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Non-Residential Smart $aver® Prescriptive Program Evaluation Report – Final

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1. Executive Summary

1.1 Program Summary

The Duke Energy Carolinas (DEC) and Duke Energy Progress (DEP) Non-Residential Smart $aver® Prescriptive Program (hereafter, the Smart $aver Program) provides incentives for electric commercial and industrial customers to purchase and install a variety of high-efficiency equipment, including lighting; HVAC equipment; pumps and drives; and qualifying process, food service, and information technology equipment. The program also uses incentives to encourage maintenance of existing equipment to reduce energy usage. Incentives are available for new construction, existing equipment retrofits, and failed equipment replacements. Prescriptive incentives under the program cannot exceed 75% of the customer's equipment cost.

The program has four delivery channels:

- The **main channel** for the program is application-based and primarily delivered through trade allies.
- The **midstream channel** allows distributors to provide incentives directly to prequalified customers on applicable equipment and receive reimbursement for those incentives from Duke Energy.
- The **Business Savings Store** on the Duke Energy website offers customers a limited number of qualified products for which they can receive an instant discount.
- The **upstream channel** was introduced in May 2020. It works directly with HVAC and food service manufacturers to provide discounted equipment to customers and increase participation in these technologies.

The incentives/discounts offered are consistent across the four delivery channels.

Since the majority of program savings were realized through the main channel and the midstream channel, the focus of this evaluation is on those two channels. The evaluation period for this program is January 1, 2019, to December 31, 2020.

1.2 Evaluation Objectives

Our evaluation focused on the estimation of ex post gross and net impacts and a limited process evaluation.

The impact evaluation focused on savings realized through the main channel and lighting savings realized through the midstream channel, which, combined, account for 96% of program savings. Measures incented through the Business Savings Store and the recently introduced upstream channel—as well as non-lighting measures incented through the midstream channel—were included in the database review and in the selection of measures for the deemed savings review. However, due to limited participation, we did not include participants with these measures in any primary data collection or research activities (i.e., installation verification surveys, desk reviews). Instead, we applied results from the analyses for main channel projects and midstream lighting projects to these participants.

Our evaluation addressed the following key objectives.

Gross Impact Evaluation

- Verify deemed savings estimates for a limited set of measures through review of measure assumptions and calculations.
  - Document causes of differences between ex ante and ex post (evaluated) savings estimates.
  - Develop a realization rate for each reviewed measure.
- Verify installed quantities and measure characteristics for a sample of main channel projects through desk reviews and on-site visits.
  - Document causes of differences between tracked and verified information.
  - Develop in-service rates (ISR) by technology (e.g., lighting, HVAC, food service).
- Verify installed quantities for a sample of midstream channel lighting projects through the participant survey and on-site visits.
  - Document causes of differences between tracked and verified information.
  - Develop ISRs for lighting projects.
- Estimate verified gross energy and peak demand savings (both summer and winter), by technology, via engineering analysis.
- Develop overall gross realization rates, for each sampled technology, by delivery channel.

Net-to-Gross Analysis

- Estimate free-ridership (FR) for the following types of projects: main channel lighting, main channel non-lighting, midstream channel lighting.
- Estimate participant spillover (PSO) (main channel and midstream channel) and trade ally spillover (TASO) (main channel only).
- Develop net-to-gross ratios (NTGRs).

Process Evaluation

- Assess customer and trade ally satisfaction with program processes.
- Assess potential impacts of the global COVID-19 pandemic on customers' business operations.
- Assess awareness of custom incentives and barriers to applying for them.
- Assess trade ally perceptions of the market for energy efficient lighting.

1.3 Key Findings

During the evaluation period, non-residential customers completed more than 15,000 projects through the DEC Smart $aver Prescriptive Program and more than 7,000 projects through the DEP Smart $aver Program. The DEC projects generated approximately 291 GWh of ex post gross energy savings, 52 MW of ex post gross summer peak demand savings, and 45 MW of ex post gross winter peak demand savings. The DEP projects generated approximately 107 GWh of ex post gross energy savings, 19 MW of ex post gross summer peak demand savings, and 16 MW of ex post gross winter peak demand savings.

The midstream channel continued to gain traction during the evaluation period and surpassed the main channel in contribution to savings for the first time; the midstream channel accounted for the highest share of ex post gross energy savings in both service territories (51% DEC, 48% DEP). The main channel accounted for the majority of the remaining savings (overall shares of 45% for DEC and 48% for DEP). A relatively small share of savings was generated through the Business Savings Store (4% DEC, 4% DEP) and through the new upstream channel (<1% DEC, <1% DEP; see Table 1).

In both jurisdictions, lighting accounted for the vast majority of program projects and savings.

Table 1. Summary of Ex Post Gross Energy Savings

Delivery Channel	DEC		DEP	
	MWh	Percent [a]	MWh	Percent [a]
Midstream Channel	147,152	51%	51,171	48%
Main Channel	131,911	45%	51,065	48%
Business Savings Store	11,202	4%	4,764	4%
Upstream Channel [b]	349	<1%	188	<1%
Total	**290,614**	**100%**	**107,188**	**100%**

[a] Individual values may not sum to totals due to independent rounding.

[b] The upstream channel was introduced towards the end of the evaluation period. The channel's contribution to program savings during the evaluation period was, therefore, very small.

Gross Impact Findings

Our gross impact analysis found overall gross realization rates for energy and demand savings close to 90%, ranging from 81% to 94% for DEC and 83% to 95% for DEP. These results were driven by the following:

- Our deemed savings review made small adjustments to lighting projects (ranging from 89% for winter demand to 97% for summer demand) and somewhat larger adjustments to projects in the HVAC category (ranging from 34% for winter demand to 84% for summer demand).
- Our desk reviews and on-site visits of main channel projects found relatively few data tracking issues with respect to the quantities of installed measures, adjusting the quantities for only nine of the 98 sampled projects. The resulting ISRs for energy savings were 99% for food service projects, 96% for HVAC and lighting projects, and 100% for pumps and drives and process equipment.
- Energy savings ISRs for lighting purchases through the midstream channel were also high, at 93%.
- Ex ante savings embed realization rates from prior evaluations. In particular, the realization rates presented below reflect differences between the current ISRs and those developed in prior evaluations. This is the driving factor in the high realization rates for food service projects.

Table 2 and Table 3 summarize the overall gross energy and demand impacts, respectively, for DEC and DEP.

Table 2. Overall Gross Energy Impacts

Technology	DEC			DEP		
	Ex Ante MWh	Realization Rate	Ex Post MWh	Ex Ante MWh	Realization Rate	Ex Post MWh
Lighting	286,978	93%	266,604	103,654	94%	97,026
HVAC	24,290	64%	15,552	9,632	75%	7,255
Pumps and Drives	3,135	100%	3,139	279	100%	279
Food Service	1,770	212%	3,753	1,253	207%	2,596
Process	1,523	101%	1,542	24	100%	24
IT	25	99%	25	8	98%	8
Total	**317,721**	**91%**	**290,614**	**114,851**	**93%**	**107,188**

Table 3. Overall Gross Demand Impacts

Technology	DEC			DEP		
	Ex Ante MW	Realization Rate	Ex Post MW	Ex Ante MW	Realization Rate	Ex Post MW
Summer Demand Impacts						
Lighting	50.32	94%	47.51	17.82	94%	16.83
HVAC	3.95	80%	3.16	1.87	88%	1.65
Pumps and Drives	0.49	100%	0.49	0.04	100%	0.04
Food Service	0.14	297%	0.42	0.10	229%	0.23
Process	0.37	102%	0.38	0.01	100%	0.01
IT	-	N/A	-	-	N/A	-
Total	**55.27**	**94%**	**51.96**	**19.84**	**95%**	**18.76**
Winter Demand Impacts						
Lighting	49.23	86%	42.40	17.37	85%	14.74
HVAC	5.25	27%	1.40	1.69	50%	0.85
Pumps and Drives	0.50	100%	0.50	0.04	100%	0.04
Food Service	0.13	304%	0.41	0.09	230%	0.22
Process	0.37	102%	0.38	0.01	100%	0.01
IT	-	N/A	-	-	N/A	-
Total	**55.49**	**81%**	**45.08**	**19.21**	**83%**	**15.86**

Net Impact Findings

We estimated the program-level NTGR to be 74.2%. Table 4 presents the individual net-to-gross (NTG) components (i.e., FR, PSO, and TASO) and the resulting NTGRs by channel and technology group (i.e., lighting and non-lighting). The NTGR is calculated as 1 – FR + PSO + TASO.

Table 4. Summary of NTG Results

	Free-Ridership	Participant SO	Trade Ally SO	NTGR
Main Channel Lighting	31.2%	0.02%	6.1%	74.9%
Main Channel Non-Lighting	36.0%	0.02%	6.1%	70.1%
Midstream Lighting	25.3%	0.00%	0.0%	74.7%
Midstream Non-Lighting [a]	36.0%	0.02%	0.0%	64.0%
Business Savings Store Lighting [b]	27.9%	0.01%	0.0%	72.1%
Business Savings Store Non-Lighting [a]	36.0%	0.02%	0.0%	64.0%
Upstream Non-Lighting [a]	36.0%	0.02%	0.0%	64.0%
Total	**28.6%**	**0.01%**	**2.8%**	**74.2%**

[a] Set to equal main channel non-lighting FR and PSO values. TASO is only applicable to the main channel.

[b] Weighted average of main channel and midstream lighting FR and PSO values. TASO is only applicable to the main channel.

Table 5 and Table 6 summarize ex post gross and net savings for the evaluation period for DEC and DEP, respectively.

Table 5. Summary of DEC Ex Post Gross and Net Savings

Technology	Ex Post Gross			NTGR	Ex Post Net		
	Energy Savings (MWh)	Summer Peak Demand (MW)	Winter Peak Demand (MW)		Energy Savings (MWh)	Summer Peak Demand (MW)	Winter Peak Demand (MW)
Midstream Channel	147,152	25.02	21.97	74.6%	109,738	18.64	16.40
Lighting	*145,831*	*24.67*	*21.93*	*74.7%*	*108,892*	*18.42*	*16.37*
Non-Lighting	*1,321*	*0.35*	*0.04*	*64.0%*	*846*	*0.23*	*0.03*
Main Channel	131,911	25.24	21.40	74.2%	97,897	18.72	15.91
Lighting	*112,908*	*21.28*	*18.90*	*74.9%*	*84,580*	*15.94*	*14.16*
HVAC	*10,934*	*2.72*	*1.26*	*70.1%*	*7,663*	*1.91*	*0.88*
Pumps and Drives	*3,093*	*0.48*	*0.49*		*2,168*	*0.34*	*0.34*
Food Service	*3,434*	*0.38*	*0.37*		*2,406*	*0.27*	*0.26*
Process	*1,542*	*0.38*	*0.38*		*1,080*	*0.27*	*0.27*
Business Savings Store	11,202	1.58	1.66	69.7%	7,806	1.14	1.19
Upstream Channel	349	0.12	0.06	64.0%	224	0.08	0.04
Total	290,614	51.96	45.08	**74.2%**	215,665	38.58	33.53

Table 6. Summary of DEP Ex Post Gross and Net Savings

Technology	Ex Post Gross			NTGR	Ex Post Net		
	Energy Savings (MWh)	Summer Peak Demand (MW)	Winter Peak Demand (MW)		Energy Savings (MWh)	Summer Peak Demand (MW)	Winter Peak Demand (MW)
Midstream Channel	51,171	8.94	7.64	74.4%	38,092	6.64	5.70
Lighting	*50,069*	*8.58*	*7.61*	*74.7%*	*37,387*	*6.41*	*5.68*
Non-Lighting	*1,102*	*0.36*	*0.02*	*64.0%*	*706*	*0.23*	*0.01*
Main Channel	51,065	9.07	7.48	74.2%	37,891	6.72	5.55
Lighting	*43,565*	*7.58*	*6.46*	*74.9%*	*32,635*	*5.68*	*4.84*
HVAC	*4,835*	*1.25*	*0.77*	*70.1%*	*3,388*	*0.87*	*0.54*
Pumps and Drives	*279*	*0.04*	*0.04*		*196*	*0.03*	*0.03*
Food Service	*2,362*	*0.20*	*0.19*		*1,655*	*0.14*	*0.14*
Process	*24*	*0.01*	*0.01*		*17*	*0.00*	*0.00*
Business Savings Store	4,764	0.69	0.71	69.8%	3,324	0.49	0.51
Upstream Channel	188	0.06	0.04	64.0%	120	0.04	0.02
Total	**107,188**	**18.76**	**15.86**	**74.1%**	79,427	13.89	11.79

Process Findings

The following are key findings from the limited process investigation:

- Participants in the main and midstream channels, as well as program trade allies, are generally satisfied with the program experience and program components. When asked to rate their satisfaction on a 0 to 10 scale – where 0 meant "not at all satisfied" and 10 meant "extremely satisfied" – participants and trade allies reported the following:
  - Main channel respondents provided mean ratings of 8.7 or higher for the program overall and all program components inquired about in the survey. They gave the highest ratings to the contractor or vendor who helped select the program-qualifying equipment and the program-qualifying equipment itself (rating of 9.3 and 9.2, respectively). The only program components with a mean rating below 9.0 were the application process (8.9) and the incentive levels (8.7).
  - Midstream channel participants are highly satisfied with their program experience. Respondents provided a mean rating of 9.6 for their overall experience with the discounted purchase and rated all program components included in the survey a 9.3 or higher.
  - In general, trade allies are satisfied with the program but gave satisfaction ratings slightly lower than participants. Mean ratings for program components range from 7.8 (incentive levels) to 9.0 (program staff interactions); the mean rating for the program overall was 8.5.
- COVID-19 undoubtedly impacted the program and both customers and trade allies during the evaluation period:
  - While the program exceeded savings goals in 2019, it fell slightly short during 2020.
  - Key COVID-19 impacts experienced by participants included material shortages, difficulty hiring or maintaining staff, temporary business closures, and decreases in revenue or profits. Of

participants who completed their projects after March 2020, few (16% main channel; 9% of midstream channel) reported that COVID-19 directly impacted their program project. Respondents who reported impacts most often noted project delays due to materials shortages and/or supply chain delays.

- A majority of surveyed trade allies, however, reported either a moderate (32%) or a great deal of impact (32%) of COVID-19 on their company's overall volume of Smart $aver projects. Trade allies most commonly reported delays in starting planned projects (51%) and completing ongoing projects (45%) due to the pandemic. Most trade allies reported little or no difference in COVID-19 impacts on Smart $aver projects compared to similar projects that did not participate in the program. Interestingly, trade allies were more likely to report a *greater* impact on Smart $aver projects in terms of delays in project starts or completions and project cancellations but a *smaller* impact in terms of difficulty selling new projects.

- Awareness of Custom Incentives among the Smart $aver Program participants is moderate (43%, main channel; 39%, midstream channel). Of those aware, only a few had received a Custom Incentive in the past (39%, main channel; 13%, midstream channel).
- Approximately, a quarter of participants (21%, main channel; 28%, midstream channel) reported having made an additional energy-efficient installation without an incentive. The main reason these customers did not apply for a Custom Incentive for these energy-efficient installations was a lack of awareness of the Custom Program.
- Trade allies most frequently cited material shortages and/or other pandemic-related delays as the most important changes in the lighting market over the past year.
- Lighting incentives continue to be an important driving force in the number of LEDs incented through the Smart $aver Prescriptive Program, with 75% of trade allies rating the incentives as "very important" in customer decisions. Trade allies, however, also attributed high importance to other, market-based factors, including increased customer awareness (74%), price reductions (63%), increases in confidence around energy savings (63%), and increases in recommendations from trade allies (63%).

1.4 Evaluation Recommendations

Based on the results of our impact evaluation, we identified the following opportunities for program improvement.

Recommendation 1: Continue to Improve Data Collection and Tracking Processes

Perform additional quality assurance steps on the data entered into the program-tracking database. While our impact analysis generally found few data tracking issues, two typos in measure quantities for lighting projects impacted the ISR for that technology. While it is impossible to ensure perfect data entry for all projects, additional checks, in particular for high-savings records, could potentially catch these impactful errors and lead to stronger realization rates.

Ensure measure units are consistent across the different delivery channels. Our database review found a few instances of different measure units being tracked for the same measure across different delivery channels. While in most cases, the issue appears to be limited to differences in labeling, in others, the difference could lead to miscalculation of measure savings. We recommend reviewing measure units across the delivery channels and synchronizing them, where appropriate. Where differences are warranted, different measure IDs and per unit deemed savings values should be developed and applied.

Recommendation 2: Ensure Program Eligibility of Incentive Measures

Ensure that only prescriptive measures receive incentives through the program. Our desk reviews found one instance of incented HVAC equipment that did not match the characteristics of any available prescriptive measures. Such equipment should not receive incentives through the Prescriptive Program but should rather be channeled through the Custom Program.

Recommendation 3: Continue Marketing and Education Around Other Smart $aver Programs

Encourage trade allies and distributors to cross-promote Smart $aver programs. Based on the limited process investigation, awareness of the Smart $aver Custom Program among Prescriptive Program participants is low. This suggests an opportunity for additional promotion of other Smart $aver offerings, especially by trade allies and distributors who are in direct contact with potential participants. We recommend that the program support trade allies and distributors in cross-promoting other Smart $aver programs, for example, by providing them with collateral (either physical or electronic) to pass along to their customers.

Recommendation 4: Continue to Develop Tools and Techniques to Support the Application Process

Offer more support regarding the Smart $aver application process. Although participants and trade allies are generally satisfied with the Smart $aver Program, several survey respondents noted the sometimes cumbersome and unclear application process. This continues to be a source of participant and trade ally dissatisfaction. In fact, a few respondents (both participants and trade allies) noted that they would have appreciated having a direct contact at Duke to help answer questions and receive more support with the application. The program should continue to develop tools to make the application clearer and easier to complete; this may include more guidance on required steps (e.g., a workflow sheet), better functionality of the online portal (e.g., lookup or pre-fill functions), and additional awareness of Duke's Customer Care Team (who are equipped to help answer questions and provide support with the application process).

2. Program Description

This section describes key elements of program design, implementation, and performance. The evaluation period addressed in this report is January 1, 2019, to December 31, 2020.

2.1 Program Design

The DEC and DEP Smart $aver Prescriptive Program provides incentives for electric commercial and industrial customers to purchase and install a variety of high-efficiency equipment, including lighting; HVAC equipment; pumps and drives; and qualifying process, food service, and information technology equipment. The program also uses incentives to encourage maintenance of existing equipment to reduce energy usage. Incentives are available for new construction, existing equipment retrofits, and failed equipment replacements. Prescriptive incentives under the program cannot exceed 75% of the customer's equipment cost.

The program has four delivery channels:

- The **main channel** for the program is application-based and primarily delivered through trade allies.
- The **midstream channel** allows distributors to provide incentives directly to prequalified customers on applicable equipment and receive reimbursement for those incentives from Duke Energy.
- The **Business Savings Store** on the Duke Energy website offers customers a limited number of qualified products for which they can receive an instant discount.
- The **upstream channel** was introduced in May 2020. It works directly with HVAC and Food Service manufacturers to provide discounted equipment to customers and increase participation in these technologies.

