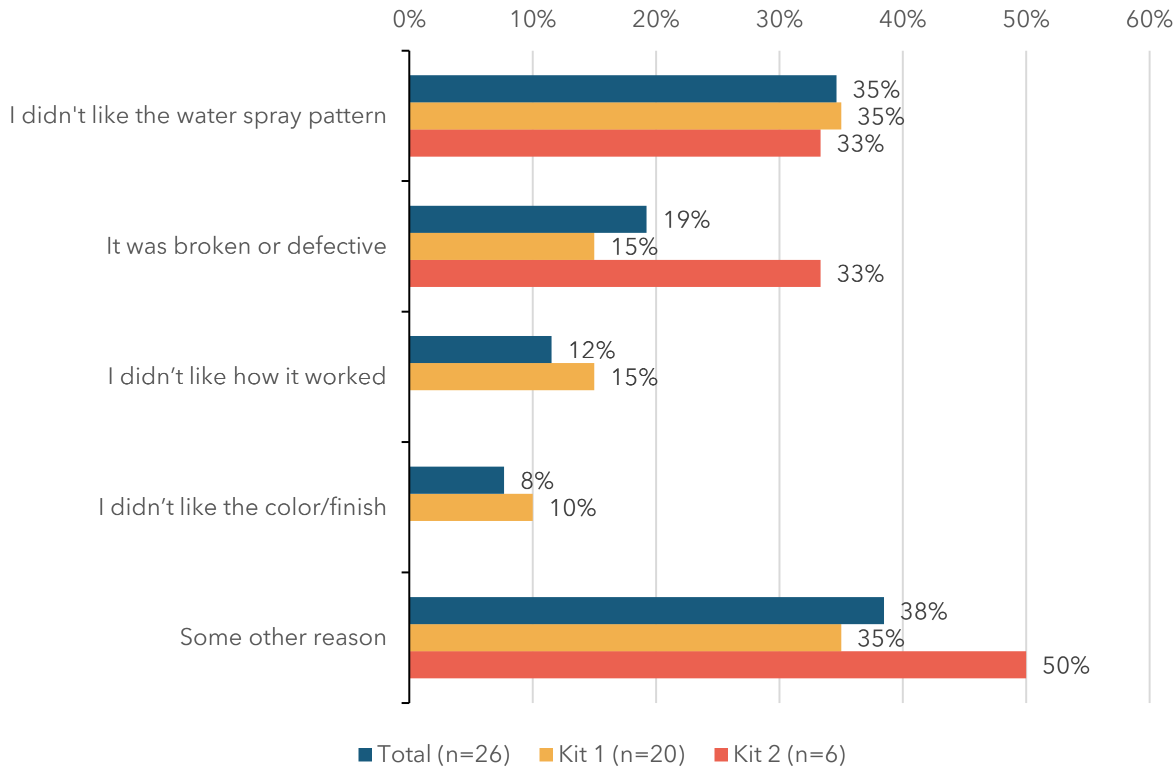
Figure 5-10: Uninstallation of Measures Included in the Kit



2022-2023 DEK SEWKP Evaluation: Participant Survey Question 26: "Which of the items were uninstalled? Select all that apply." (n=33).

Respondents who said they uninstalled one or more of their showerheads were asked a follow-up question to determine what their primary reason for doing so was. As shown in Figure 5-12, respondents most commonly gave another reason for uninstalling their showerhead(s) than what was provided. Of the reasons that were provided, respondents most commonly selected that they did not like the water spray pattern of their showerhead(s). Respondents who provided another reason for uninstalling their showerhead(s) reported reasons such as receiving different showerheads afterwards, conducting bathroom renovations, water pressure complaints, and noise complaints, among others.

Figure 5-11: Reasons for Uninstalling Showerheads



2022-2023 DEK SEWKP Evaluation: Participant Survey Question 30: "Why were those items uninstalled? - Showerheads" (n=26) Multiple responses allowed.

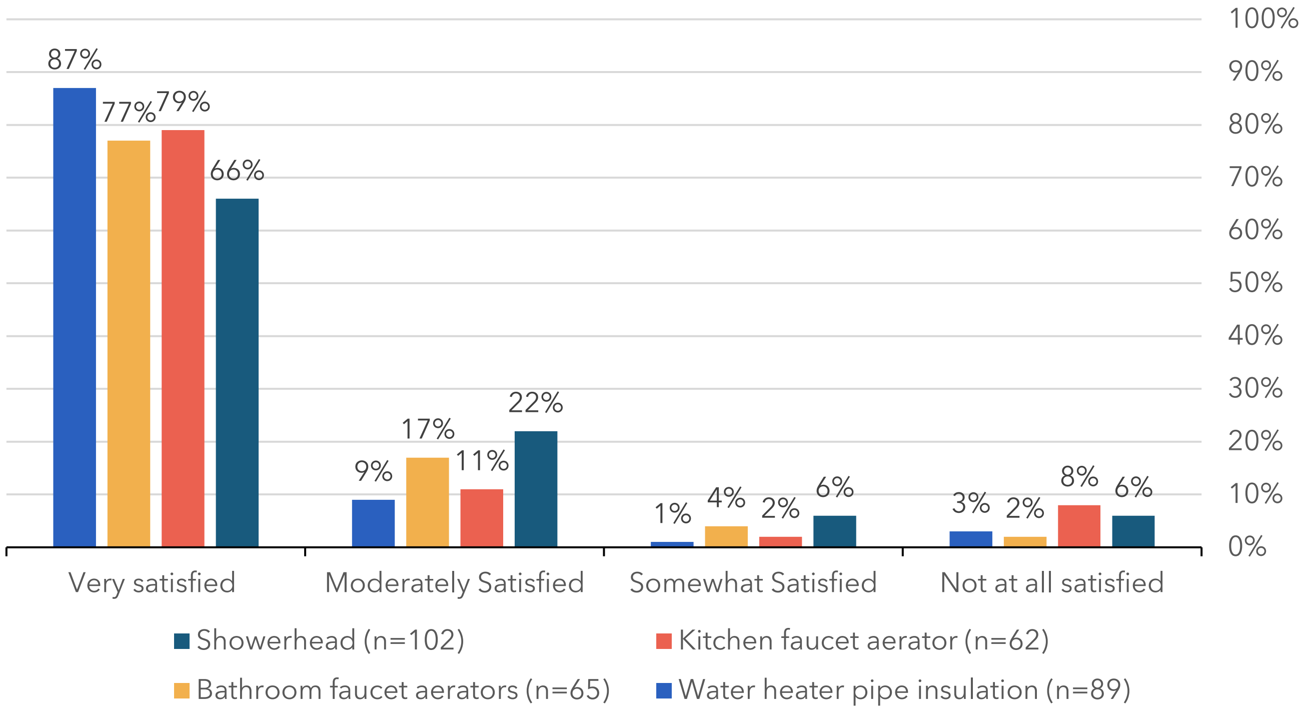
5.1.2.5 Measure Satisfaction

Nearly all kit recipients reported moderate to high satisfaction with the items they installed from their kit. Figure 5-13 shows the satisfaction levels among respondents with installed measures. To best gauge the experience with the measures, the evaluation team asked respondents to rate their satisfaction with all measures they installed, including those they later uninstalled. Respondents were generally most highly satisfied with the water heater insulation and were least highly satisfied with the showerhead. Although a low percentage of respondents felt dissatisfied with their measures, some provided open-ended comments most often pointed to dissatisfaction with the water pressure or issues with water flow.

"Not a very good showerhead. Not enough pressure."

"Poor quality"

Figure 5-12: Participant Satisfaction with Installed Measures



2022-2023 DEK SEWKP Evaluation: Participant Survey Question 23: On a scale from 0 to 10, where 0 is "not at all satisfied" and 10 is "very satisfied", how satisfied are you overall with the item(s) you installed?

Respondents rated their satisfaction with the measures on a scale ranging from 0 ("very dissatisfied") to 10 ("very satisfied"). Not at all satisfied indicates 0-2 ratings, somewhat satisfied indicates (3-4), moderately satisfied indicates 5-7 ratings, and highly satisfied indicates 8-10 ratings.

In general, participants who received Kit 2 were more satisfied across all measures. However, the satisfaction rate for the showerhead was much lower in both Kit 1 and Kit 2 compared to the faucet aerators and water heater pipe insulation. Participants in both groups showed a higher satisfaction level for water heater pipe insulation than for any other measures. Table 5-4 shows the level of satisfaction between the kits.

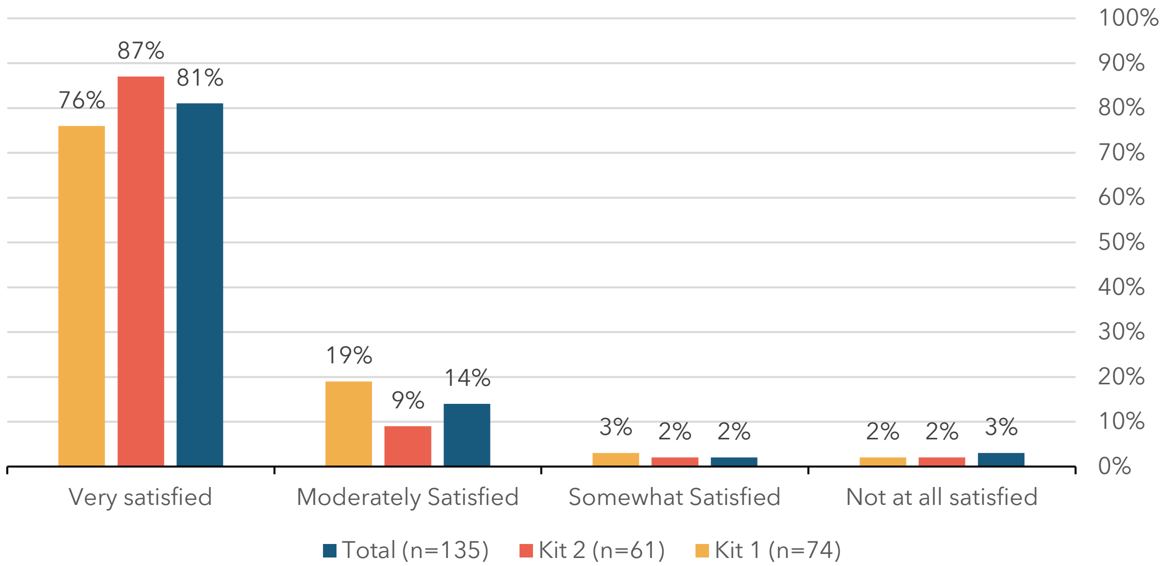
Table 5-4: Measure Satisfaction Levels

Measure Satisfaction	Showerhead		Kitchen faucet aerator		Bathroom faucet aerator		Water heater pipe insulation	
	Kit 1 (n=58)	Kit 2 (n=48)	Kit 1 (n=39)	Kit 2 (n=27)	Kit 1 (n=35)	Kit 2 (n=33)	Kit 1 (n=47)	Kit 2 (n=45)
Very satisfied	65%	67%	74%	88%	68%	88%	85%	89%
Moderately Satisfied	21%	24%	16%	4%	26%	9%	9%	9%
Somewhat Satisfied	7%	4%	0%	4%	3%	3%	2%	0%
Not at all satisfied	7%	4%	10%	4%	3%	0%	4%	2%

5.1.2.6 Program Satisfaction

Overall, almost all kit recipients reported moderate to high satisfaction with the program. Figure 5-14 shows the satisfaction levels among respondents with installed measures. Of the small percentage of surveyed participants who were not satisfied with the program, most expressed dissatisfaction with the items that were in the kit.