The incentives/discounts offered are consistent across the four delivery channels.

2.2 Program Implementation

Duke Energy's staff implement the Smart $aver Program with contractor support for specific program components. The program is also offered in other Duke Energy territories, and most program staff share responsibilities across the territories. In the DEC and DEP territories, the program is managed by three program staff, with support from Duke Energy marketing staff, a trade ally outreach team, a team of Business Energy Advisors (BEAs), and operational support for processing applications. In addition, Large Business Account Managers and Local Government and Community Relations staff assist with outreach efforts.

The program is marketed to commercial and industrial customers through targeted outreach and communications by the program. Marketing approaches during the evaluation period primarily included email and online marketing. Additional outreach was conducted by Large Business Account Managers, BEAs, and Community Relations staff.

2.3 Program Performance

Based on the program-tracking database, the program completed 15,015 projects in DEC's territory and 7,111 projects in DEP's territory. Over half of the projects were completed through the program's midstream channel, accounting for half of ex ante gross savings. The main channel accounted for the majority of the remaining

projects and savings, with the Business Savings Store contributing a much smaller share. The new upstream channel, introduced towards the end of the evaluation period, accounted for less than 1% of projects and savings in both jurisdictions. Overall, these projects accounted for approximately 318 GWh and 115 GWh in ex ante gross savings for DEC and DEP, respectively.

Table 7 summarizes these results, by jurisdiction.

Table 7. Summary of Projects and Ex Ante Gross Savings

Delivery Channel	Projects		Ex Ante Gross Savings	
	Number	Percent	MWh	Percent
DEC				
Midstream Channel	8,755	58%	160,140	50%
Main Channel	4,136	28%	144,300	45%
Business Savings Store	2,095	14%	12,761	4%
Upstream Channel	29	<1%	521	<1%
Total	**15,015**	**100%**	**317,721**	**100%**
DEP				
Midstream Channel	4,010	56%	55,199	48%
Main Channel	2,197	31%	53,745	47%
Business Savings Store	891	13%	5,620	5%
Upstream Channel	13	<1%	286	<1%
Total	**7,111**	**100%**	**114,851**	**100%**

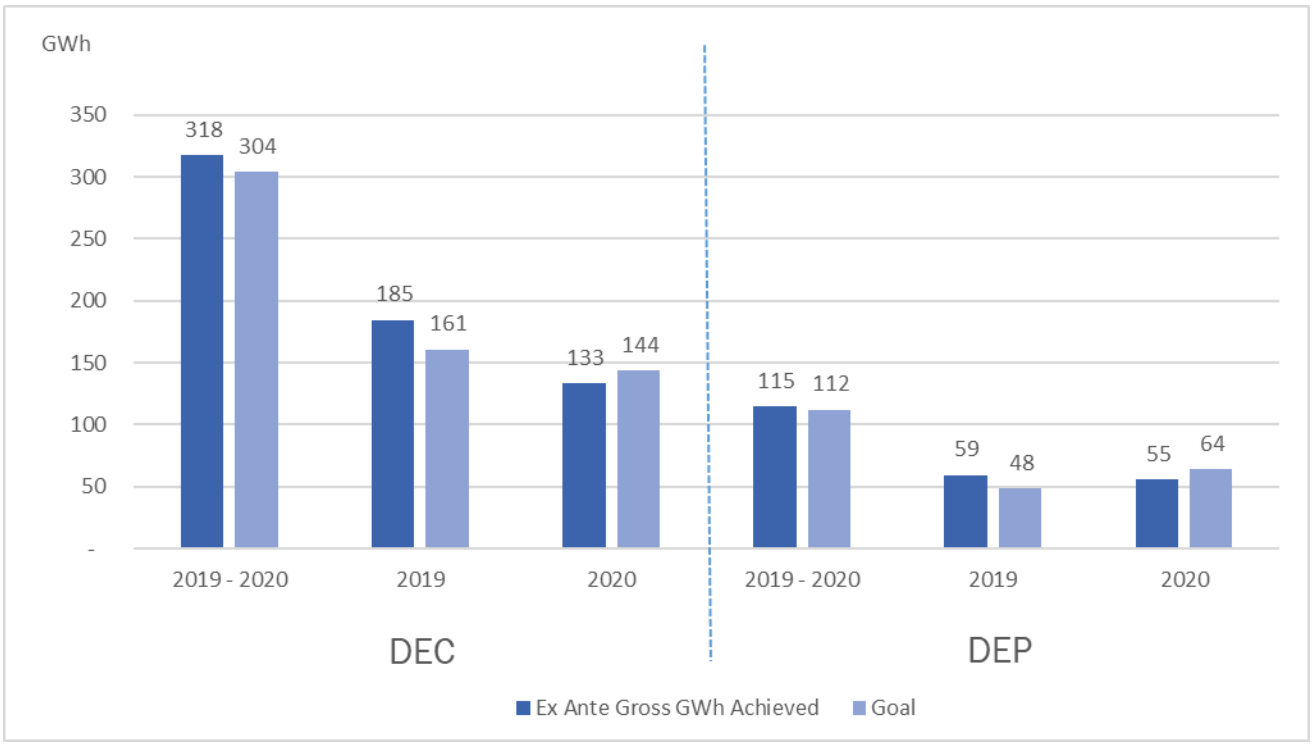
[b] The upstream channel was introduced towards the end of the evaluation period. The channel's contribution to program savings during the evaluation period was, therefore, very small.

Across the evaluation period (2019 and 2020), both jurisdictions slightly exceeded their ex ante savings goals. However, program performance varied by year:

- In 2019, the program had a strong year, achieving 185 GWh and 59 GWh of energy savings for DEC and DEP, respectively, compared to goals of 161 GWh and 48 GWh.
- Ex ante gross energy savings in 2020 (133 GWh for DEC; 55 GWh for DEP) fell short of the goals of 144 GWh and 64 GWh. The savings were undoubtedly impacted by the COVID-19 pandemic.

Figure 1 compares achieved ex ante gross energy savings (in MWh) to program goals.

Figure 1. Achieved Ex Ante Gross Savings Compared to Goal



3. Overview of Evaluation Activities

To address the objectives outlined in Section 1.2, the evaluation team performed a range of data collection and analytic activities, including:

- Program staff interviews (n=1)
- Program material review
- Program-tracking database review
- Main channel participant survey (n=129)
- Midstream channel participant survey (n=104)
- Trade ally survey (n=82)
- Engineering desk reviews (n=98)
- On-site visits (n=37)
- Deemed savings review of select measures

3.1 Program Staff Interviews

We conducted an in-depth interview with the Smart $aver Program manager in June 2021. The purpose of the interview was to collect information on the Smart $aver Program, including changes in program design and implementation since the last evaluation and the program's goals, successes, and challenges during the evaluation period.

3.2 Program Material Review

In an effort to reduce costs, this evaluation included a limited process evaluation. As a result, we reviewed limited program materials, including application materials and documentation of incented technologies and incentive levels. In support of the gross impact evaluation, we also reviewed a variety of secondary materials documenting Duke Energy's ex ante deemed savings assumptions as well as supporting documentation for projects selected for the desk reviews (see description below).

3.3 Program-Tracking Database Review

We received a data extract from the program-tracking database that contained the data needed to support our evaluation. Our team of energy data scientists and engineers cleaned the data and created two evaluation datasets (one at the measure level and one at the project level) that reflected program activity during the evaluation period and were used for the gross impact analysis and survey sampling. Key data-cleaning activities included verification of installation dates, removal of duplicate and otherwise ineligible records (e.g., zero savings), development of project IDs, development of ex ante savings (by multiplying per-unit savings by measure quantities), and cleaning of customer and trade ally contact information for sampling purposes.

3.4 Main Channel Participant Survey

We fielded an outbound phone survey with a stratified random sample of customers who participated in the main channel.[1] We fielded the main channel survey with customers who participated between January 1, 2020 and December 31, 2021. While the evaluation period is January 1, 2019, through December 31, 2020, excluding 2019 participants reduced the potential for recall issues due to the long-elapsed time between the Duke-incented project and survey fielding. We included 2021 participants to ensure sufficient sample sizes to develop rigorous evaluation results.[2]

The survey was fielded in June 2022. The survey was designed to collect information on FR and PSO for main channel projects (in support of the net impact analysis) and on program processes, such as participant satisfaction, impacts of COVID-19, and why customers may not have applied for Custom Incentives for additional non-incentivized measures. The main channel participant survey instrument can be found in the Appendix.

Sample Design

The survey sample was designed to allow for the development of statistically significant FR estimates (targeting 10% relative precision at 90% confidence) for lighting and non-lighting projects. We further stratified the sample in both groups based on project savings. While the sampling unit for this survey was the unique customer contact, the FR questions had to be asked about a specific project completed by that customer. Because many customers had completed more than one project during 2020 and 2021, our sampling approach prioritized projects in strata with fewer available sample points (i.e., non-lighting projects and projects with larger savings). To promote survey participation, we offered an incentive of $25 to every participant who completed the survey.

A total of 129 main channel participants who completed projects in 2020 or 2021 responded to the survey: 54 participants from 2020 and 75 participants from 2021; 90 participants with lighting projects and 39 participants with non-lighting projects. The average time to complete the survey was approximately 17 minutes; the response rate was 14.2%. Table 8 summarizes the population and survey completes, by jurisdiction and technology.

Table 8. Main Channel Participant Survey Completes by Technology

Technology	DEC		DEP	
	# of Projects in Population (Main Channel)	# of Completes	# of Projects in Population (Main Channel)	# of Completes
Lighting	2,921	57	1,552	33
Non-Lighting	1,457	24	812	15
Food Service	*751*	*0*	*425*	*0*
HVAC	*634*	*22*	*375*	*13*
Pumps and Drives	*48*	*1*	*10*	*2*
Process	*24*	*1*	*2*	*0*
Total	**4,136**	**81**	**2,197**	**48**

[1] Although online surveys are the industry standard when email addresses are available, the evaluation fielded the survey as a phone survey upon the project team's request. A third-party call center, ResponsivMR, conducted all phone interviews.
[2] Survey fielding was delayed relative to the original schedule due to changes in survey mode and question wording requested by the program team.

3.5 Midstream Channel Participant Survey

In April and May 2022, we fielded an outbound phone survey with participants in the midstream channel who made lighting purchases through this channel between January 1, 2020, and December 31, 2021.[3] While the evaluation period is January 1, 2019 through December 31, 2020, excluding 2019 participants reduced the potential for recall issues due to the long-elapsed time between the Duke-incented project and the survey. We included 2021 participants to ensure sufficient sample sizes to develop rigorous evaluation results.[4] Similarly, while the midstream channel includes non-lighting measures, the vast majority of midstream savings were associated with lighting measures. As such, our survey only included participants who made lighting purchases.

The objective of this survey was to verify the purchase and installation of the incented lighting products (in support of the gross impact analysis) and to collect information on FR and PSO for midstream channel projects (in support of the net impact analysis). Process questions were limited to participant satisfaction, impacts of COVID-19, and barriers to applying for Custom Incentives. The midstream channel participant survey instrument can be found in the Appendix.

Sample Design

The survey sample was designed to allow for the development of statistically significant ISR and FR estimates (targeting 10% relative precision at 90% confidence). We stratified the sample based on savings. While the sampling unit for this survey was the unique customer contact, the ISR and FR questions had to be asked about a specific purchase made by that customer. Similar to the main channel sampling approach, since many customers had made more than one purchase in 2020 and 2021, our sampling approach prioritized purchases in strata with fewer available sample points (i.e., purchases with larger savings).

A total of 104 participants with midstream lighting purchases in 2020 or 2021 completed the survey: 61 participants from 2020 and 43 participants from 2021. The average time to complete the survey was approximately 22 minutes; the response rate was 13.8%. Table 9 summarizes the population and midstream channel survey completes by jurisdiction.

Table 9. Midstream Channel Participant Survey Completes

Jurisdiction	Population (Lighting Purchases)	Survey Completes
DEC	8,610	72
DEP	3,854	32
Total	**12,464**	**104**

3.6 Trade Ally Survey

We conducted an online survey with trade allies who completed at least one project through the DEC and/or DEP Smart $aver Program during the evaluation period. The survey was fielded in December 2021 and January 2022. The goal of this survey was to support estimation of TASO attributable to the Smart $aver Program.

[3] Although online surveys are the industry standard when email addresses are available, the evaluation fielded the survey as a phone survey upon the project team's request. A third-party call center, ResponsivMR, conducted all phone surveys.
[4] Survey fielding was delayed relative to the original schedule due to changes in survey mode and question wording requested by the program team.

The trade ally survey instrument can be found in the Appendix.

Sample Design

We sent an email invitation to each trade ally company that completed at least one project through the Smart $aver Program during 2019 or 2020 and had a valid email address (N=623, i.e., we attempted a census of trade ally companies). As such, our data collection approach was not sample-based, and the concept of sampling precision does not apply. To promote participation in the survey, we offered an incentive of $50 to every trade ally who completed the survey.

Overall, 82 trade allies with projects in 2019 or 2020 completed the survey, including 41 that served DEC customers, 14 that served DEP customers, and 27 that supported projects in both jurisdictions. The response rate was 15.5%.

3.7 Main Channel Engineering Desk Reviews and On-Site Visits

To verify measure quantities reported in the program-tracking database, our engineering team performed 98 desk reviews of main channel projects, sampled by technology. The desk reviews consisted of a thorough examination of all available program documentation for the projects, including applications, invoices, and specification sheets. Our team also performed 12 on-site visits to confirm measure quantities and other key project parameters of incented projects.

To select projects for desk reviews, we used a stratified random sampling approach, stratifying by technology and project savings (see Table 10). The projects selected for on-site visits were a subset of the 98 desk review projects. We targeted a precision level of 10% at 90% confidence for the resulting quantity adjustments, by technology.

Table 10. Summary of Main Channel Verification

Technology	Number of Projects (Main Channel)		
	Population	Desk Reviews	On-site Visits [a]
Lighting	4,473	44	6
Food Service	1,176	20	4
HVAC	1,009	20	1
Pumps and Drives	58	8	-
Process	26	6	1
Total	**6,742**	**98**	**12**

[a] *Note:* We visited a total of 19 sites. For 7 sites, we were unable to collect valid installation information.

3.8 Midstream On-Site Visits

In addition to the on-site visits for main channel projects, our team also performed 25 on-site visits to confirm measure quantities and other key project parameters of incented midstream channel projects (Table 11). The projects selected for on-site visits were a subset of the 94 participants who provided valid responses to the midstream survey (nested sample), selected at random from among respondents who agreed in the survey to participate in an onsite visit.

Table 11. Summary of Midstream Channel Verification

Technology	Number of Projects (Midstream Channel)		
	Population	Survey Completes (with Valid ISR Data)	On-site Visits
Lighting	12,464	94	25

3.9 Deemed Savings Review of Select Measures

To assess ex ante per-unit savings values, our engineering team performed a focused deemed savings review, which included 11 measures[5] that had not been evaluated in the past and were of interest to program staff.

For each of the 11 selected measures, we reviewed existing program documents, program tracking data, assumptions, Technical Reference Manuals (TRMs), and other resources as applicable to determine the appropriateness of the per-unit savings values. We then recommended changes to per-unit savings for all 11 measures, based on our review of these materials.

[5] The reviewed measures included seven lighting measures (LED tubes, LED highbay fixtures, LED flood lights, LED downlights, LED linear ambient fixtures, LED track lighting, and networked lighting controls) and four HVAC measures (connected smart thermostats, advanced rooftop controls, roof insulation, and guest room energy management systems).

4. Impact Evaluation

4.1 Methodology

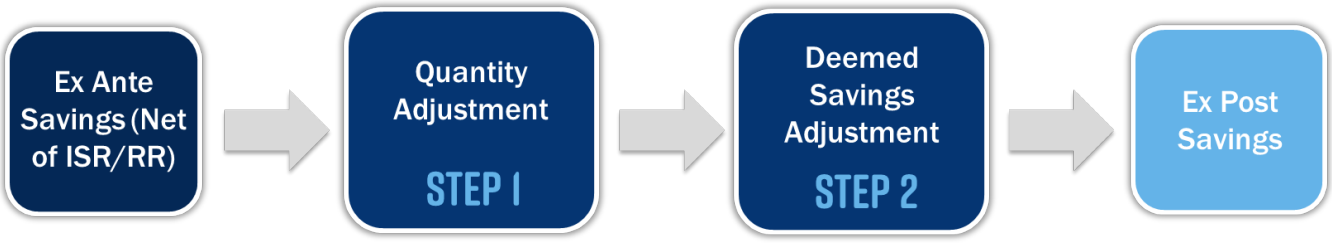
Our gross impact evaluation included five key evaluation activities: (1) a program-tracking database review; (2) a deemed savings review to verify per unit savings for select measures; (3) engineering desk reviews to verify measure quantities for main channel projects; (4) a survey-based ISR analysis for midstream channel lighting participants; and (5) on-site visits with a sample of main channel and midstream channel participants.

The evaluation team used these activities to develop ex post (verified) gross savings and realization rates at the technology level, by delivery channel. The methodology consisted of two general steps:

- Step 1: Quantity Adjustment
  - For the main channel, the quantity adjustment was based on a sample of 98 engineering desk reviews and 12 on-site visits. We developed technology-specific quantity adjustment factors, which we applied to the main channel measure quantities in the program-tracking database.
  - For the midstream channel, the quantity adjustment was based on responses from the midstream channel participant survey and 25 on-site visits. We developed a lighting-specific quantity adjustment factor, which we applied to the midstream quantities of lighting measures in the program-tracking database.
  - For the Business Savings Store, the new upstream channel, and midstream non-lighting purchases, the quantity adjustments were based on the main channel and/or midstream channel quantity adjustments, by equipment type (i.e., lighting vs. non-lighting).
- Step 2: Deemed Savings Adjustment
  - Based on the deemed savings review, we developed updated per-unit savings values for 11 reviewed measures. For measures not part of the deemed savings review, ex post per unit savings were set to equal ex ante savings.

To develop ex post gross savings, we applied the quantity adjustments and deemed savings adjustments to ex ante savings. Note that ex ante savings embed ISRs from the prior evaluation. In order to not double-apply ISRs, the prior ISRs were removed from ex ante savings before the new quantity adjustments was applied. Figure 2 depicts this process.

Figure 2. Gross Impact Evaluation Approach



The following subsections provide more detail on the gross impact evaluation activities.

4.1.1 Program-Tracking Database Review

The first step in the gross impact evaluation was to perform a database review. This review consisted of several steps. First, we reviewed data from the program-tracking database and developed unique project identifiers. Second, we calculated ex ante savings, by technology, by multiplying per-unit database savings by measure quantities. Third, we verified dates of installation, identified duplicate records, and checked for any other qualifying parameters that may disqualify measures (e.g., not achieving the minimum efficiency level).

The database review resulted in a clean dataset that reflected the eligible population of program projects with complete data required to estimate savings, including measure- and project-level ex ante savings. We used this dataset to draw samples for the engineering desk reviews and surveys, and to develop ex ante gross impacts by technology and delivery channel.

4.1.2 Main Channel Quantity Adjustment

The purpose of the desk reviews and on-site visits was to verify measure types and quantities included in the program-tracking database. We performed desk reviews for a sample of 98 main channel projects, sampling by technology (see Section 3.7). We reviewed all available project documentation for sampled projects, including the project application; any supplied calculations, invoices, specification sheets, and inspection forms; and any other project-specific data made available to our team. For all sampled projects, we compared measure types and quantities listed on project documents with those provided in the program-tracking database to ensure consistency and check for any errors. If inconsistencies were found, quantities listed on project documents superseded those in the tracking database for use in calculating ex post savings.

Following the desk reviews, we selected a sample of 20 projects from among the desk review projects (nested sample) to perform on-site visits. We selected all projects for which our desk reviews had found discrepancies (10); the remaining sample (10) was drawn at random. We visited a total of 19 of the 20 sampled sites. We were not able to visit the 20th site due to a last minute scheduling issue. For seven of the 19 visited sites, we were unable to collect sufficient installation information due to the following reasons: (1) we could not access the site (the site contact was unavailable); (2) we could not access the equipment (it was in a restricted area or on the roof); and (3) we could only verify a portion of the installed lighting equipment, which prevented us from developing an ISR for the site.

We used the on-site visits to confirm installation of the energy-efficient measure(s) and other project-specific parameters as applicable (e.g., type, size). We developed an on-site data collection plan, which documented the general on-site data collection approach, including the data to be collected during the visits; the requirements for technicians, such as badging and apparel; and any safety or training requirements, including COVID-19 protocols.

Based on information from both desk reviews and on-site visits, we developed technology-level quantity adjustment factors to apply to main channel projects.

4.1.3 Midstream Channel Quantity Adjustment

As part of the midstream channel participant survey, we asked customers to verify receipt, installation, and continued operation of lighting measures recorded in the program-tracking database. We used this information to calculate a preliminary quantity adjustment as the number of lamps or fixtures installed and operational at the time of the survey, divided by the number of lamps or fixtures in the program-tracking database (by respondent and type of lighting measure).

Following the survey, we selected a random sample of 25 projects from among the completed surveys to perform on-site visits. We used the on-site visits to confirm installation of the energy-efficient measure(s) and other project-specific parameters as applicable (e.g., type, wattage).

We then developed aggregated, measure-level ISRs by combining the information gathered during the on-site visits with information from midstream channel survey responses to develop gross realization rates, weighting by savings. We used these ISRs as the quantity adjustments for midstream channel lighting purchases.

4.1.4 Quantity Adjustments for Other Channels/Technologies

Due to the small contributions of the Business Savings Store, the new upstream channel, and midstream non-lighting purchases to overall program savings, we did not conduct research specific to these types of purchases. Instead, we applied results from the main channel and midstream channel analyses, by technology group (i.e., lighting and non-lighting).

4.1.5 Deemed Savings Adjustment

The purpose of the deemed savings review was to update per-unit savings assumptions for select measures incented through the Smart $aver Program. Measures were chosen by Duke Energy program staff and included priority measures that had not been studied in past evaluations.

Table 12 presents the measures included in the deemed savings review and their total program ex ante energy savings, by technology.

Table 12. Summary of Measures Reviewed

Technology	Reviewed Measures	Ex Ante kWh
Lighting	LED 2-ft Tube 1-LED, replacing or in lieu of T8 fluorescent	224
	LED 3-ft Tube 1-LED, replacing or in lieu of T8 fluorescent	429
	LED 4-ft Tube 1-LED, replacing or in lieu of T8 fluorescent	3,787
	LED 8-ft Tube 1-LED, replacing or in lieu of T8 fluorescent	1,192
	LED Downlight greater than 18W	945
	LED Highbay Fixture replacing 2-lamp 8-ft T12 fixture	22,532
	LED Highbay Fixture replacing 4-lamp 4-ft T5HO fixture	3,491
	LED Highbay Fixture replacing 6-lamp 4-ft T8 fixture	1,381
	LED Linear Ambient Fixture	6,022
	LED Track Lighting (replacing or ILO INCD, HAL, CFL, or HID track lighting)	13,337
	LED FLD replacing or ILO up to 100W HAL, INCD, or HID	1,036
	LED FLD replacing or ILO GRT 100W HAL, INCD, or HID	4,704
	LED FLD replacing or ILO greater than 500W HAL, INCD, or HID	28,067
	Networked Lighting Controls	73,936
HVAC	Connected Smart Thermostats	30,049
	ARC HP less than 10 Tons	6,665
	ARC HP 10 to 15 Tons	18,661
	ARC HP greater than 15 Tons	401,389
	ARC less than 10 Tons, Gas Heat	15,408
	ARC 10 to 15 Tons, Gas Heat	13,888

Technology	Reviewed Measures	Ex Ante kWh
	ARC greater than 15 Tons, Gas Heat	63,659
	Roof Insulation	291,070
	Guest Room Energy Management, Electric Heating	199,558

For the selected measures, we reviewed all program-supplied ex ante documentation and exchanged several rounds of questions with Duke Energy to clarify specific assumptions. We leveraged a variety of TRMs, (with a primary focus on the Mid-Atlantic TRM V10) as well as ENERGY STAR®,[6] Duke Energy-specific studies, and other references, as needed.

An Excel spreadsheet providing the details of the deemed savings review was provided under separate cover.

4.2 Gross Impact Results

Table 13 and [A] A key driver of realization rates for HVAC measures was the update to deemed savings values for Roof Insulation, including correction of an error in the ex ante deemed savings algorithm. Without this deemed savings update, HVAC realization rates would have been 84% for DEC and 80% for DEP. These rates may be better values to use for planning purposes.

Table 14 summarize the overall gross energy and demand impacts for DEC and DEP (including savings from all four delivery channels) resulting from the two-step adjustment approach described above. The following subsections provide more detailed results from the quantity and deemed savings adjustment analyses, including realization rates.

Table 13. Overall Gross Energy Impacts

Technology	DEC			DEP		
	Ex Ante MWh	Realization Rate	Ex Post MWh	Ex Ante MWh	Realization Rate	Ex Post MWh
Lighting	286,978	93%	266,604	103,654	94%	97,026
HVAC [A]	24,290	64%	15,552	9,632	75%	7,255
Pumps and Drives	3,135	100%	3,139	279	100%	279
Food Service	1,770	212%	3,753	1,253	207%	2,596
Process	1,523	101%	1,542	24	100%	24
IT	25	99%	25	8	98%	8
Total	**317,721**	**91%**	**290,614**	**114,851**	**93%**	**107,188**

[A] A key driver of realization rates for HVAC measures was the update to deemed savings values for Roof Insulation, including correction of an error in the ex ante deemed savings algorithm. Without this deemed savings update, HVAC realization rates would have been 84% for DEC and 80% for DEP. These rates may be better values to use for planning purposes.

[6] ENERGY STAR and the ENERGY STAR mark are registered trademarks owned by the US Environmental Protection Agency.

Table 14. Overall Gross Demand Impacts

Technology	DEC			DEP		
	Ex Ante MWh	Realization Rate	Ex Post MWh	Ex Ante MWh	Realization Rate	Ex Post MWh
Summer Demand Impacts						
Lighting	50.32	94%	47.51	17.82	94%	16.83
HVAC [A]	3.95	80%	3.16	1.87	88%	1.65
Pumps and Drives	0.49	100%	0.49	0.04	100%	0.04
Food Service	0.14	297%	0.42	0.10	229%	0.23
Process	0.37	102%	0.38	0.01	100%	0.01
IT	-	N/A	-	-	N/A	-
Total	**55.27**	**94%**	**51.96**	**19.84**	**95%**	**18.76**
Winter Demand Impacts						
Lighting	49.23	86%	42.40	17.37	85%	14.74
HVAC [A]	5.25	27%	1.40	1.69	50%	0.85
Pumps and Drives	0.50	100%	0.50	0.04	100%	0.04
Food Service	0.13	304%	0.41	0.09	230%	0.22
Process	0.37	102%	0.38	0.01	100%	0.01
IT	-	N/A	-	-	N/A	-
Total	**55.49**	**81%**	**45.08**	**19.21**	**83%**	**15.86**

[A] A key driver of realization rates for HVAC measures was the update to deemed savings values for Roof Insulation, including correction of an error in the ex ante deemed savings algorithm. Without this deemed savings update, HVAC summer demand realization rates would have been 93% for DEC and 92% for DEP while winter demand realization rates would have been 66% for DEC and 64% for DEP. These rates may be better values to use for planning purposes.

4.2.1 Program-Tracking Database Review

Overall, the program-tracking database contained all information needed to complete the various evaluation tasks. We provide the following observations:

- Duke Energy staff compiles program-tracking data from various sources, with several fields containing similar, but not necessarily identical data (e.g., customer contact information). To-date, Duke Energy has not been able to provide a data dictionary, which would be helpful in resolving data issues and navigating the changing data fields and names that we have received over the course of several evaluations of this program.
- Review of the data showed some inconsistencies in the "Unit of Measure" field. Most of the inconsistencies appear to stem from different vendors in charge of compiling data for the different delivery channels. While in most cases, the issue appears to be limited to differences in labeling, in others (e.g., Occupancy Sensors per watt), the tracked quantities appear to match the different units. Since measure IDs and the associated per unit savings are the same, this could lead to miscalculation of measure savings. The following table summarizes key inconsistencies in measure units.

Table 15. Inconsistencies in Measure Units

Measures	Unit of Measure		
	Main Channel	Midstream Channel	Business Savings Store
Bi-level Controls Exterior Retrofit	per kW controlled	per watt controlled	n/a
High Bay 6L T5 HO (2 fixtures) retrofit replc 1000W HID	per fixture (ballasts + bulbs)	per 2 fixtures (ballasts + bulbs)	n/a
LED 6ft Case Lights, T8 to LED	per lamp	per fixture	n/a
LED 6ft Case Lights, T8 to LED - With Controls	per lamp	per fixture	n/a
Occupancy Sensors per watt	per watt	per watt controlled	Sensor
Water Heater Pipe Insulation	n/a	n/a	Pipe wrap Pre rinse sprayers

4.2.2 Main Channel Quantity Adjustment

Based on our desk reviews and on-site visits, we adjusted the quantities for nine of the 98 sampled main channel projects. While most of the adjustments were minor, two involved significant data entry errors for lighting projects (projects #3 and #4 in Table 16), and one involved a prescriptive incentive being provided for a custom HVAC measure (project #7). Table 16 summarizes the quantity adjustments made for the nine projects.

Table 16. Summary of Main Channel Projects with Quantity Adjustments

Sample Project #	Measure	Technology	Unit of Measure	Quantity	
				Database (Ex Ante)	Desk Review (Ex Post)
#1	Fluorescent Delamping 4-ft T8	Lighting	Lamps removed	552	768
#2	LED Panel 2x4 replacing or in lieu of T8 FL	Lighting	Fixtures	117	115
#3	LED Exterior replacing up to 175W HID retrofit (wall pack)	Lighting	Fixtures	1,091	1
#4	LED Highbay replacing 251W–400W HID Lamp	Lighting	Fixtures	214	14
#5	Occupancy Sensors per watt	Lighting	Watts controlled	17,040	18,520
#6	LED Panel 2x4 replacing or in lieu of T8 FL	Lighting	Fixtures	15	14
	Occupancy Sensors per watt		Watts controlled	7,084	10,764
#7	ARC HP greater than 15 Ton	HVAC	Tons	325	-
#8	Anti-Sweat Heater Controls	Food Service	Doors	10	-
	ECM Walk-In Cooler and Freezer Motors – ECM replacing PSC		Horsepower	1.59	1.58
#9	Compressed Air Audit and Leak Repair	Process	per SCFM	122.0	121.7

The quantity adjustments for the nine projects resulted in realization rates different from 100% for food service, HVAC, lighting, and process equipment. The lighting category had the greatest quantity adjustment for energy savings (95.6%) as a result of the two data entry errors. We did not adjust quantities within the pumps and drives technologies category because we did not find discrepancies in our review. We achieved a relative precision, at 90% confidence, of 7% or better for all technologies.

Overall quantity adjustments for main channel projects are 95.8% for energy savings, and 96.3% and 96.0%, respectively, for summer and winter demand savings. Table 17 summarizes the main channel quantity adjustment results.

Table 17. Main Channel Quantity Adjustments

Technology	Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)	Sample Size	Projects with Discrepancies
Lighting	95.59%	96.07%	95.96%	44	6
HVAC	96.11%	96.31%	95.50%	20	1
Food Service	98.58%	99.93%	99.98%	20	1
Pumps and Drives	100.00%	100.00%	100.00%	8	-
Process	99.98%	99.99%	99.99%	6	1
Total	**95.85%**	**96.26%**	**96.04%**	**98**	**9**

4.2.3 Midstream Channel Quantity Adjustment

The midstream channel participant survey and on-site visits identified 24 out of 94 sampled lighting projects with discrepancies between tracked and in-service quantities. The resulting energy savings ISR was 93.4%, with a relative precision of 4%, at 90% confidence (see Table 18).

The ISR was mainly driven by respondents who indicated that they had not yet installed some or all of the incented lighting measures (11 of the 24 projects with discrepancies) or that they had removed some or all measures (15 out of 24) because they were broken or defective.

Table 18. Midstream Quantity Adjustments

Technology	kWh	Summer kW	Winter kW	Sample Size	Projects with Quantity Discrepancies
Lighting	93.39%	93.15%	93.07%	94	24

4.2.4 Quantity Adjustments for Other Channels/Technologies

As noted above, the quantity adjustments from the main and midstream channels were applied to the Business Savings Store, the new upstream channel, and midstream channel non-lighting purchases, by technology:

- For Business Savings Store lighting purchases, we applied the savings-weighted average of the main channel and midstream channel lighting ISRs.
- For midstream, upstream, and Business Savings Store non-lighting purchases, we applied the savings-weighted average of the ISRs for the various main channel non-lighting technologies.

Table 19 summarizes these results.

Table 19. Quantity Adjustments for Other Channels/Technologies

Technology	kWh	Summer kW	Winter kW
Lighting	94.35%	94.48%	94.38%
Non-Lighting	97.06%	97.15%	96.33%

4.2.5 Deemed Savings Adjustment

The deemed savings review resulted in modifications to per-unit savings assumptions for all 11 selected measures within the lighting and HVAC technology categories.[7] Key adjustments included:

- Lighting Measures
  - For all lighting measures, we updated the following: (1) hours of use (HOU) based on program tracking data; (2) waste heat factors (WHF) based on the Arkansas TRM v8.1, which provides a better climate match with the DEC/DEP service territory than the Mid-Atlantic TRM; and (3) coincidence factors (CF) based on CFs from Mid-Atlantic TRM V10 and building type weights from program tracking data.
  - For highbay lighting, we also updated baseline wattages based on Duke Energy Progress' baseline wattage tables and efficient wattages based on baseline lumens.
  - For LED track lighting and LED floods, ex ante did not claim winter demand savings; ex post developed winter demand values.
- HVAC Measures
  - For connected smart thermostats, the ex post analysis used an algorithm and key inputs from the Mid-Atlantic TRM V10, which resulted in a significant reduction in per unit savings. The key driver is an updated cooling savings factor of 3%, based on the Mid-Atlantic TRM, compared to an ex ante factor of 14.3%, which is the average of values from the WI Focus on Energy 2019 TRM (20.5%) and the IL TRM v7.0 (8.0%). Ex post estimated heating savings for smart thermostats were zero in the ex ante value, but despite these additional savings, ex post per unit savings are less than one-third of ex ante per unit savings for this measure.
  - The roof Insulation measure also had low realization rates of 7% for DEC and 9% for DEP (for energy savings). Key drivers were (1) Ex post savings are based on an algorithm from the IL-TRM V10. The ex ante algorithm was from the 2016 Pennsylvania TRM and contained a transcription error in the heating savings calculation. (2) Ex post savings apply the percentage of buildings that have electric heating and cooling, respectively, based on CBECS 2018 data. In addition, ex post savings split electric heating into electric resistance and heat pumps, also based on CBECS 2018 data. Ex ante assumes 100% of buildings have electric resistance heating and cooling.
  - Ex post per unit values for guest room energy management systems with electric heat were around two-thirds of ex ante values, Ex post values are based on an algorithm from the WI Focus on Energy 2019 TRM, with EFLH and CF values from the Arkansas TRM V8.1 and Mid-Atlantic TRM V10. The ex ante algorithm was from the 2009 Ohio TRM.
  - For advanced rooftop control (ARC) measures, we were not able to develop verified savings that take into account the climate of the DEC or DEP territory using available TRMs. Therefore, the ex ante savings approach is maintained with an updated HOU value based on program tracking data.

An Excel spreadsheet providing the details of the deemed savings review was provided under separate cover.

To develop technology-level deemed savings adjustments, we (1) multiplied revised per-unit savings values by ex ante quantities, at the measure-level, to calculate deemed savings-adjusted gross savings (for all measures

[7] The deemed savings review did not include measures within the pumps and drives, food service, process, or information technology categories.

that were not included in the deemed savings review, ex post per unit values were set to equal ex ante values); and (2) divided these adjusted gross savings by ex ante savings, by technology.

Table 20 summarizes the results of the deemed savings review, by technology.

Table 20. Deemed Savings Review Adjustments

Technology	Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)
Lighting	96.9%	98.2%	89.2%
HVAC	69.7%	84.2%	34.0%
Food Service	100.0%	100.0%	100.0%
Pumps and Drives	100.0%	100.0%	100.0%
Process	100.0%	100.0%	100.0%
IT	100.0%	n/a	n/a
Total	**94.9%**	**97.1%**	**84.4%**

4.2.6 Overall Gross Realization Rates

Based on the analyses summarized above, the overall program-level realization rates for energy savings, summer peak demand, and winter peak demand are 91.5%, 94.0%, and 81.2%, respectively, for DEC and 93.3%, 94.6%, and 82.6%, respectively, for DEP (see Table 21). For HVAC measures, these rates are primarily driven by the substantial deemed savings review adjustments for the four reviewed measures, which account for almost half of ex ante HVAC energy savings. Quantity adjustments account for most of the overall realization rate for lighting. For food service projects, estimated quantity adjustments are small, and no food service measures were included in the deemed savings review. For this technology, the large realization rates of over 200% are the result of removing low ISRs developed in prior evaluations and replacing them with the quantity adjustment of 99% estimated in this evaluation.

Table 21. Overall Gross Realization Rates

Technology	DEC			DEP		
	Energy Savings (MWh)	Summer Peak Demand (MW)	Winter Peak Demand (MW)	Energy Savings (MWh)	Summer Peak Demand (MW)	Winter Peak Demand (MW)
Lighting	92.9%	94.4%	86.1%	93.6%	94.4%	84.9%
HVAC	64.0%	80.1%	26.7%	75.3%	88.4%	50.3%
Food Service	212.0%	297.0%	304.0%	207.2%	228.9%	229.6%
Pumps and Drives	100.1%	100.1%	100.2%	100.1%	100.1%	100.3%
Process	101.3%	102.0%	102.0%	100.0%	100.0%	100.0%
IT	98.5%	N/A	N/A	98.3%	N/A	N/A
Total	**91.5%**	**94.0%**	**81.2%**	**93.3%**	**94.6%**	**82.6%**

In addition to the realization rates summarized above, Duke Energy requires realization rates that can be applied to new measures, for planning purposes. These rates should reflect only the ISR results from the current evaluation; they should not reflect the corrections of prior results embedded in ex ante values discussed above. These planning rates are calculated by multiplying each technology's ISRs by its deemed savings adjustments. They are presented in Table 22.