Figure 5-13: Participant Program Satisfaction

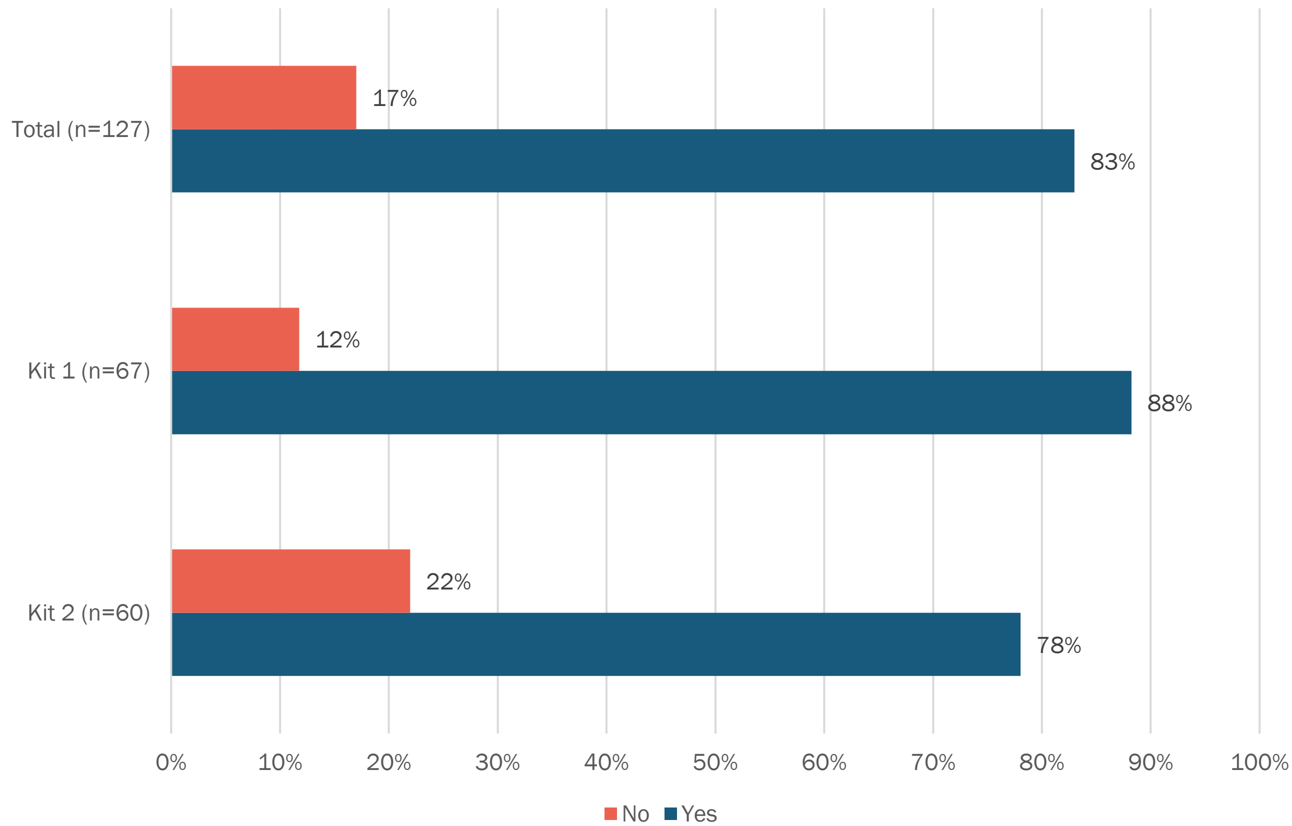


2022-2023 DEK SEWKP Evaluation: Participant Survey Question 23: On a scale from 0 to 10, where 0 is "not at all satisfied" and 10 is "very satisfied", how satisfied are you overall with the program?

5.1.2.7 Kit Instructional Materials

In addition to energy-saving measures, the Save Energy and Water Kit includes a detailed instructional booklet that provides information on how to install the provided measures. Most respondents (88% of Kit 1 respondents; 78% of Kit 2 respondents) said they read the included instructions, and most of them (84% of Kit 1 respondents; 81% of Kit 2 respondents) found it very helpful. Figure 5-15 shows the full breakdown of how respondents interacted with the instructions.

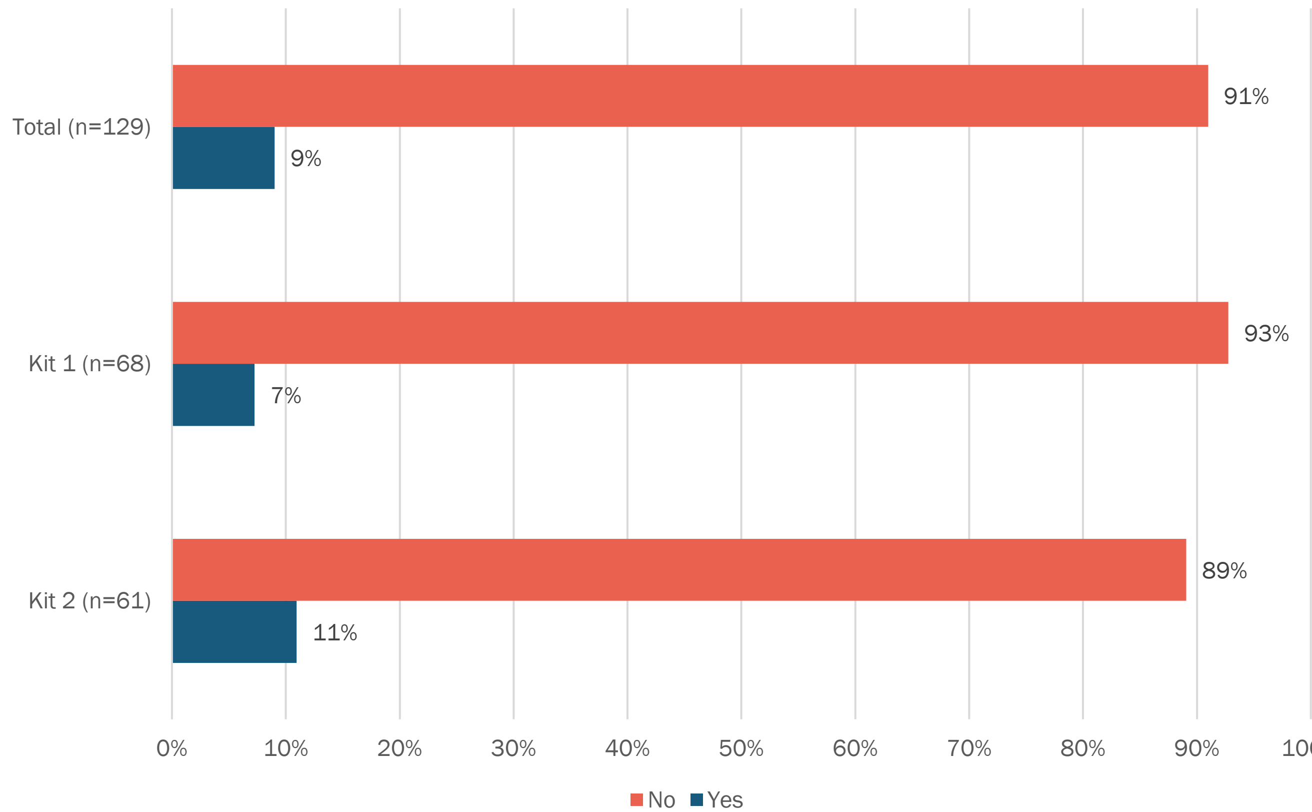
Figure 5-14: Respondent Usage of Included Instructions



2022-2023 DEK SEWKP Evaluation: Participant Survey Question 9: "Did you read the included instructions on how to install the items that came in the kit?" (n=127).

Duke Energy also provided online instructional how-to videos to show participants how to install kit measures. Only 7% of Kit 1 respondents and 11% of Kit 2 respondents watched the how-to tutorial videos. However, of those respondents who watched the how-to tutorial videos, 100% found them highly helpful. Figure 5-16 shows the full breakdown of how respondents interacted with the online installation videos.

Figure 5-15: Respondent Usage of Online Installation Videos



2022-2023 DEK SEWKP Evaluation: Participant Survey Question 12: "Did you watch any of Duke Energy's online installation videos on how to install the items that came in the kit?" (n=129).

5.1.2.8 Demographics

Additionally, the evaluation team collected demographic information from respondents to better understand the examined population. 93% of all survey participants reported owning their homes, with only 7% respondents reporting that they rent (n=145). Additionally, 80% of the respondents reported living in a single-family detached home, as shown in Table 5-5.

Table 5-5: Participant Housing Type

Measure	Kit 1 (n=78)	Kit 2 (n=66)	Total (n=144)
Single-family detached	68%	94%	80%
Single-family attached (such as a townhouse or condo)	9%	6%	8%
Apartment or condominium with 5 units or more	8%	0%	4%
Manufactured or mobile home	14%	0%	8%
Other, please specify:	1%	0%	1%

Demographics indicated that the participant sample was highly educated, with almost half of respondents having a bachelor's degree (25%) or a graduate degree (26%, n=137). Of respondents who reported their income, the highest proportion earned between $100,000 and $150,000 a year (24%, n=100). Additionally, 37% of respondents reported that there were only two people in the household year-round (n=139). Table 5-6, Table 5-7, and Table 5-8 show the full breakdowns of each of these results.

Table 5-6: Participant Education Level

Education Level	Percentage
Doctorate	4%
Graduate degree, professional degree	26%
College degree (Bachelor's degree)	25%
Some college (including Associate degree)	18%
Trade or technical school	5%
High school graduate or equivalent (such as GED)	20%

Table 5-7: Income Distribution

Income Range	Percentage
Under $20,000	4%
$20,000 to under $30,000	7%
$30,000 to under $40,000	9%
$40,000 to under $50,000	5%
$50,000 to under $60,000	10%
$60,000 to under $75,000	12%
$75,000 to under $100,000	13%
$100,000 to under $150,000	24%
$150,000 to under $200,000	9%
$200,000 or more	7%

Table 5-8: Number of Occupants

Number of Occupants	Percentage
I live by myself	14%
Two people	37%
Three people	16%
Four people	17%
Five people	11%
Six people	4%
Seven people	1%