Table 22. Overall Gross Realization Rates – Alternate Rates for Planning Purposes

Technology	DEC			DEP		
	Energy Savings (MWh)	Summer Peak Demand (MW)	Winter Peak Demand (MW)	Energy Savings (MWh)	Summer Peak Demand (MW)	Winter Peak Demand (MW)
Lighting	91.38%	92.74%	84.20%	91.44%	92.76%	84.20%
HVAC	67.15%	81.14%	32.44%	67.21%	81.21%	32.45%
Food Service	99.96%	99.96%	99.95%	100.00%	100.00%	100.00%
Pumps and Drives	98.45%	99.67%	99.64%	98.44%	99.60%	99.56%
Process	99.98%	99.99%	99.99%	99.98%	99.99%	99.99%
IT	97.06%	n/a	n/a	97.06%	n/a	n/a
Total	**89.76%**	**92.01%**	**79.86%**	**89.81%**	**92.03%**	**79.82%**

5. Net-to-Gross Analysis

5.1 Methodology

Our NTG analysis includes consideration of FR and PSO with participants in the main and midstream channels. We also assessed TASO associated with trade allies who participated in the main channel during the evaluation period. FR and PSO are based on the participant telephone survey, while TASO is based on the online trade ally survey.

The NTGR is calculated as follows:

$$NTGR = 1 - FR + PSO + TASO$$

Due to the small contributions of the Business Savings Store, the new upstream channel, and midstream non-lighting purchases to overall program savings, we did not conduct NTG research specific to these types of purchases. Instead, we applied results from the main channel and midstream channel analyses, by technology group (i.e., lighting and non-lighting).

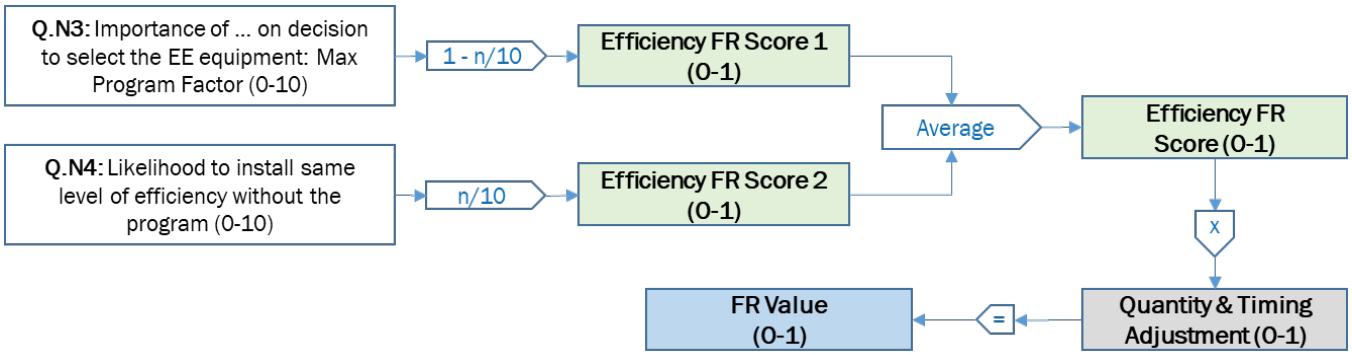
5.1.1 Free-Ridership

Free riders are program participants who would have completed the same energy efficiency upgrade without the program. FR scores represent the percentage of savings that would have been achieved in the absence of the program. FR scores can range from 0% (not a free-rider; the participant would not have completed the project without the program) to 100% (a full free-rider; the participant would have completed the project without the program). FR scores between 0% and 100% represent partial free riders (i.e., participants who were to some degree influenced by the program to complete the energy efficiency upgrade).

FR survey questions focus on the importance of various program factors on the decision to install/purchase energy-efficient equipment, the likelihood of choosing the same efficiency level in the absence of the program (the counterfactual), and the likely size and timing of the project/purchase without the program. These questions are used to determine program influence on levels of efficiency, measure quantity (where applicable), and project timing. We developed two measurements of program influence on levels of efficiency and used consistency checks in cases where inconsistent responses were given. Responses about measure quantity and project timing were used to adjust the efficiency-based FR rate, allowing the program to receive credit in cases where the program influenced project size and timing rather than, or in addition to, the level of efficiency.

Figure 3 presents a diagram of the FR algorithm used for this evaluation, including references to question numbers. A more detailed description of the algorithm can be found in the Appendix.

Figure 3. Overview of Free-Ridership Algorithm



We developed separate FR estimates for three analysis groups: main channel lighting, main channel non-lighting, and midstream lighting. We explored the possibility of developing separate FR estimates for the various non-lighting technologies incented through the main channel (i.e., HVAC equipment; process equipment; pumps and drives; and food service equipment). However, due to the small number of unique customers who completed non-lighting projects, we did not obtain enough responses to develop rigorous FR estimates at the technology level (despite an attempted census of these projects).

We developed FR estimates for the three analysis groups as follows:

- We first developed a FR estimate for each survey respondent, using the algorithm depicted above.
- We then aggregated respondent-level FR estimates to the stratum level, weighting the sampled projects within each stratum by their ex post gross savings.
  - For main channel non-lighting projects, we combined the strata for large and medium projects, due to a relatively low number of responses. We also created a separate stratum for one project because it accounted for close to half of sampled savings.
  - For main channel and midstream lighting projects, we utilized the four size-based strata used for sample development as we had a sufficient number of survey responses in each stratum.
- For each analysis group, we developed a FR value by applying ex post savings weights to reflect the relative contribution of each stratum to the group's overall savings.

In addition, we rolled up FR results to the lighting level (across the two delivery channels) as Duke uses these values for planning purposes in DSMore. We developed these aggregate values by applying ex post savings weights to reflect the relative contribution of the two channels to overall lighting savings.

5.1.2 Participant Spillover

PSO refers to additional energy efficiency upgrades participants made at the time of, or after, their participation in the Smart $aver Program that were influenced by the program, but for which they did not receive a program incentive. PSO was estimated separately for the main and midstream channels and is expressed as a percentage of delivery channel savings.

To determine if a survey respondent is eligible for PSO savings, we asked a series of questions about additional energy efficiency installations that they made without receiving an incentive and the degree to which the program influenced their decision to install the efficient equipment. The survey included two program influence questions:

SP2a. On a scale of 0-10, where 0 means "no influence" and 10 means "greatly influenced," how much did your experience with the Duke Energy-discounted equipment or interactions with Duke Energy staff influence your decision to make efficiency improvements without a rebate?

SP2b. If you had not purchased the Duke Energy-discounted <TECH> equipment, how likely is it that <COMPANY> would still have made the additional energy efficient improvements? Please use a 0 to 10 scale, where 0 means you "definitely WOULD NOT have implemented this equipment" and 10 means you "definitely WOULD have implemented this equipment."

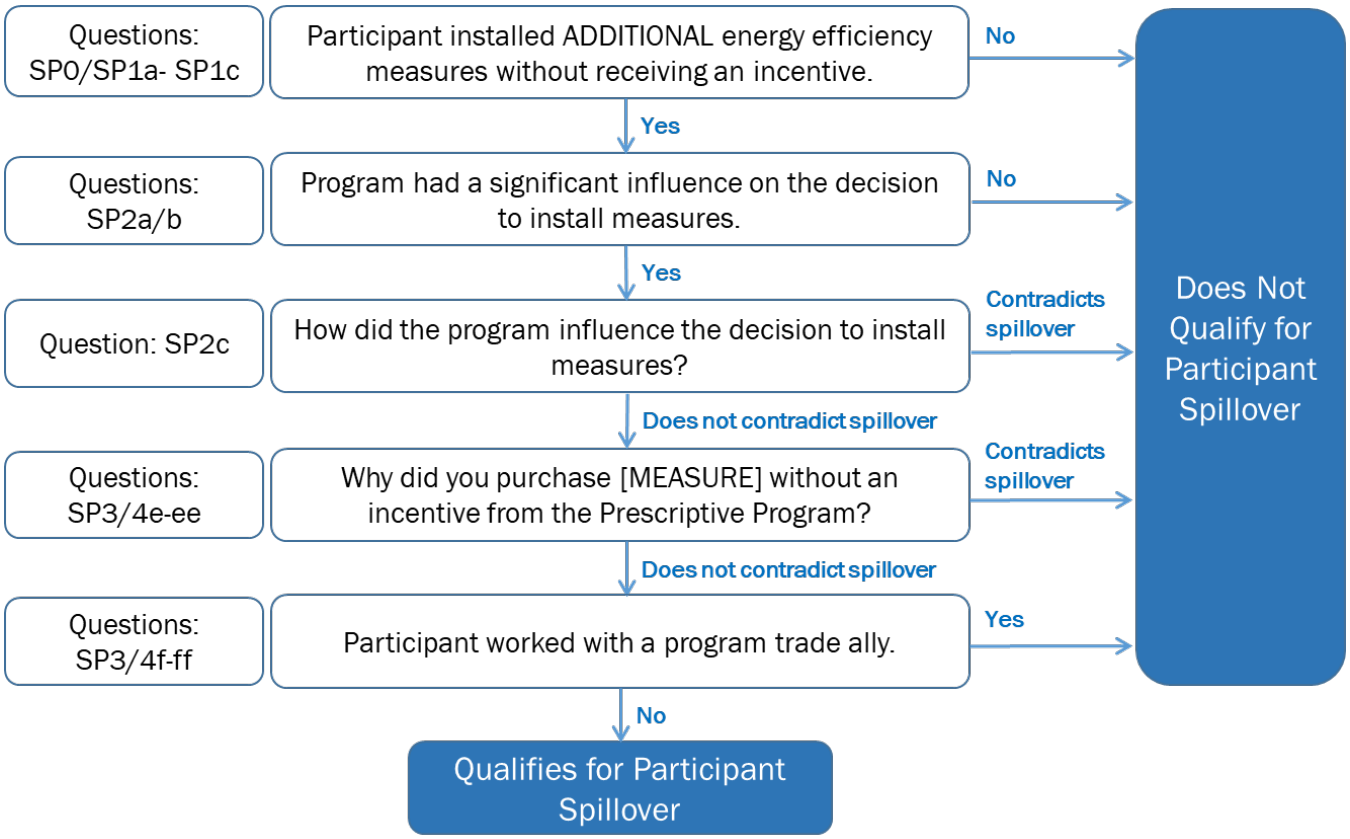
To supplement these numeric responses, we asked open-ended questions about how the program influenced the decision to make the energy-efficient installations and why the participant made the installations without a program incentive. A respondent's additional energy efficiency installations were deemed eligible for PSO if two conditions were met: (1) the Program Influence Factor (see below) was greater than 7.0 and (2) the open-ended responses did not contradict that the installations were eligible for PSO. The Program Influence Factor is defined as follows:

Program Influence Factor = (SP2a Response + (10 – SP2b Response)) ÷ 2

In addition, we applied a third PSO eligibility condition: that the participant did not work with a participating trade ally. This condition was necessary because this evaluation also estimated TASO. When estimating spillover (SO) from multiple sources, it is important to avoid double-counting. In the case of this evaluation, double counting could occur if participants and trade allies report SO from the same projects. We avoided such double counting by determining if the participant's SO project was completed by a trade ally who is in the sample frame for the TASO survey (i.e., the trade ally completed at least one project through the Smart $aver Program during the evaluation period). If so, the SO reported by the participant was excluded from the PSO estimate as it will be captured through the TASO analysis (see also Section 5.1.3).

Figure 4 presents a diagram of the PSO eligibility determination methodology used for this evaluation, including references to question numbers.

Figure 4. Participant Eligibility for Spillover – Methodology



The survey also included a few follow-up questions about SO-eligible measures, including the type of equipment and, for lighting measures only, information on the quantity of measures installed, whether they were installed in a conditioned space, and the type of lighting they replaced.

For participants with qualifying installations, we conducted follow-up interviews to collect more-detailed information for each additional measure, such as baseline and efficient wattages or the age of the equipment. We then used the program's ex post deemed savings values to develop SO savings for each measure.

We developed a "PSO Rate," which is calculated using the following formula:

$$PSO\ Rate = \frac{SO\ in\ Sample}{Ex\ Post\ Gross\ Impacts\ in\ Sample}$$

5.1.3 Trade Ally Spillover

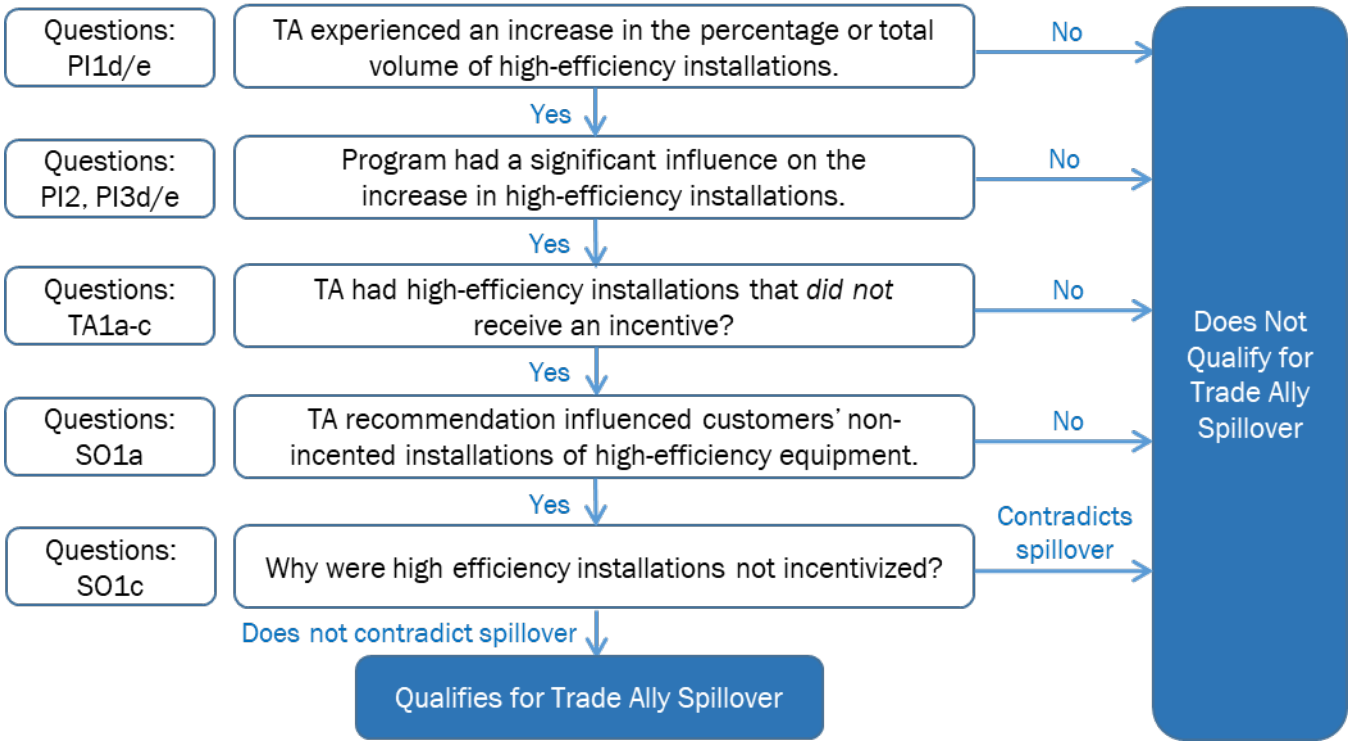
TASO refers to non-incented energy efficiency upgrades made by customers who were influenced by a participating trade ally who was, in turn, influenced by the Smart $aver Program. TASO is estimated at the program level and is expressed as a percentage of program savings. This section presents a high-level overview of the TASO methodology.

To determine if a trade ally was eligible for SO savings, the online survey asked a series of SO-related questions. We considered a trade ally eligible for SO if the following conditions were met:

- Since working with the Smart $aver Program, either the trade ally's percentage of high-efficiency installations increased or the trade ally's total volume of high-efficiency installations increased.
- The trade ally rated the importance of the Smart $aver Program on at least one of these increases an 8, 9, or 10 (on a scale of 0 to 10).
- The trade ally reported having installed at least some high-efficiency equipment without an incentive from the Smart $aver Program during the evaluation period.
- The trade ally gave a rating of 8, 9, or 10 (on a scale of 0 to 10) for the importance of their recommendation on installations of high-efficiency equipment that did not receive an incentive from the Smart $aver Program.
- The trade ally's open-ended response about why customers with high-efficiency installations did not receive an incentive from the program did not contradict that the non-incented, high-efficiency installations qualified as SO.

Figure 5 presents a diagram of the TASO eligibility determination methodology used for this evaluation, including references to question numbers.

Figure 5. Trade Ally Eligibility for Spillover – Methodology



For each respondent who met these qualifying conditions, we determined SO savings from the non-incented, high-efficiency installations through:

- Survey questions about:
  - The respective shares of the trade ally's total high-efficiency installations that did and did not receive a program incentive;

- The level of increase in the percentage or total volume of high-efficiency installations, and whether factors other than the program contributed to the increase (resulting in an "Attribution Factor"); and
- For trade allies who could not report the respective shares of total high-efficiency installations that did and did not receive a program incentive: the size of non-incented, high-efficiency installations relative to those that did receive an incentive (resulting in a "Size Adjustment" factor).

- Program-tracking data savings associated with the Smart $aver Program projects for that respondent.

For respondents who met the five qualifying conditions outlined above, SO savings were considered to be equal to a portion of the savings of their non-incented, high-efficiency installations. SO for each qualifying trade ally respondent (i) is calculated using the following equation. Data inputs to this formula are further described in the Appendix.

$$TASO\ Respondent_i = \left(\frac{Savings\ from\ Program\ Database_i}{\%\ Efficient\ Installations\ that\ Received\ Incentive_i} - Savings\ from\ Program\ Database_i \right) * Attribution\ Factor_i * Size\ Adjustment_i$$

To extrapolate savings to the program, we developed a "Respondent SO Ratio" by dividing the sum of the estimated SO savings by total program savings associated with all survey respondents. We then applied this Respondent SO Ratio to program savings associated with all trade allies (whether a survey respondent or not) to derive the overall SO estimate (in MWh). Finally, we estimated the "Program-Level SO Ratio" by dividing the overall SO estimate (in MWh) by total program ex post savings (in MWh). This final step is necessary to normalize the SO rate to the entire Smart $aver Program, taking into account that some customers complete projects without a trade ally.

A more detailed description of the TASO algorithm can be found in the Appendix.

5.2 Net-to-Gross Results

We estimated the program-level NTGR to be 74.2%. Table 23 presents the individual NTG components (i.e., FR, PSO, and TASO) and the resulting NTGRs by channel and technology group (i.e., lighting and non-lighting). The NTGR is calculated as 1 – FR + PSO + TASO.