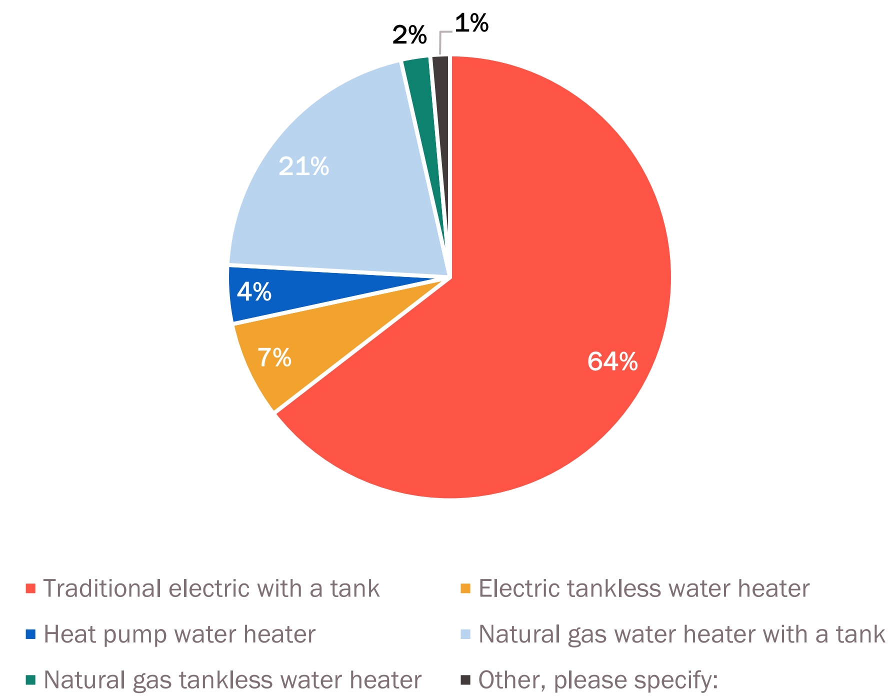
Over one-half of the homes measured between 1,000 - 1,500 square feet (29%), or 1,500-2,000 (24%) square feet, as shown in Table 5-9.

Table 5-9: Home Square Feet

Home Square Feet	Percentage
500 to under 1,000 square feet	11%
1,000 to under 1,500 square feet	29%
1,500 to under 2,000 square feet	24%
2,000 to under 2,500 square feet	24%
2,500 to under 3,000 square feet	7%
Greater than 3,000 square feet	6%

Most respondents indicated they had a traditional electric water heater with a tank (64%), followed by natural gas water heater with a tank (21%). Only 7% of the respondents reported having electric tankless water heaters. Additionally, nearly all (97%) respondents reported getting their water from a municipal source.

Figure 5-16: Water Heater Type



More than half (53%) of the surveyed participants reported having two showers in their homes, and 28% reported having just one shower. Around 31% of the respondents reported having two bathroom faucets in their homes, followed by 28% having three bathroom faucets. Eighty five percent of the respondents reported having one kitchen faucet in their homes.

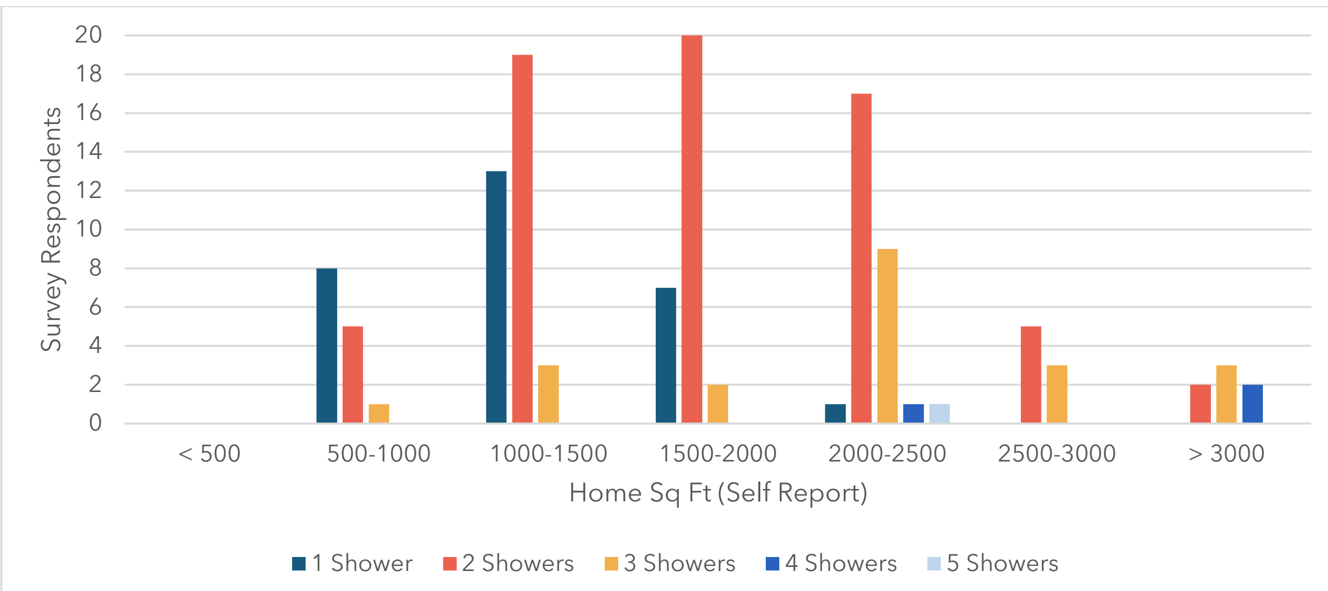
Table 5-10: Number of Shower, Bathroom and Kitchen Faucets

Quantity	Number of Showers			Number of Bathroom Sink Faucets			Number of Kitchen Faucets		
	Total (n=148)	Kit 1 (n=80)	Kit 2 (n=68)	Total (n=146)	Kit 1 (n=79)	Kit 2 (n=67)	Total (n=146)	Kit 1 (n=79)	Kit 2 (n=67)
One	28%	37%	18%	19%	30%	6%	85%	89%	82%
Two	53%	54%	51%	31%	37%	24%	13%	9%	18%
Three	16%	9%	25%	28%	25%	30%	1%	3%	0%
Four	2%	0%	5%	13%	4%	24%	1%	0%	0%
Five or more	1%	0%	2%	9%	4%	15%			

The evaluation team investigated the relationship between number of showers in the home, home square footage, and kit size to provide additional context for the Showerhead 2 ISR presented in Section 3.3.4.1. Participants are provided with Kit 1 if their home is less than 1,500 square feet or are provided with Kit 2 if their home is more than 1,500 square feet, as described in Section 2.2.1. The only notable difference between Kit 1 and Kit 2 is that Kit 2 contains a second showerhead.