Table 23. Summary of NTG Results

	Free-Ridership	Participant SO	Trade Ally SO	NTGR
Main Channel Lighting	31.2%	0.02%	6.1%	74.9%
Main Channel Non-Lighting	36.0%	0.02%	6.1%	70.1%
Midstream Lighting	25.3%	0.00%	0.0%	74.7%
Midstream Non-Lighting [a]	36.0%	0.02%	0.0%	64.0%
Business Savings Store Lighting [b]	27.9%	0.01%	0.0%	72.1%
Business Savings Store Non-Lighting [a]	36.0%	0.02%	0.0%	64.0%
Upstream Non-Lighting [a]	36.0%	0.02%	0.0%	64.0%
Total	**28.6%**	**0.01%**	**2.8%**	**74.2%**

[a] Set to equal main channel non-lighting FR and PSO values. TASO is only applicable to the main channel.

[b] Weighted average of main channel and midstream lighting FR and PSO values. TASO is only applicable to the main channel.

In addition to the results presented in Table 23, we developed weighted NTG averages at the technology group level. These values are used for planning purposes in DSMore and are shown in Table 24.

Table 24. NTG Summary for DSMore Table

	Free-Ridership	Participant SO	Trade Ally SO	NTGR
Lighting	27.9%	0.01%	2.6%	74.7%
Non-Lighting	36.0%	0.02%	4.7%	68.7%

5.2.1 Free-Ridership

A total of 112 main channel participants and 93 midstream channel participants provided valid responses to the FR questions in the participant surveys and were included in the FR analysis. Using the algorithm summarized in Section 5.1.1 above, we estimate program-level FR to be 28.6%.

Relative precision levels for all FR estimates are 3.0% or better at 90% confidence. It should be noted that we attempted a census for main channel non-lighting projects. As such, the concept of relative precision does not apply to this analysis group.

Table 25 summarizes the FR estimates for the three analysis groups, including precision levels, as well as FR values applied to the channels and technology groups not included in the surveys.

Table 25. Summary of DEC and DEP FR Estimates

Project Type	n	Free-Ridership	NTGR (1-FR)	Relative Precision (90% Conf.)
Main Channel Lighting	77	31.2%	68.8%	1.6%
Main Channel Non-Lighting	35	36.0%	64.0%	n/a
Midstream Lighting	93	25.3%	74.7%	3.0%
Midstream Non-Lighting [a]	N/A	36.0%	64.0%	N/A
Business Savings Store Lighting [b]	N/A	27.9%	72.1%	N/A
Business Savings Store Non-Lighting [a]	N/A	36.0%	64.0%	N/A
Upstream Non-Lighting [a]	N/A	36.0%	64.0%	N/A
Total	**N/A**	**28.6%**	**71.5%**	**N/A**

[a] Set to equal main channel non-lighting values.

[b] Weighted average of main channel and midstream lighting values.

Participants' FR-related survey responses show the following:

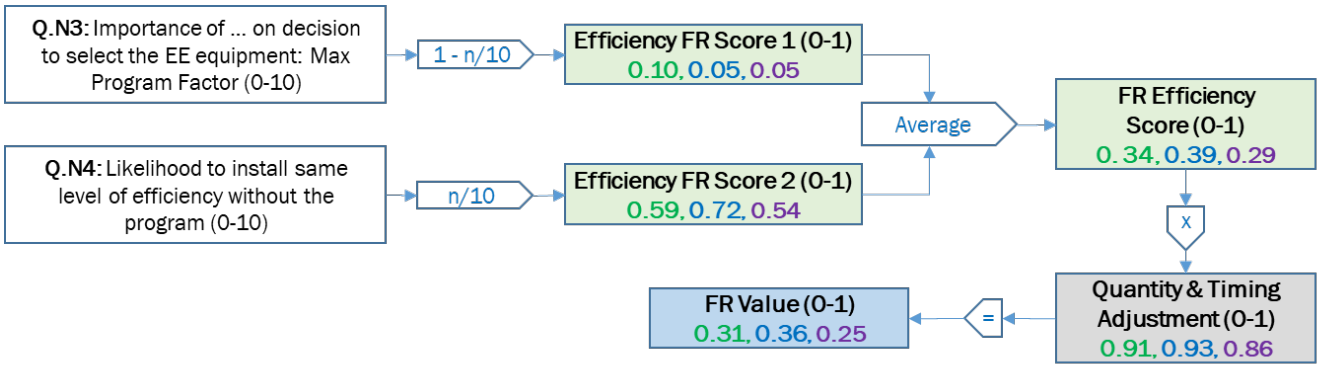
- **Efficiency:** Participants with lighting projects generally reported a high degree of program influence on the efficiency level of their projects, resulting in a savings-weighted Efficiency FR Scores of 0.34 for main channel projects and 0.29 for midstream channel projects. Participants with main channel non-lighting projects reported slightly lower influence, resulting in an Efficiency FR Score of 0.39. Key findings for the two efficiency sub-scores include:
  - A majority of participants (73%) provided an importance rating of 10 (on a scale of 0 to 10, where 10 means "very important") for at least one program component, most often the incentive. Regardless of project type, participants were similar in their likelihood to provide this maximum rating (70%, main channel lighting; 69%, main channel non-lighting; 77%, midstream channel lighting).
  - The average likelihood of main channel non-lighting participants to have selected the same level of efficiency without the program was 7.2 (on a scale of 0 to 10, where 0 means "not at all likely" and 10 means "extremely likely"), compared to 5.9 and 5.4, respectively, for main channel and midstream channel lighting participants.
- **Quantity:** The program had a significant influence on the scope of many incented projects, particularly midstream lighting projects with participants reporting that 42% of the efficient measures would not have been installed at the same time without the program. This share was lower for both main channel lighting projects (29%) and main channel non-lighting projects (20%). These results suggest that customers have more flexibility in the scope of lighting projects and that the program was successful in encouraging some of them to make additional upgrades.
- **Timing:** Responses to the timing questions show trends similar to those observed for the quantity questions: Participants reported that the program was responsible for a greater acceleration of lighting projects compared to non-lighting projects. The resulting timing adjustment factors, applied to the quantity that participants would not have installed at the same time without the program, are 0.67 for midstream lighting projects, 0.75 for main channel lighting projects, and 0.78 for main channel non-lighting projects.[8]

[8] A higher factor means a lower adjustments, i.e., less program influence on the timing of the project.

- **Quantity and Timing Adjustment:** Combining the responses to the quantity and timing questions resulted in overall Quantity and Timing Adjustments of 0.91 (main channel lighting), 0.93 (main channel non-lighting), and 0.86 (midstream channel lighting), meaning the program can claim credit for 14% (1 – 0.86 = 0.14) of midstream lighting savings but only 7% (1 – 0.93 = 0.07) of main channel non-lighting savings that would be considered free-rider savings based on efficiency alone.

Figure 6 summarizes FR results, using the diagram presented in Figure 3.

Figure 6. Program-Level Free-Ridership Results



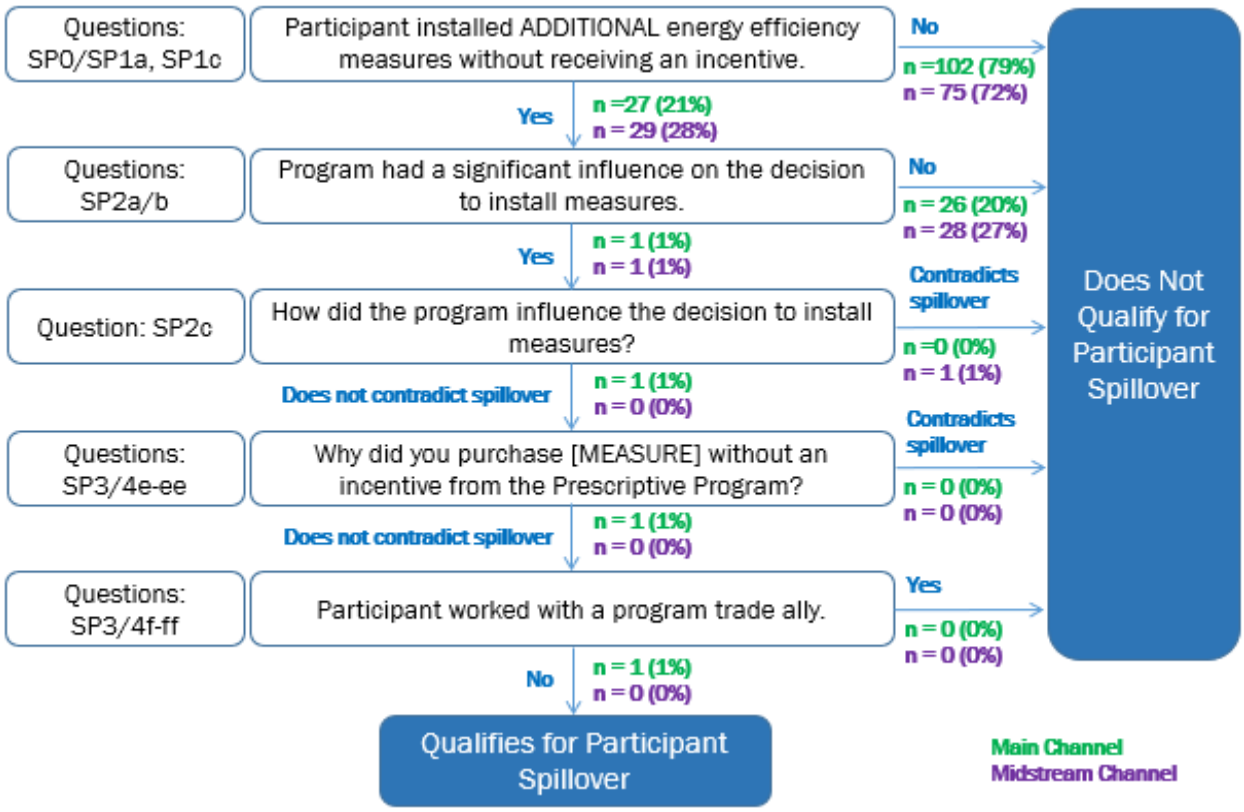
5.2.2 Participant Spillover

A total of 129 main channel and 104 midstream channel participants completed the SO questions in the participant surveys and were included in the PSO analysis. Most of these participants did not install any additional energy efficiency measures without receiving an incentive (79%, main channel; 72%, midstream channel) or were not influenced by the program (20%, main channel; 27%, midstream channel).

One respondent with a main channel project initially reported being influenced by the program but clarified in an open-ended response that the project was rejected for incentives by Duke Energy. Only one survey respondent with a main channel project qualified for PSO. As such, the PSO Rate for the main channel is 0.02%, while the PSO Rate for the midstream channel is 0%.

Figure 7 summarizes the analysis of PSO eligibility, using the same diagram as in Figure 4.

Figure 7. Participant Eligibility for Spillover – Results



The main channel respondent with PSO reported installing 10 exterior LEDs, as summarized in Table 26. We used the measure type and quantity reported by the respondent and the program's ex post deemed savings value for this measure to determine PSO savings.

Table 26. Summary of Measure-Level Participant Spillover

Participant	Measure	Quantity	Analysis Summary	kWh Per-unit	Total kWh
Main Channel					
#1	Exterior LEDs	10	Deemed savings value for LED FLD replacing or ILO up to 100W HAL, INCD, or HID	159	1,587
Total Main Channel					**1,587**

To determine the PSO Rate for each channel, we divided the channel's PSO savings by the total ex post gross savings of the sampled projects completed by survey respondents. This calculation yielded a PSO rate of 0.02% for the main channel and of 0% for the midstream channel.

$$\textit{PSO Rate–Main Channel} = \frac{\textit{PSO in Main Channel Sample}}{\textit{Ex Post Gross Impacts in Main Channel Sample}} = \frac{\textit{1,587 kWh}}{\textit{8,306,200 kWh}} = \textit{0.02\%}$$

$$\textit{PSO Rate–Midstream Channel} = \frac{\textit{PSO in Midstream Channel Sample}}{\textit{Ex Post Gross Impacts in Midstream Channel Sample}} = \frac{\textit{0 kWh}}{\textit{5,539,429 kWh}} = \textit{0 \%}$$

Table 27 summarizes the PSO estimates for the three analysis groups, as well as those applied to the other groups.

Table 27. Summary of DEC and DEP SO Estimates

Project Type	Participant SO
Main Channel Lighting	0.02%
Main Channel Non-Lighting	0.02%
Midstream Lighting	0.00%
Midstream Non-Lighting [a]	0.02%
Business Savings Store Lighting [b]	0.01%
Business Savings Store Non-Lighting [a]	0.02%
Upstream Non-Lighting [a]	0.02%
Total	**0.01%**

[a] Set to equal main channel non-lighting values.

[b] Weighted average of main channel and midstream lighting values.

5.2.3 Trade Ally Spillover

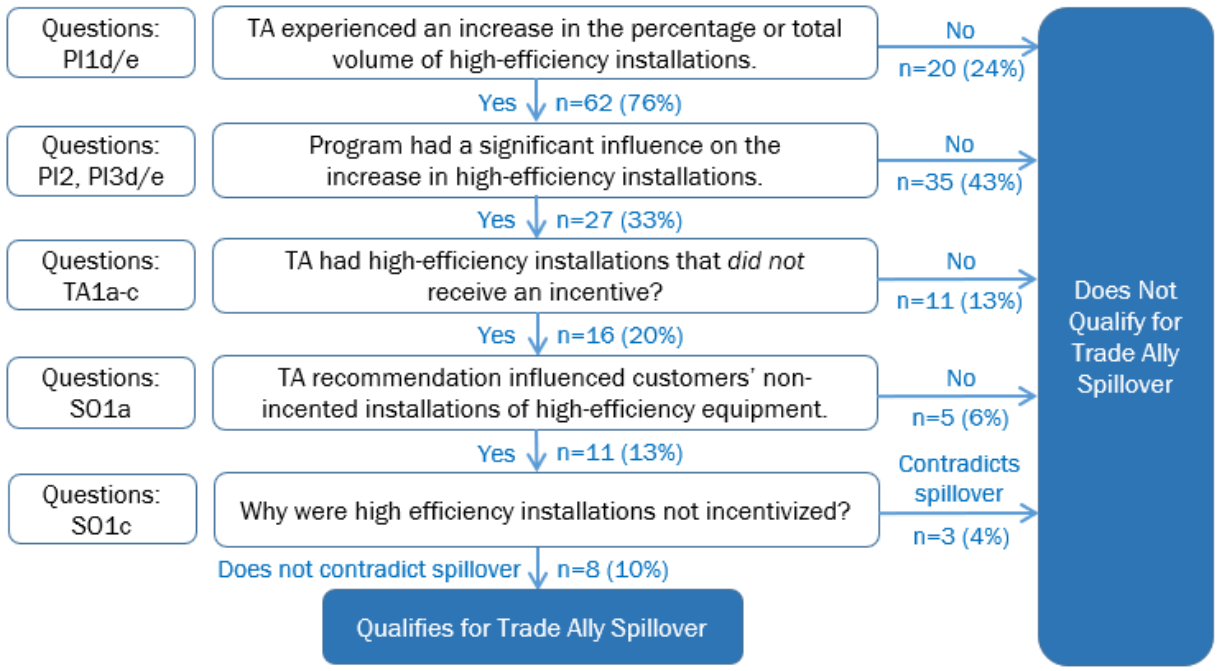
A total of 82 main channel trade allies responded to the SO section of the online survey. Approximately three-quarters of responding trade allies (76%) reported increases in either the percentage or the total volume of their high-efficiency installations and one-third (33%) attribute these increases to the program. Trade allies most often credit the program incentive for the increases in energy-efficient installations, pointing specifically to reduced upfront costs and a better return on investment (ROI). Trade allies also pointed to market factors unrelated to the program that contributed to increases in high-efficiency sales, most prominently the longer-term energy savings.

Nearly two-thirds of trade allies (63%) reported having had at least one high-efficiency project that did not receive a program incentive during the evaluation period. On average, trade allies reported that 11% of their installations during the evaluation period were standard efficiency, while 65% were high efficiency and received an incentive, and 23% were high efficiency and did not receive an incentive. On average, trade allies estimated that non-incented, high-efficiency installations were smaller, about 84% the size of those that received an incentive from the Smart $aver Program.

Trade allies also reported that it was not very common for projects that receive an incentive from Duke Energy to also include high-efficiency equipment that is not included in the incentive application (32% slightly common and 29% not at all common). When this does happen, the most common reason is that the non-incented products are not eligible for incentives through the Smart $aver Program, generally because the product is not ENERGY STAR or DesignLights Consortium (DLC) certified.

Overall, 10% of responding trade allies qualified for TASO. Trade allies who did not qualify for TASO experienced no increase in their energy-efficient installations (24%); were not influenced by the program (43%); did not have any non-incented, high-efficiency installations (13%); did not think that their recommendations influenced their customers' choice of non-incented, high-efficiency equipment (6%); or provided an open-ended response that contradicted the presence of SO (4%). Figure 8 summarizes these SO eligibility results.

Figure 8. Trade Ally Eligibility for Spillover – Results



Trade allies who qualified for SO most often indicated that the high-efficiency installations were completed without an incentive because the equipment did not qualify for program incentives or because the incentive amount was too low. Non-incented high-efficiency equipment primarily included various types of LED lighting, although a few trade allies also mentioned non-lighting equipment, such as coolers, air compressors, cycling and blow purge desiccant dryers, and demand expanders.

We estimated SO savings for each of the trade allies who qualified for SO (8 respondents, or 10%) using the trade ally's program savings from the program-tracking database as well as their survey responses on (1) the share of high-efficiency installations that received a program incentive; (2) the level of increase in the percentage or total volume of high-efficiency installations, and whether factors other than the program contributed to the increase; and (3) the relative size of incented and non-incented projects (for trade allies who could not report the respective shares of total high-efficiency installations that did and did not receive a program incentive). Respondent-level TASO savings ranged from 2,724 kWh to just over 1,467 MWh. Interestingly, the trade ally with the highest estimated spillover reported that only 5% of their revenues were from high efficiency equipment with an incentive, whereas 75% were from high efficiency equipment that did not receive an incentive. This trade ally reported a failure on their part to promote the program as the main reason that customers with qualifying equipment were not participating in the program.

Table 28 summarizes the results of the respondent-level TASO savings.

Table 28. Summary of Respondent-Level Trade Ally Spillover

Trade Ally	Ex Post Gross Program Savings (kWh)	Percent of High-Efficiency Installations that Received Incentive	Attribution Factor	Estimated Spillover Savings (kWh)
#1	195,603	6%	50%	1,467,023
#2	2,730,634	70%	50%	585,136
#3	339,478	57%	50%	125,833
#4	82,472	89%	100%	10,309
#5	69,183	88%	50%	4,612
#6	11,283	74%	100%	4,062
#7	69,689	90%	50%	3,872
#8	51,763	95%	100%	2,724
Total				**2,203,570**

The SO savings from these eight trade allies (accounting for 2,203,570 kWh) were used to extrapolate SO savings for the population of program participants. Following the methodology described in Section 5.1.3, we estimated a Respondent SO Ratio of 6.60% and a Program-Level SO Ratio of 6.05%.

5.3 Net Impact Results

Table 29 and Table 30 present the ex post net impacts for DEC and DEP, respectively, that result from applying the evaluation NTGRs to ex post gross savings.

The DEC program realized net energy savings of approximately 216 GWh during the evaluation period. The midstream channel contributed 110 GWh to this total, while the main channel contributed 98 GWh, the Business Savings Store contributed 8 GWh, and the new upstream channel contributed less than 1 GWh.

Table 29. Summary of DEC Net Program Savings

Channel/Technology	Ex Post Gross			NTGR	Ex Post Net		
	Energy Savings (MWh)	Summer Peak Demand (MW)	Winter Peak Demand (MW)		Energy Savings (MWh)	Summer Peak Demand (MW)	Winter Peak Demand (MW)
Midstream Channel	147,152	25.02	21.97	74.6%	109,738	18.64	16.40
Lighting	*145,831*	*24.67*	*21.93*	*74.7%*	*108,892*	*18.42*	*16.37*
Non-Lighting	*1,321*	*0.35*	*0.04*	*64.0%*	*846*	*0.23*	*0.03*
Main Channel	131,911	25.24	21.40	74.2%	97,897	18.72	15.91
Lighting	*112,908*	*21.28*	*18.90*	*74.9%*	*84,580*	*15.94*	*14.16*
HVAC	*10,934*	*2.72*	*1.26*	*70.1%*	*7,663*	*1.91*	*0.88*
Pumps and Drives	*3,093*	*0.48*	*0.49*		*2,168*	*0.34*	*0.34*
Food Service	*3,434*	*0.38*	*0.37*		*2,406*	*0.27*	*0.26*
Process	*1,542*	*0.38*	*0.38*		*1,080*	*0.27*	*0.27*
Business Savings Store	11,202	1.58	1.66	69.7%	7,806	1.14	1.19
Upstream Channel	349	0.12	0.06	64.0%	224	0.08	0.04
Total	290,614	51.96	45.08	**74.2%**	215,665	38.58	33.53

The DEP program realized net energy savings of approximately 79 GWh during the evaluation period. The midstream and main channels each contributed 38 GWh to this total, while the Business Savings Store contributed 3 GWh and the new upstream channel contributed less than 1 GWh.

Table 30. Summary of DEP Net Program Savings

Technology	Ex Post Gross			NTGR	Ex Post Net		
	Energy Savings (MWh)	Summer Peak Demand (MW)	Winter Peak Demand (MW)		Energy Savings (MWh)	Summer Peak Demand (MW)	Winter Peak Demand (MW)
Midstream Channel	51,171	8.94	7.64	74.4%	38,092	6.64	5.70
Lighting	*50,069*	*8.58*	*7.61*	*74.7%*	*37,387*	*6.41*	*5.68*
Non-Lighting	*1,102*	*0.36*	*0.02*	*64.0%*	*706*	*0.23*	*0.01*
Main Channel	51,065	9.07	7.48	74.2%	37,891	6.72	5.55
Lighting	*43,565*	*7.58*	*6.46*	*74.9%*	*32,635*	*5.68*	*4.84*
HVAC	4,835	1.25	0.77	*70.1%*	*3,388*	*0.87*	*0.54*
Pumps and Drives	*279*	*0.04*	*0.04*		*196*	*0.03*	*0.03*
Food Service	*2,362*	*0.20*	*0.19*		*1,655*	*0.14*	*0.14*
Process	*24*	*0.01*	*0.01*		*17*	*0.00*	*0.00*
Business Savings Store	4,764	0.69	0.71	69.8%	3,324	0.49	0.51
Upstream Channel	188	0.06	0.04	64.0%	120	0.04	0.02
Total	**107,188**	**18.76**	**15.86**	**74.1%**	79,427	13.89	11.79

6. Process Results

The scope of the 2022 Smart $aver Program evaluation included a limited process evaluation. As such, our participant and trade ally surveys included questions around three topics of interest to the program team: (1) satisfaction with the Smart $aver Program, (2) impacts of the global COVID-19 pandemic on customers' business operations, and (3) barriers to the use of Custom Incentives for additional energy-efficiency upgrades that did not receive a Prescriptive Incentive. In addition, the trade ally survey included a set of questions about the market for energy efficient lighting in the DEC and DEP service territories.

6.1 Program Satisfaction

The participant and trade ally surveys explored satisfaction with the Smart $aver Program overall, as well as with individual program components. All satisfaction questions asked respondents to rate their satisfaction on a scale of 0 to 10, where 0 meant "not at all satisfied" and 10 meant "extremely satisfied." Consistent with Duke Energy's practices, we categorized numeric responses as follows:

- 0 to 4 = "Dissatisfied"
- 5 to 7 = "Neutral"
- 8 to 10 = "Satisfied"

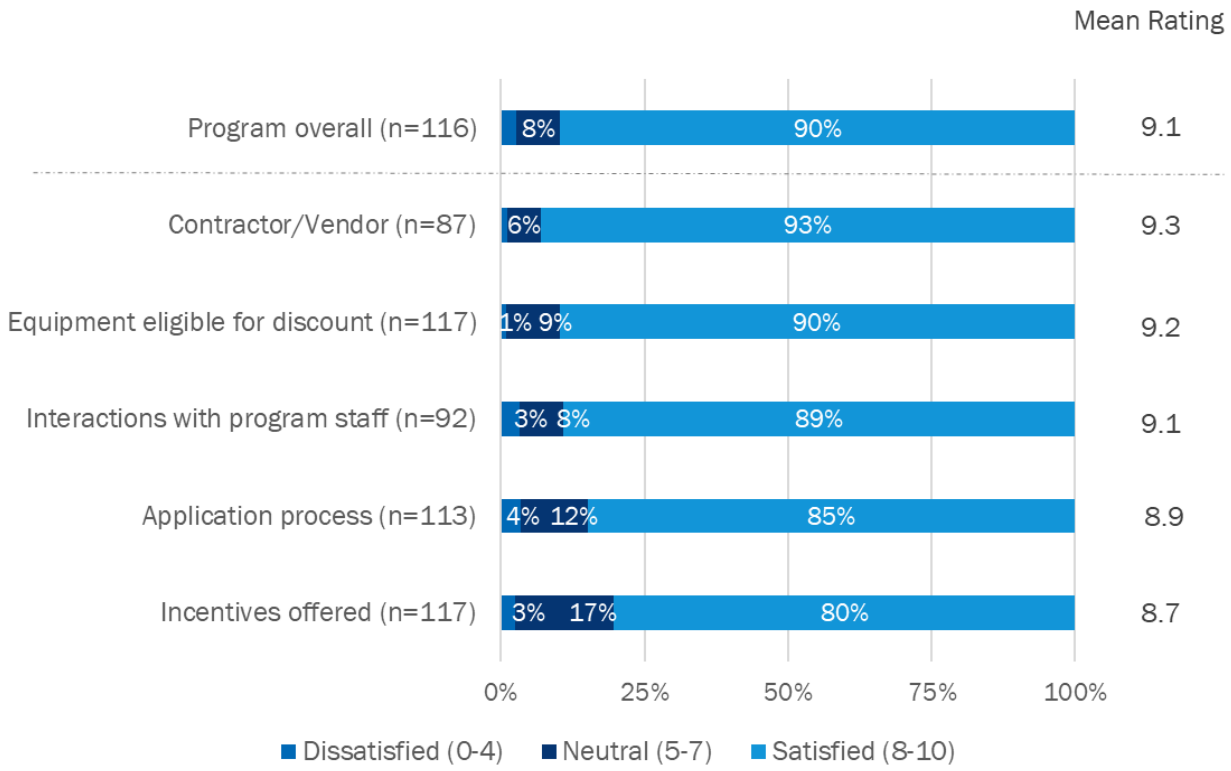
Respondents who provided a rating below 8 were asked an open-ended follow-up question to provide more information about their lack of satisfaction.

6.1.1 Participant Satisfaction

Main Channel Participants

Main channel participants are satisfied with their program experience, providing mean ratings of 8.7 or higher for the program overall and all program components inquired about in the survey. Survey respondents gave the highest ratings to the contractor or vendor who helped select the program-qualifying equipment and the program-qualifying equipment itself, rating them a 9.3 and 9.2 out of 10, respectively. The only program components with a mean rating below 9.0 were the application process (8.9) and the incentive levels (8.7). Figure 9 summarizes these results.

Figure 9. Main Channel Participant Satisfaction with Program Components



Note: Base sizes for the different components vary due to survey skip logic and "don't know" and "refused" responses, which were excluded from this analysis.

High satisfaction with the contractor/vendor is particularly significant when considering that contractors/vendors are the most common way that main channel participants learn about the program (39% of respondents).[9] Additionally, participants most commonly identified installation contractors (48%) as the most influential source when identifying and recommending the equipment they ultimately installed through the program.[10]

Satisfaction levels were generally similar for DEC and DEP main channel participants. The program components with the largest satisfaction differences across jurisdictions included the application process (8.6, DEC; 9.3 DEP), interactions with program staff (8.9, DEC; 9.5 DEP), and the program overall (8.9, DEC; 9.4 DEP), with DEP having slightly higher satisfaction ratings for all three components.

While satisfaction of main channel participants was generally high overall, several respondents who gave a rating of less than "satisfied" suggested that Duke offer more information and/or help with the application process and provide a broader selection of program-eligible measures. Specific feedback included:

- *"It would have been better if someone from Duke Energy came by rather than a contractor. It would have been direct contact."*

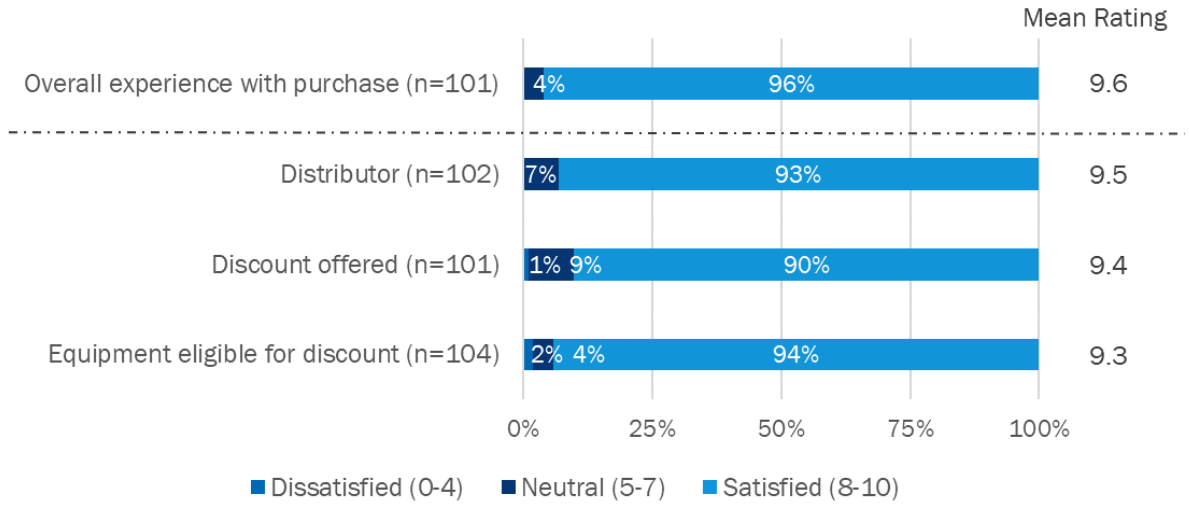
[9] Another 30% learned about the incentives directly from Duke Energy (through the Duke Energy staff, 17%; the Duke Energy website, 10%; Duke Energy emails, 2%; or bill inserts, 1%), and 17% learned about the incentives via word-of-mouth.
[10] Other influential sources include someone internal to the company (41%) and Duke Energy staff (5%).

- *"Make the application process clearer and easier to do."*
- *"Website improvement."*

Midstream Channel Participants

Midstream channel participants' exposure to the program is a slightly more limited, as they are subject to fewer program processes compared to main channel participants. Figure 10 shows that midstream channel participants had slightly higher satisfaction with all program components inquired about in the survey compared to main channel participants, with all mean ratings at 9.3 or above and a 9.6 mean overall rating of their experience with the discounted purchase.

Figure 10. Midstream Channel Participant Satisfaction with Program Components



Note: Base sizes for the different components vary due to "don't know" and "refused" responses, which were excluded from this analysis.

Not surprisingly, midstream channel participants most commonly learn about the program discounts from their distributor (69%). In addition, distributors are most often the most influential source when identifying and recommending the lighting equipment they purchased through the program (58%).[11]

While satisfaction by midstream channel participants was generally high and consistent across jurisdictions, many respondents who gave a rating of less than "satisfied" noted a general desire for more eligible measures, increased access to program information, and higher discounts. Some participants provided more specific comments and suggestions for improvement, including:

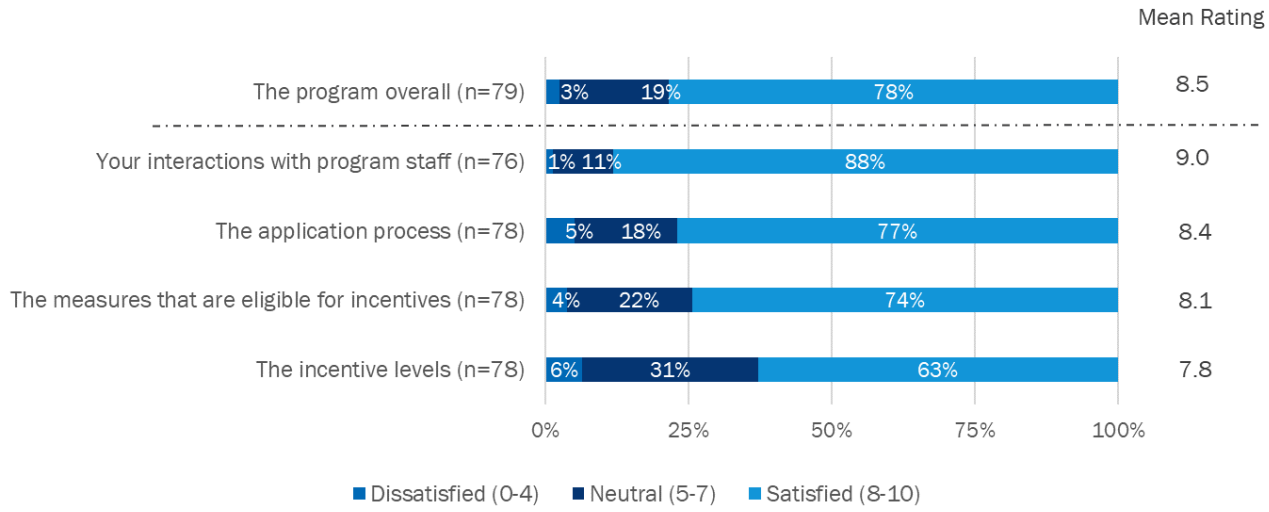
- *"As a small business, I would like Duke to provide more information about what items are covered in the discount program, because we are very motivated to be energy efficient."*
- *"Better communication directly from Duke representative so I am fully informed as to all the available discounts."*
- *"Include smart thermostats."*

[11] Other influential sources include someone internal to the company (31%) and the installation contractor (6%).

6.1.2 Trade Ally Satisfaction

In general, trade allies are satisfied with the program but gave satisfaction ratings slightly lower than main channel or midstream channel participants. Mean trade ally satisfaction ratings for program components range from 7.8 to 9.0, with trade allies expressing particularly high satisfaction with program staff interactions (mean rating of 9.0). Trade allies expressed lower satisfaction with incentive levels (mean rating of 7.8). The mean rating for the program overall was 8.5, with 78% of trade allies providing a "satisfied" rating (see Figure 11).

Figure 11. Trade Ally Satisfaction with Program Components



Note: Base sizes for the different components vary due to "not applicable" responses, which were excluded from this analysis.

Respondents who provided a less than "satisfied" rating for eligible measures or incentive levels were asked to specify measures that should be added or receive a higher incentive. In response, trade allies offered the following:

- **Measures trade allies would like to see added:** More refrigeration equipment, more retrofit options, and multifamily ceiling fixtures.
- **Measures trade allies would like to receive a higher incentive:** Linear fixtures, parking fixtures, panels and strip fixtures, smaller LED flood lights, flat panels, and refrigeration equipment.

In terms of the application process, one trade ally suggested the following:

- *"Instead of an automatic reply to the prescriptive incentive email about the application it would be better to have a specific point of contact to communicate with throughout the process."*

6.2 Impacts of COVID-19

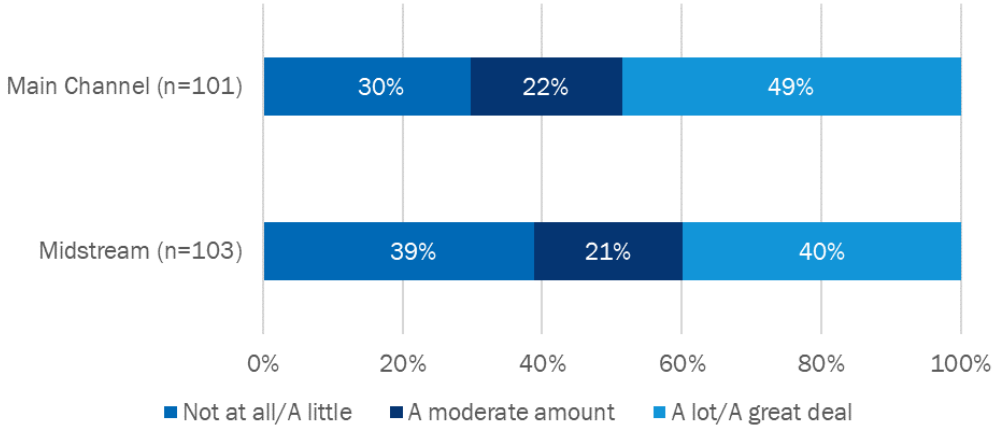
The program team was interested in the impact that the global COVID-19 pandemic—and any associated containment measures—may have had on the business operations of Smart $aver Program participants and trade allies. It should be noted that the participant surveys were fielded with customers who participated in

the program in 2020 and 2021 (see also Sections 3.4 and 3.5 above). As such, some of the COVID-related impacts reported by participants might reflect conditions outside the evaluation period.

6.2.1 Participant Impacts

Over half of the main channel and midstream channel respondents experienced at least moderate impacts as a result of the pandemic (70%, main channel; 61%, midstream channel). Main channel respondents, however, were more likely to experience a greater degree of pandemic-related impacts compared to midstream participants (see Figure 12).