Participant survey respondents are asked to provide the number of showers in their home, as well as an estimation of their home square footage. Figure 5-18 shows that there is a wide disparity between number of showers and home square footage, where the second largest group of participants with two showers in their home report that their home is between 1,000 and 1,500 square feet.

Figure 5-17: Number of Showers by Home Square Feet



Additionally, there appears to be some discrepancy between the kit size distributed and participant self-reported square footage. Figure 5-19 shows that many participants did not receive the appropriate kit size based on their home size.

Figure 5-18: Kit Size by Home Square Feet

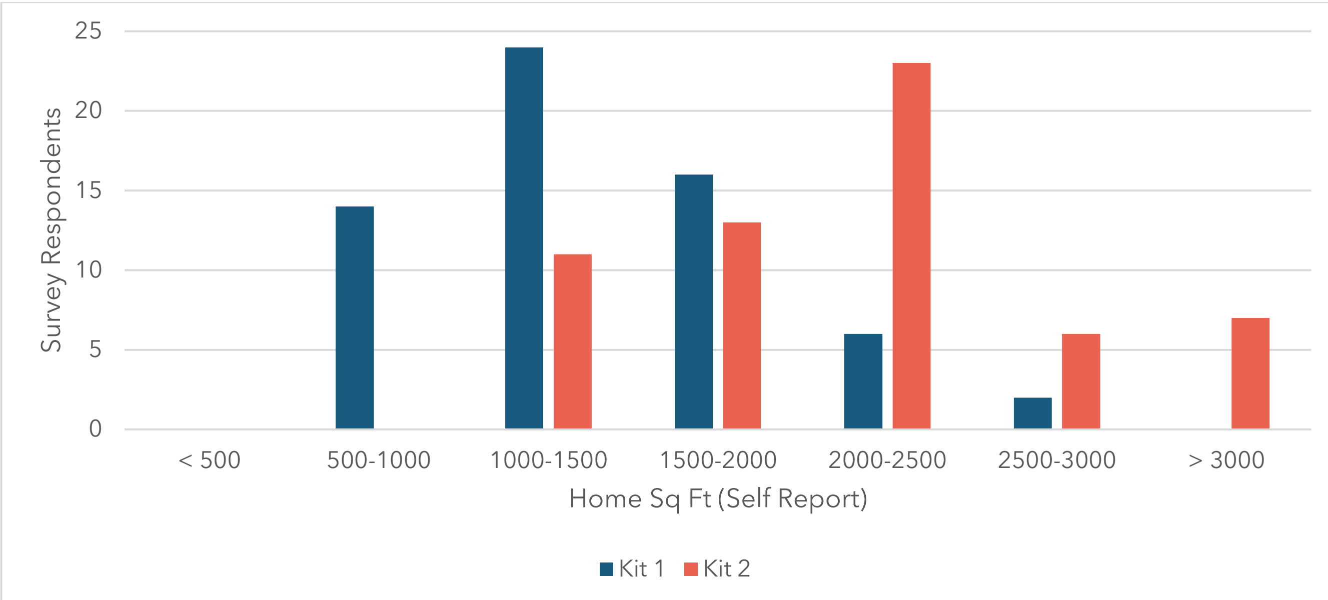
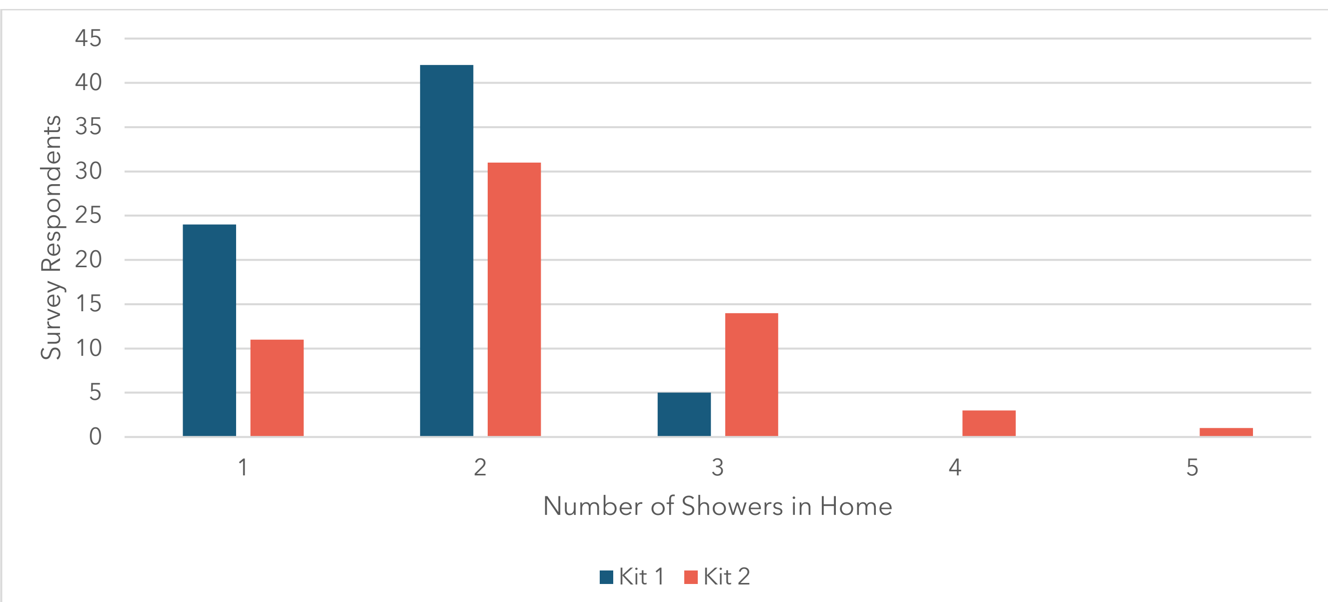


Figure 5-20 presents kit size compared to the number of showers in participating homes. Over 40 survey respondents who received kit 1 reported that they have a second shower in their home.

Figure 5-19: Kit Size by Number of Showers



6 Conclusions and Recommendations

The evaluation findings led to the following conclusions and recommendations for the program.

Conclusion 1: Most survey respondents (91%) said they did not watch the online installation videos, but all respondents that did watch the videos reported that they were very helpful. Also, 83% of respondents said they read the installation instructions that were included in the kit. Customers who did not read the instructions and did not watch the online installation videos were less likely to install showerheads and kitchen faucet aerators.

> **Recommendation:** The online ordering platform and postcard could provide an opportunity to mention the online installation videos. During the program implementation staff interview, AM Conservation staff noted that the installation videos were recently added directly to the e-commerce site.

> **Recommendation:** Review marketing strategies for the online installation videos and ensure customers are aware of this resource. The instructions included in the kit could also make mention of the online installation videos through a note or incorporation of a feature such as a QR code that is linked to the instruction video website. Future evaluations should assess awareness of the online installation videos through participant surveys.

Conclusion 2: The quantity of showerheads provided in kits do not always align with showers in the recipient homes, and some kits are being provided to homes that do not have an electric water heater. The in-service rate for showerhead 2, provided only in kit 2, is 18% for the DEK 2022-2023 population, while most respondents who did not install showerhead 2 indicate they do not need a second showerhead or do not have a second shower. The current approach for determining which households receive a second showerhead (Kit 2) is dependent upon home square footage data from a third-party data supplier and a threshold of 1,500 square feet set by Duke Energy, where homes containing 1,500 or more square feet of living space receive Kit 2. This methodology does not appear to be consistent with customer self-reported data, which is discussed in detail at the end of Section 5.1.2.8. Additionally, only 77% of survey respondents indicated that they have an electric water heater in their home. These factors both reduce the verified electricity savings attributable to the program.

> **Recommendation:** Incorporate a small set of questions within the online ordering platform and postcard to help verify key participant information. This can include

asking participants how many showerheads they want to install, and the type of water heater in their home.

Recommendation: Consider claiming secondary impacts attributable to kit measures. The primary impacts that are typically included in the evaluation of kit measures estimate electricity savings at the water heater in participating homes. Mid-Atlantic TRM v10 provides algorithms to estimate impacts of kit measures for homes that have a natural gas water heater, that can be used in cost-effectiveness calculations for non-electricity savings. There are also secondary electricity impacts for most kit measures due to water savings. Reduced water consumption in homes can be used to estimate electricity savings at municipal water supply and wastewater treatment facilities, which are attributable to all program participants regardless of water heater type. These secondary impacts have been estimated for the DEK 2022-2023 SEWKP program, as outlined in Section 3.5.

Conclusion 3: A significant portion of survey respondents indicated that they did not receive a kit after ordering one. This included 9.0% of Kit 1 recipients and 15.9% of Kit 2 recipients, amounting to 11.8% of the total program population.

Recommendation: The evaluation team and Duke Energy should investigate potential causes of participants claiming they did not receive kits in future evaluations in all jurisdictions. This can be done by incorporating questions regarding kit delivery into IDIs with program implementers, and by adding follow up questions to participant surveys for participants who claim they did not receive a kit.

Conclusion 4: The overall in-service rate of water heater pipe insulation wrap has increased to 42% in the 2022-2023 DEK evaluation, with an in-service rate of 48% for unit 1 and 36% for unit 2, relative to an in-service rate of 30% in the 2018-2019 evaluation. Additionally, 87% of survey respondents indicated they were very satisfied with this measure. This observation is most likely attributed to the new foam insulation sections that are included in program kits, which replaced previously offered insulating pipe tape beginning in 2022.

Recommendation: The evaluation team recommends that Duke Energy continue to offer this type of water heater pipe insulation wrap to program participants. The increase to in-service rate has the potential to increase program savings, while high participant satisfaction with this measure suggests that it will continue to be popular among future program participants in DEK and other jurisdictions.

Appendix A Summary Form

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 heater pipe insulation wrap 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	May 24, 2024
Region(s)	Kentucky
Evaluation Period	February 1, 2022 – May 31, 2023
Annual Gross MWh Savings	787
Per Kit Gross kWh Savings	346
Annual Gross MW Savings	0.66 (summer), 0.88 (winter)
Net-to-Gross Ratio	108.52%
Process Evaluation	Yes
Previous Evaluation(s)	2018-2019

Evaluation Methodology

Impact Evaluation Activities

Web & Phone surveys (Kit 1 n=85, Kit 2 n=74) and analysis of 4 unique measures

Impact Evaluation Findings

Realization rates:

- 104% (energy); 94% (summer demand); 95% (winter demand)

Process Evaluation Activities

Web & Phone surveys (Kit 1 n=85, Kit 2 n=74)

1 interview with program staff

1 interview with implementation staff

Process Evaluation Findings

- Pipe insulation had the highest satisfaction rating of any of the kit measures.
- Most participants used the online ordering platform to request their kit, and nearly all of those respondents said it functioned properly.
- While most respondents did not watch the installation videos, those who did found them helpful.
- Participants also found the written instructions helpful.
- 11.8% of participants reported that they did not receive a kit, leading to a decrease in program population.
- Participants were largely satisfied with the program overall.