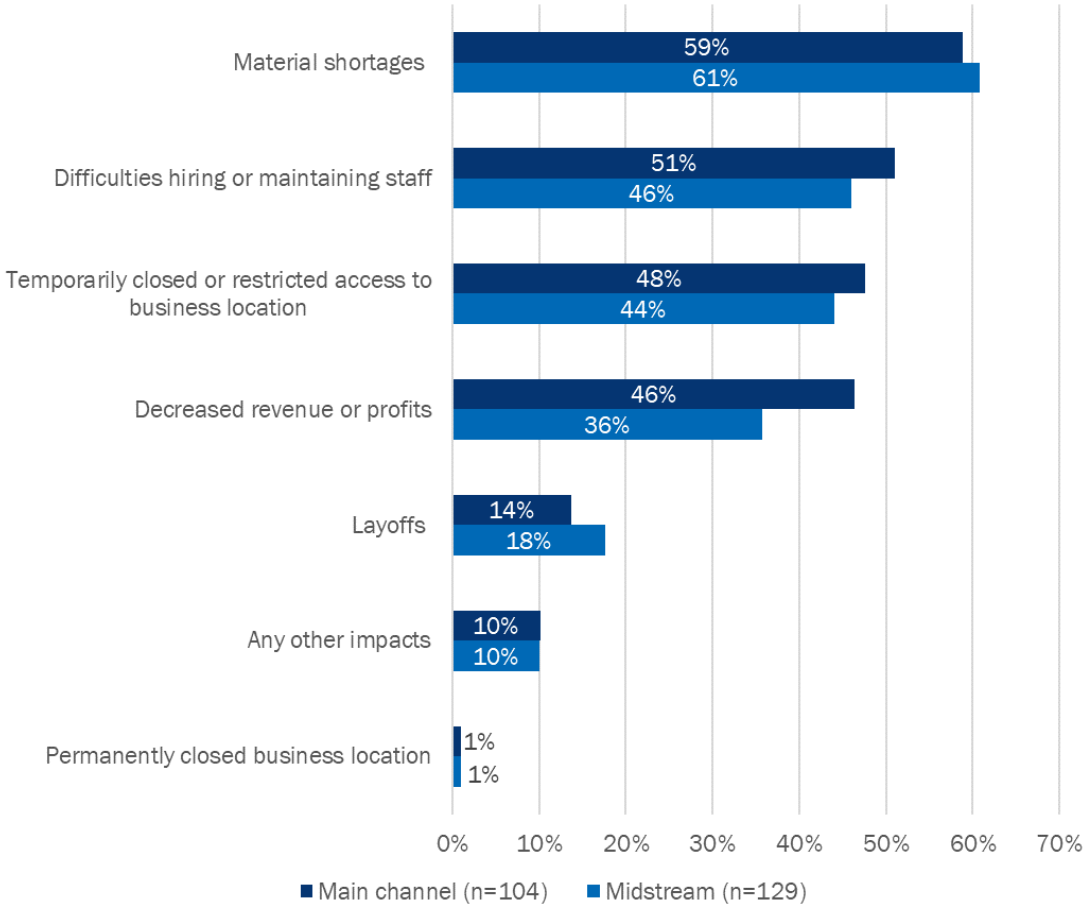
Figure 12. Degree of COVID-19 Impact on Participants' Operations



Note: Respondents with an answer of "Don't know" were excluded from the analysis.

Key impacts of the global COVID-19 pandemic experienced by participants at the location of their project included material shortages, difficulty hiring or maintaining staff, temporary business closures, and decreases in revenue or profits (see Figure 13). The magnitude of these impacts was generally similar for main channel and midstream channel participants.

Figure 13. Specific COVID-19 Impacts Experienced at Location of Smart $aver® Program Project

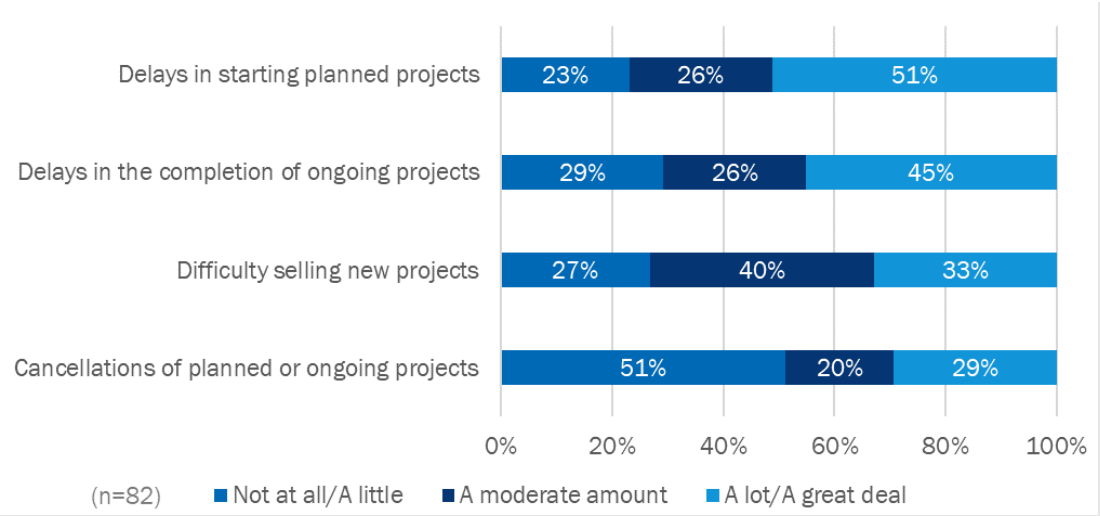


Of participants who completed their projects after March 2020 (n=115 main channel respondents; n=93 midstream channel respondents), few (16% of main channel respondents; 9% of midstream channel respondents) reported that COVID-19 impacted their project in any way. Respondents who reported impacts most often noted project delays due to materials shortages and/or supply chain delays.

6.2.2 Trade Ally Impacts

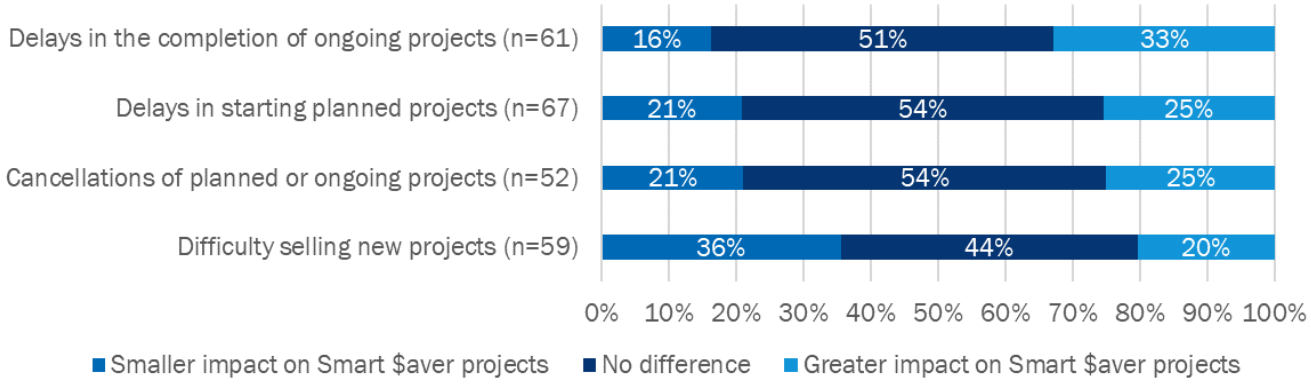
Trade allies reported experiencing a range of impacts on energy efficiency projects in 2020 as a result of the COVID-19 pandemic. Approximately three-fourths of surveyed trade allies reported moderate or great impacts related to delays in starting planned projects (77%), selling new projects (73%), or completing ongoing projects (71%). Close to half (49%) reported the cancellation of planned or ongoing projects (see Figure 14).

Figure 14. COVID-19 Impacts on Trade Allies' Energy Efficiency Projects



When asked to compare COVID-19 impacts on Smart $aver projects to similar projects that did not participate in the program, trade allies most often reported that there was no difference between the two project types. Interestingly, trade allies were more likely to report a *greater* impact on Smart $aver projects in terms of delays in project starts or completions and project cancellations but a *smaller* impact in terms of difficulty selling new projects (see Figure 15).

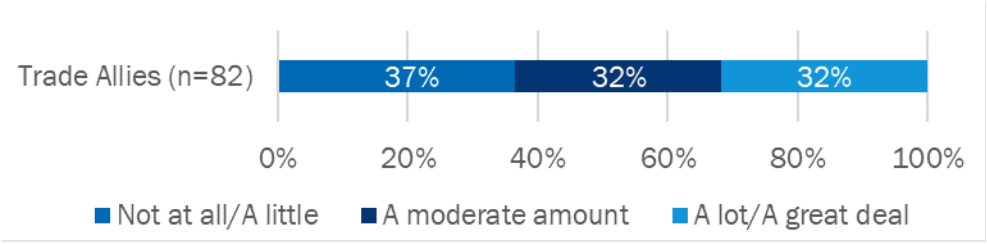
Figure 15. COVID-19 Impacts on Trade Allies' Smart $aver Projects Relative to Other Projects



Note: Base sizes for the different components vary due to survey skips as well as "not applicable" or "don't know" responses, which were excluded from this analysis.

Finally, trade allies were almost evenly split in the level of impact COVID-19 and subsequent containment measures had on their company's overall volume of Smart $aver projects in 2020, from little to no impact (37%), to moderate impact (32%), to a great deal of impact (32%), as shown in Figure 16.

Figure 16. Degree of COVID-19 Impact on the Volume of Smart $aver Projects

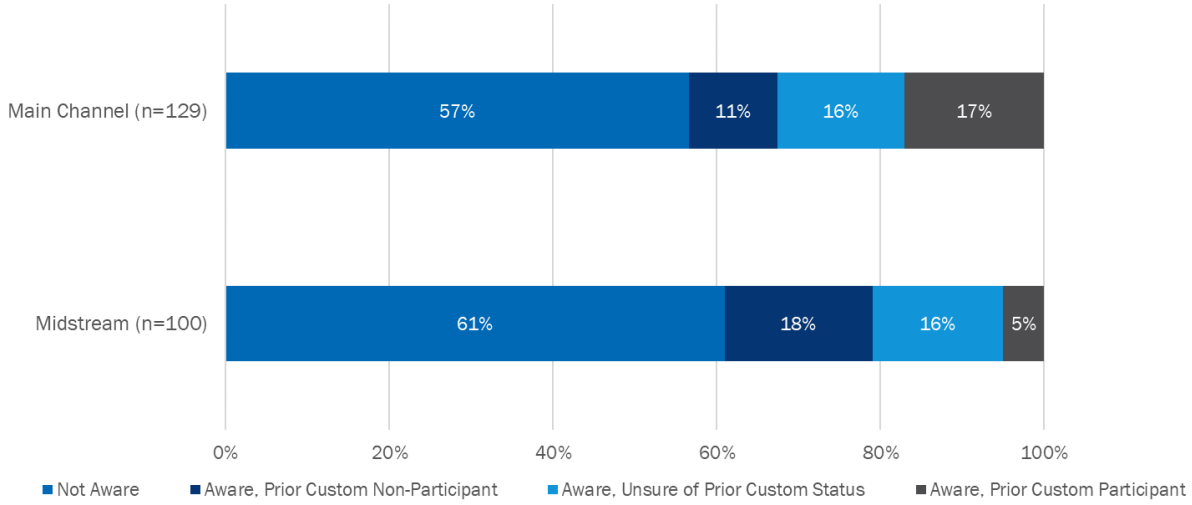


6.3 Custom Incentives

Duke Energy was also interested in understanding customer awareness of Custom Incentives and why Prescriptive Program participants who install energy efficiency upgrades without an incentive do not pursue Custom Incentives.

Overall, awareness of Custom Incentives among Smart $aver Program participants is moderate across both channels (43% for main channel participants and 39% for midstream channel participants). Of those aware, a higher proportion of main channel participants recalled receiving a Custom Incentive in the past (39%, compared to 13% for the midstream channel), although a large percentage in both channels are unsure about their company's prior participation in the Custom Program (see Figure 17).

Figure 17. Participant Awareness of Custom Incentives and Prior Use of Program



As part of the spillover analysis, the main channel and midstream channel participant surveys asked respondents about additional energy-efficient installations they had made as part of, or following, their Smart $aver Program project; whether Duke Energy incentives were available for those installations; and whether they had applied for an incentive. Approximately a quarter of participants (21%, main channel; 28%, midstream channel) reported having made an additional energy-efficient installation without an incentive.

The main reason these customers did not apply for a Custom Incentive for these energy-efficient installations was a lack of awareness of the Custom Program (78% main channel; 66% midstream channel), suggesting an

opportunity for additional customer outreach and education—potentially through trade allies at the time of installing prescriptive measures. Other reasons included a lack of awareness that the project could qualify for a Custom Incentive, the approval wait time being too long, the application process being too burdensome/unsure of the steps, and the equipment not qualifying for a Custom Incentive.

It should be noted that some of these additional energy-efficient installations would likely fall under the umbrella of the Smart $aver Prescriptive Program (based on additional information collected in open-ended survey responses). In addition, the survey could not discern whether the equipment would have actually qualified for a Custom (or Prescriptive) Incentive (i.e., whether the efficiency levels would have met Smart $aver requirements).

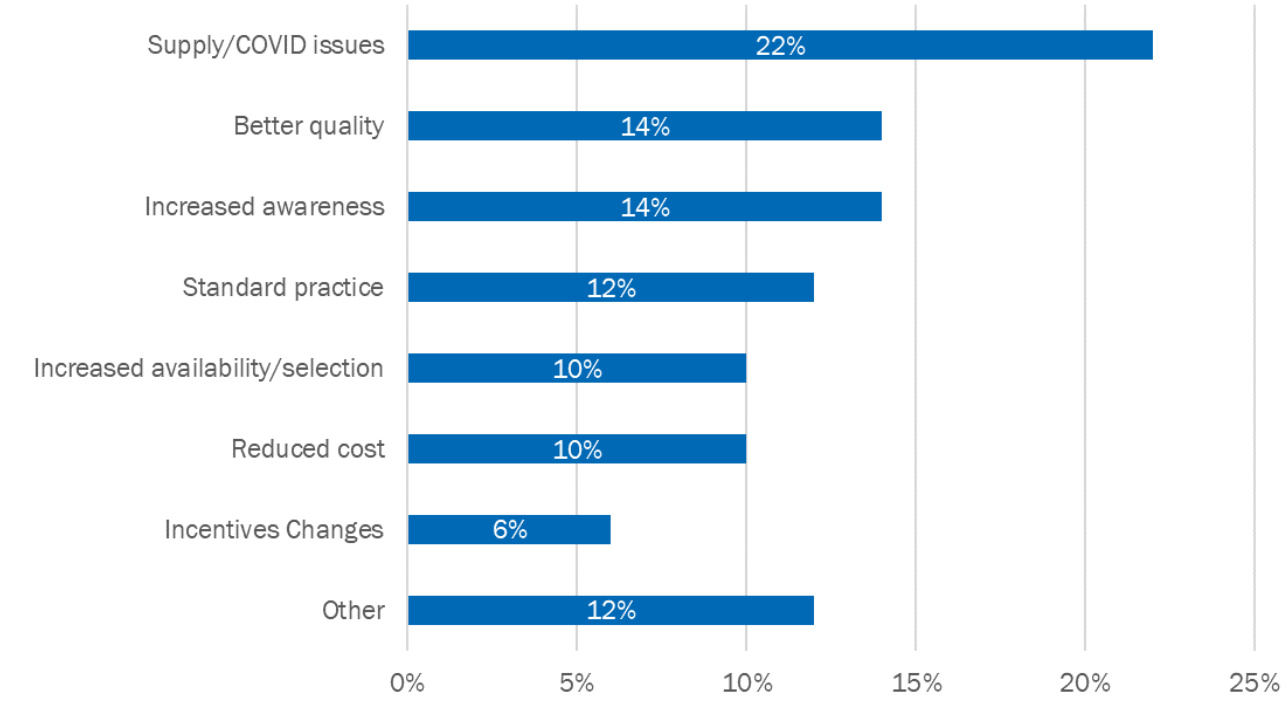
6.4 Lighting Market Trends and Drivers of LED Sales

During the evaluation period, lighting projects continued to dominate the DEC and DEP Smart $aver Prescriptive Program. As the lighting market evolves and LED lighting becomes more commonplace, a better understanding of trends in the lighting market and the role of the Smart $aver Program in customer decision-making will be useful when planning future program offerings. To explore this topic, our trade ally survey included a series of questions about the market for energy efficient lighting in the DEC and DEP service territories.

Not surprisingly, trade allies most frequently identified material shortages and/or other COVID-related delays as the most important changes in the lighting market over the past year (22% – of those who identified any market changes; see Figure 18). In addition, improved quality (14%; including better efficiency, improved warranties, and the integration of controls), increased awareness (14%), changes in the standard practices (12%), increased availability/selection (10%), and reduced costs (10%) were frequently mentioned market changes. A small share of trade allies (6%) also noted incentives changes, likely referring to the increase in incentives that the program implemented in the summer of 2020 in response to the COVID pandemic. Common sentiments among respondents included:

- *"Shipping timelines have been difficult to work with."*
- *"I think most people already prefer to choose LEDs"*
- *"Customers are being more aware of the need to go green and saving on their power bills."*
- *"Drastic decrease in price of LED products as well as longer lead times "*
- *"I have noticed an increase on dollar amounts for rebates as well as there being more options for rebates."*

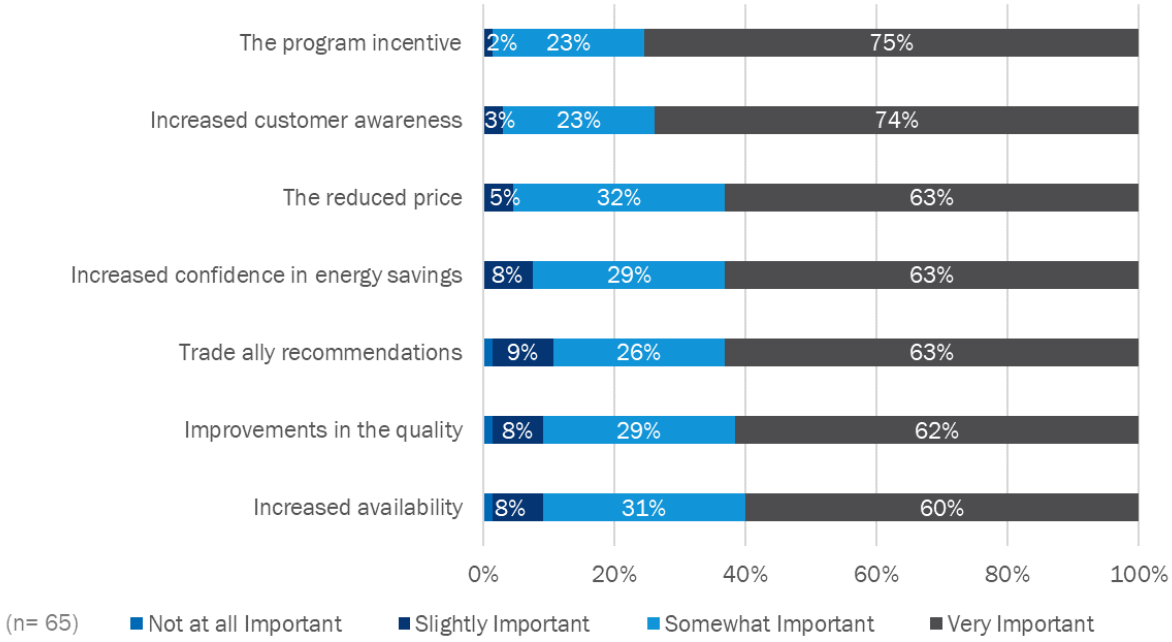
Figure 18. Recent Changes in Lighting Market



(n=50)

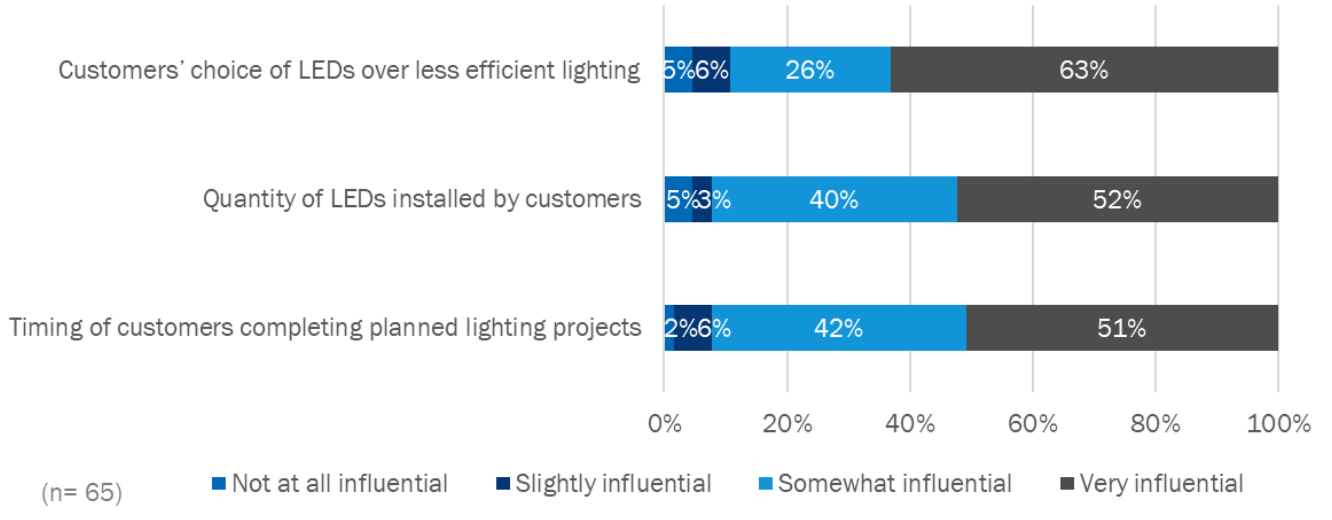
When asked about factors contributing to the significant increase in the number of LEDs incented through the Smart $aver Prescriptive Program, trade allies stressed the importance of the program incentive, with 75% considering it very important. Trade allies, however, also attributed high importance to other, market-based factors, including increased customer awareness (74%), price reductions (63%), increases in confidence around energy savings (63%), and increases in recommendations from trade allies (63%; see Figure 19).