Appendix B Measure Impact Results

Table B-1: DEK Per Unit Verified Impacts by Measure - Key Measure Parameters

Measure	Gross Energy Savings (kWh)	Gross Summer Demand (kW)	Gross Winter Demand (kW)	Energy Realization Rate	Free Ridership	Spillover	Net to Gross Ratio
Showerhead	187.8	0.0134	0.0185	106%	12.52%	21.44%	108.92%
Kitchen Aerator	21.3	0.0030	0.0039	66%	13.65%		107.79%
Bathroom Aerator	12.7	0.0019	0.0025	133%	11.59%		109.85%
Water Heater Pipe Insulation Wrap	4.2	0.0005	0.0005	72%	16.68%		104.76%

DSMore%20table%20DEK%20SEWKP%2

Appendix C Program Performance Metrics

This appendix provides key program performance metrics, or PPIs. See Section 5 for the underlying results and more detailed findings.

DEK Program Experience PPIs

Program experience & satisfaction PPIs	Participants %	Participants n
Overall satisfaction with program	95%	135
Usefulness of kit instructions	83%	104
Satisfaction with kit measures		
Showerhead	88%	102
Kitchen faucet aerator	90%	62
Bathroom faucet aerator	94%	65
Water heater pipe insulation wrap	96%	89
Program influence on behavior PPIs		
Installed at least one kit measure	86%	159
Most common measure installed: *showerhead*	64%	159
Respondents reporting program attributable spillover	16%	159
Challenges and opportunities for improvement PPIs		
Measure with lowest installation rate: kitchen faucet aerator	39%	159
Measure with highest uninstallation rate: showerhead	79%	33
Measure with highest dissatisfaction: kitchen faucet aerator	8%	62

DEK Participant Demographics

Ownership Status	
Own	93%
Rent	7%

Household Size	
One to two	51%
Three	16%
Four	17%
Five +	17%

Education	
High school or less	20%
Trade or technical school	5%
Some college	18%
Bachelor's degree	25%
Some graduate school	2%
Graduate degree	26%
Doctorate	4%

Income	
<$30k	11%
$30k to <$60k	24%
$60k to <$75k	12%
$75k to <$100k	13%
$100k+	40%

Note: Refusals and "don't know" responses are not shown. Additionally, tables may not sum to 100% due to rounding.

DEK Participant Household Characteristics

Housing Type	
Detached	80%
Attached	8%

Water Heater Fuel Type	
Electric with tank	64%
Electric tankless	7%

Mobile	8%
Apartment or condo	4%
Other	1%

Heat pump water heater	4%
Natural gas with tank	21%
Natural gas tankless	2%
Other	1%

Home Square Feet	
Less than 1,000	11%
1,000-1,499	29%
1,500-1,999	24%
2,000-2,999	30%
3,000+	6%

Number of Showers	
1	28%
2	53%
3	16%
4+	3%

Number of Kitchen Faucets	
1	85%
2	13%
3+	1%

Number of Bathroom Faucets	
1-2	50%
3-4	41%
5+	9%

Note: Tables may not sum to 100% due to rounding.

Appendix D Interview and Survey Instruments

To be included as PDF in final version.

Appendix E Participant Demographics

DEK		
Home type	**(%)**	**(n)**
Single-family detached	80%	115
Single-family attached	8%	11
Apartment or condo 5 units or more	4%	6
Manufactured or mobile home	8%	11
Other	1%	1
Home size	**(%)**	**(n)**
Less than 500 square feet	0%	0
500 to under 1,000 square feet	11%	14
1,000 to under 1,500 square feet	29%	35
1,500 to under 2,000 square feet	24%	29
2,000 to under 2,500 square feet	24%	29
2,500 to under 3,000 square feet	7%	8
Greater than 3,000 square feet	6%	7
Ownership Status	**(%)**	**(n)**
Own / buying	93%	135
Rent / lease	7%	10
Occupy rent-free	0%	0
Water Heater Fuel Type	**(%)**	**(n)**
Electric	76%	106
Natural Gas	23%	32
Other	1%	2
Household Size	**(%)**	**(n)**
I live by myself	14%	19
Two people	37%	52
Three people	16%	22
Four people	17%	23
Five people	11%	15
Six people	4%	6
Seven people	1%	2
Eight or more people	0%	0
Household Income	**(%)**	**(n)**
Under $20,000	4%	4
20 to under $30,000	7%	7
30 to under $40,000	9%	9

DEK		
40 to under $50,000	5%	5
50 to under $60,000	10%	10
60 to under $75,000	12%	12
75 to under $100,000	13%	13
100 to under $150,000	24%	24
150 to under $200,000	9%	9
$200,000 or more	7%	7
Education Level	**(%)**	**(n)**
Less than high school	0%	0
Some high school	1%	1
High school graduate or equivalent (such as GED)	20%	27
Trade or technical school	5%	7
Some college (including Associate degree)	18%	24
College degree (Bachelor's degree)	25%	34
Some graduate school	2%	3
Graduate degree, professional degree	26%	35
Doctorate	4%	6

Appendix F Participant Responses by State

Measurement	KY
Survey Responses	159
Kit 1	85
Kit 2	74
Average Occupants per Home	2.92
Electric Water Heater %	77%
Showerheads	
Provided	213
Installed	105
Removed	28
Installed %	49%
Removed %	27%
In-Service Rate	36%
Shower per Day (per person)	0.48
Minutes per Shower	11.5
Showerheads per Home	1.78
Kitchen Faucet Aerator	
Provided	145
Installed	53
Removed	7
Installed %	37%
Removed %	13%
In-Service Rate	32%

Measurement	KY
Bathroom Faucet Aerator	
Provided	284
Installed	85
Removed	8
Installed %	30%
Removed %	9%
In-Service Rate	27%
Water Heater Pipe Insulation Wrap	
Provided	252
Installed	107
Removed	1
Installed %	42%
Removed %	1%
In-Service Rate	42%
Average Length Installed (per 3' Section)	2.6