Figure 19. Key Factors Contributing to the Increase in LEDs Incented through the Smart $aver Program



Trade allies also provided their perception of the influence of program LED incentives on customer projects in terms of the selected equipment as well as the timing and quantity of their lighting projects. Overall, trade allies believe the program incentive has the highest influence on equipment selection and that many customers would not select LEDs in the absence of the incentive (63% consider it very influential). Trade allies attribute a slightly lower influence of the incentive on the size of LED projects and on project timing (52% and 51%, respectively, consider it very influential; see Figure 20).

Figure 20. Influence of Program Incentives on Customer Projects



7. Key Findings and Recommendations

7.1 Key Findings

During the evaluation period, non-residential customers completed more than 15,000 projects through the DEC Smart $aver Prescriptive Program and more than 7,000 projects through the DEP Smart $aver Program. The DEC projects generated approximately 291 GWh of ex post gross energy savings, 52 MW of ex post gross summer peak demand savings, and 45 MW of ex post gross winter peak demand savings. The DEP projects generated approximately 107 GWh of ex post gross energy savings, 19 MW of ex post gross summer peak demand savings, and 16 MW of ex post gross winter peak demand savings.

The midstream channel gained a lot of traction during the evaluation period and surpassed the main channel in contribution to savings; the midstream channel accounted for the highest share of ex post gross energy savings in both service territories (51% DEC, 48% DEP). The main channel accounted for the majority of the remaining savings (overall shares of 45% for DEC and 48% for DEP). A relatively small share of savings was generated through the Business Savings Store (4% DEC, 4% DEP) and through the newly introduced upstream channel (<1% DEC, <1% DEP; see Table 31).

In both jurisdictions, lighting accounted for the vast majority of program projects and savings.

Table 31. Summary of Ex Post Gross Energy Savings

Delivery Channel	DEC		DEP	
	MWh	Percent [a]	MWh	Percent [a]
Midstream Channel	147,152	51%	51,171	48%
Main Channel	131,911	45%	51,065	48%
Business Savings Store	11,202	4%	4,764	4%
Upstream Channel [b]	349	<1%	188	<1%
Total	**290,614**	**100%**	**107,188**	**100%**

[a] Individual values may not sum to totals due to independent rounding.

[b] The upstream channel was introduced towards the end of the evaluation period. The channel's contribution to program savings during the evaluation period was, therefore, very small.

Gross Impact Findings

Our gross impact analysis found overall gross realization rates for energy and demand savings close to 90%, ranging from 81% to 94% for DEC and 83% to 95% for DEP. These results were driven by the following:

- Our deemed savings review made small adjustments to lighting projects (ranging from 89% for winter demand to 97% for summer demand) and somewhat larger adjustments to projects in the HVAC category (ranging from 34% for winter demand to 84% for summer demand).
- Our desk reviews and on-site visits of main channel projects found relatively few data tracking issues with respect to the quantities of installed measures, adjusting the quantities for only nine of the 98 sampled projects. The resulting ISRs for energy savings were 99% for food service projects, 96% for HVAC and lighting projects, and 100% for pumps and drives and process equipment.
- Energy savings ISRs for lighting purchases through the midstream channel were also high, at 93%.

- Ex ante savings embed realization rates from prior evaluations. In particular, the realization rates presented below reflect differences between the current ISRs and those developed in prior evaluations. This is the driving factor in the high realization rates for food service projects.

Table 32 and Table 33 summarize the overall gross energy and demand impacts, respectively, for DEC and DEP.

Table 32. Overall Gross Energy Impacts

Technology	DEC			DEP		
	Ex Ante MWh	Realization Rate	Ex Post MWh	Ex Ante MWh	Realization Rate	Ex Post MWh
Lighting	286,978	93%	266,604	103,654	94%	97,026
HVAC	24,290	64%	15,552	9,632	75%	7,255
Pumps and Drives	3,135	100%	3,139	279	100%	279
Food Service	1,770	212%	3,753	1,253	207%	2,596
Process	1,523	101%	1,542	24	100%	24
IT	25	99%	25	8	98%	8
Total	**317,721**	**91%**	**290,614**	**114,851**	**93%**	**107,188**

Table 33. Overall Gross Demand Impacts

Technology	DEC			DEP		
	Ex Ante MW	Realization Rate	Ex Post MW	Ex Ante MW	Realization Rate	Ex Post MW
Summer Demand Impacts						
Lighting	50.32	94%	47.51	17.82	94%	16.83
HVAC	3.95	80%	3.16	1.87	88%	1.65
Pumps and Drives	0.49	100%	0.49	0.04	100%	0.04
Food Service	0.14	297%	0.42	0.10	229%	0.23
Process	0.37	102%	0.38	0.01	100%	0.01
IT	-	N/A	-	-	N/A	-
Total	**55.27**	**94%**	**51.96**	**19.84**	**95%**	**18.76**
Winter Demand Impacts						
Lighting	49.23	86%	42.40	17.37	85%	14.74
HVAC	5.25	27%	1.40	1.69	50%	0.85
Pumps and Drives	0.50	100%	0.50	0.04	100%	0.04
Food Service	0.13	304%	0.41	0.09	230%	0.22
Process	0.37	102%	0.38	0.01	100%	0.01
IT	-	N/A	-	-	N/A	-
Total	**55.49**	**81%**	**45.08**	**19.21**	**83%**	**15.86**

Net Impact Findings

We estimated the program-level NTGR to be 74.2%. Table 34 presents the individual net-to-gross (NTG) components (i.e., FR, PSO, and TASO) and the resulting NTGRs by channel and technology group (i.e., lighting and non-lighting). The NTGR is calculated as 1 – FR + PSO + TASO.

Table 34. Summary of NTG Results

	Free-Ridership	Participant SO	Trade Ally SO	NTGR
Main Channel Lighting	31.2%	0.02%	6.1%	74.9%
Main Channel Non-Lighting	36.0%	0.02%	6.1%	70.1%
Midstream Lighting	25.3%	0.00%	0.0%	74.7%
Midstream Non-Lighting [a]	36.0%	0.02%	0.0%	64.0%
Business Savings Store Lighting [b]	27.9%	0.01%	0.0%	72.1%
Business Savings Store Non-Lighting [a]	36.0%	0.02%	0.0%	64.0%
Upstream Non-Lighting [a]	36.0%	0.02%	0.0%	64.0%
Total	**28.6%**	**0.01%**	**2.8%**	**74.2%**

[a] Set to equal main channel non-lighting FR and PSO values. TASO is only applicable to the main channel.

[b] Weighted average of main channel and midstream lighting FR and PSO values. TASO is only applicable to the main channel.

Table 35 and Table 36 summarize ex post gross and net savings for the evaluation period for DEC and DEP, respectively.

Table 35. Summary of DEC Ex Post Gross and Net Savings

Technology	Ex Post Gross			NTGR	Ex Post Net		
	Energy Savings (MWh)	Summer Peak Demand (MW)	Winter Peak Demand (MW)		Energy Savings (MWh)	Summer Peak Demand (MW)	Winter Peak Demand (MW)
Midstream Channel	147,152	25.02	21.97	74.6%	109,738	18.64	16.40
Lighting	*145,831*	*24.67*	*21.93*	*74.7%*	*108,892*	*18.42*	*16.37*
Non-Lighting	*1,321*	*0.35*	*0.04*	*64.0%*	*846*	*0.23*	*0.03*
Main Channel	131,911	25.24	21.40	74.2%	97,897	18.72	15.91
Lighting	*112,908*	*21.28*	*18.90*	*74.9%*	*84,580*	*15.94*	*14.16*
HVAC	*10,934*	*2.72*	*1.26*	*70.1%*	*7,663*	*1.91*	*0.88*
Pumps and Drives	*3,093*	*0.48*	*0.49*		*2,168*	*0.34*	*0.34*
Food Service	*3,434*	*0.38*	*0.37*		*2,406*	*0.27*	*0.26*
Process	*1,542*	*0.38*	*0.38*		*1,080*	*0.27*	*0.27*
Business Savings Store	11,202	1.58	1.66	69.7%	7,806	1.14	1.19
Upstream Channel	349	0.12	0.06	64.0%	224	0.08	0.04
Total	290,614	51.96	45.08	**74.2%**	215,665	38.58	33.53

Table 36. Summary of DEP Ex Post Gross and Net Savings

Technology	Ex Post Gross			NTGR	Ex Post Net		
	Energy Savings (MWh)	Summer Peak Demand (MW)	Winter Peak Demand (MW)		Energy Savings (MWh)	Summer Peak Demand (MW)	Winter Peak Demand (MW)
Midstream Channel	51,171	8.94	7.64	74.4%	38,092	6.64	5.70
Lighting	*50,069*	*8.58*	*7.61*	*74.7%*	*37,387*	*6.41*	*5.68*
Non-Lighting	*1,102*	*0.36*	*0.02*	*64.0%*	*706*	*0.23*	*0.01*
Main Channel	51,065	9.07	7.48	74.2%	37,891	6.72	5.55
Lighting	*43,565*	*7.58*	*6.46*	*74.9%*	*32,635*	*5.68*	*4.84*
HVAC	*4,835*	*1.25*	*0.77*	*70.1%*	*3,388*	*0.87*	*0.54*
Pumps and Drives	*279*	*0.04*	*0.04*		*196*	*0.03*	*0.03*
Food Service	*2,362*	*0.20*	*0.19*		*1,655*	*0.14*	*0.14*
Process	*24*	*0.01*	*0.01*		*17*	*0.00*	*0.00*
Business Savings Store	4,764	0.69	0.71	69.8%	3,324	0.49	0.51
Upstream Channel	188	0.06	0.04	64.0%	120	0.04	0.02
Total	**107,188**	**18.76**	**15.86**	**74.1%**	79,427	13.89	11.79

Process Findings

The following are key findings from the limited process investigation:

- Participants in the main and midstream channels, as well as program trade allies, are generally satisfied with the program experience and program components. When asked to rate their satisfaction on a 0 to 10 scale – where 0 meant "not at all satisfied" and 10 meant "extremely satisfied" – participants and trade allies reported the following:
  - Main channel respondents provided mean ratings of 8.7 or higher for the program overall and all program components inquired about in the survey. They gave the highest ratings to the contractor or vendor who helped select the program-qualifying equipment and the program-qualifying equipment itself (rating of 9.3 and 9.2, respectively). The only program components with a mean rating below 9.0 were the application process (8.9) and the incentive levels (8.7).
  - Midstream channel participants are highly satisfied with their program experience. Respondents provided a mean rating of 9.6 for their overall experience with the discounted purchase and rated all program components included in the survey a 9.3 or higher.
  - In general, trade allies are satisfied with the program but gave satisfaction ratings slightly lower than participants. Mean ratings for program components range from 7.8 (incentive levels) to 9.0 (program staff interactions); the mean rating for the program overall was 8.5.
- COVID-19 undoubtedly impacted the program and both customers and trade allies during the evaluation period:
  - While the program exceeded savings goals in 2019, it fell slightly short during 2020.
  - Key COVID-19 impacts experienced by participants included material shortages, difficulty hiring or maintaining staff, temporary business closures, and decreases in revenue or profits. Of

participants who completed their projects after March 2020, few (16% main channel; 9% of midstream channel) reported that COVID-19 directly impacted their program project. Respondents who reported impacts most often noted project delays due to materials shortages and/or supply chain delays.

- A majority of surveyed trade allies, however, reported either a moderate (32%) or a great deal of impact (32%) of COVID-19 on their company's overall volume of Smart $aver projects. Trade allies most commonly reported delays in starting planned projects (51%) and completing ongoing projects (45%) due to the pandemic. Most trade allies reported little or no difference in COVID-19 impacts on Smart $aver projects compared to similar projects that did not participate in the program. Interestingly, trade allies were more likely to report a *greater* impact on Smart $aver projects in terms of delays in project starts or completions and project cancellations but a *smaller* impact in terms of difficulty selling new projects.

- Awareness of Custom Incentives among the Smart $aver Program participants is moderate (43%, main channel; 39%, midstream channel). Of those aware, only a few had received a Custom Incentive in the past (39%, main channel; 13%, midstream channel).
- Approximately, a quarter of participants (21%, main channel; 28%, midstream channel) reported having made an additional energy-efficient installation without an incentive. The main reason these customers did not apply for a Custom Incentive for these energy-efficient installations was a lack of awareness of the Custom Program.
- Trade allies most frequently cited material shortages and/or other pandemic-related delays as the most important changes in the lighting market over the past year.
- Lighting incentives continue to be an important driving force in the number of LEDs incented through the Smart $aver Prescriptive Program, with 75% of trade allies rating the incentives as "very important" in customer decisions. Trade allies, however, also attributed high importance to other, market-based factors, including increased customer awareness (74%), price reductions (63%), increases in confidence around energy savings (63%), and increases in recommendations from trade allies (63%).

7.2 Evaluation Recommendations

Based on the results of our impact evaluation, we identified the following opportunities for program improvement.

Recommendation 1: Continue to Improve Data Collection and Tracking Processes

Perform additional quality assurance steps on the data entered into the program-tracking database. While our impact analysis generally found few data tracking issues, two typos in measure quantities for lighting projects impacted the ISR for that technology. While it is impossible to ensure perfect data entry for all projects, additional checks, in particular for high-savings records, could potentially catch these impactful errors and lead to stronger realization rates.

Ensure measure units are consistent across the different delivery channels. Our database review found a few instances of different measure units being tracked for the same measure across different delivery channels. While in most cases, the issue appears to be limited to differences in labeling, in others, the difference could lead to miscalculation of measure savings. We recommend reviewing measure units across the delivery channels and synchronizing them, where appropriate. Where differences are warranted, different measure IDs and per unit deemed savings values should be developed and applied.

Recommendation 2: Ensure Program Eligibility of Incentive Measures

Ensure that only prescriptive measures receive incentives through the program. Our desk reviews found one instance of incented HVAC equipment that did not match the characteristics of any available prescriptive measures. Such equipment should not receive incentives through the Prescriptive Program but should rather be channeled through the Custom Program.

Recommendation 3: Continue Marketing and Education Around Other Smart $aver Programs

Encourage trade allies and distributors to cross-promote Smart $aver programs. Based on the limited process investigation, awareness of the Smart $aver Custom Program among Prescriptive Program participants is low. This suggests an opportunity for additional promotion of other Smart $aver offerings, especially by trade allies and distributors who are in direct contact with potential participants. We recommend that the program support trade allies and distributors in cross-promoting other Smart $aver programs, for example, by providing them with collateral (either physical or electronic) to pass along to their customers.

Recommendation 4: Continue to Develop Tools and Techniques to Support the Application Process

Offer more support regarding the Smart $aver application process. Although participants and trade allies are generally satisfied with the Smart $aver Program, several survey respondents noted the sometimes cumbersome and unclear application process. This continues to be a source of participant and trade ally dissatisfaction. In fact, a few respondents (both participants and trade allies) noted that they would have appreciated having a direct contact at Duke to help answer questions and receive more support with the application. The program should continue to develop tools to make the application clearer and easier to complete; this may include more guidance on required steps (e.g., a workflow sheet) and better functionality of the online portal (e.g., lookup or pre-fill functions).

8. Summary Form

DUKE ENERGY CAROLINAS/ DUKE ENERGY PROGRESS NON-RESIDENTIAL SMART $AVER® PRESCRIPTIVE PROGRAM

COMPLETED EM&V FACT SHEET

PROGRAM DESCRIPTION

The Duke Energy Carolinas and Duke Energy Progress Non-Residential Smart $aver® Prescriptive Program provides incentives to commercial and industrial customers for a range of measures, including lighting; HVAC systems; motors, pumps, and variable frequency drives (VFDs); process equipment; food service products; and information technology equipment. The program works with trade allies to promote the program and drive participation. The program also offers three alternative channels where customers can purchase a subset of products at comparable incentive levels either online through the Business Savings Store, directly from distributors (midstream), or from HVAC and Food Service manufacturers (upstream).

Date:	March 20, 2023
Region(s):	Duke Energy Carolinas (DEC) Duke Energy Progress (DEP)
Evaluation Period:	January 1, 2019 – December 31, 2020
Annual MWh Savings (ex post net):	DEC: 215,665 MWh DEP: 79,427 MWh
Coincident MW Impact (ex post net):	DEC: 38.58 MW (Summer), 33.53 MW (Winter) DEP: 13.89 MW (Summer), 11.79 MW (Winter)
Measure Life:	Not Evaluated
Net-to-Gross Ratio:	Main Channel Lighting: 74.9% Main Channel Non-Lighting: 70.1% Midstream Lighting: 74.7%
Process Evaluation:	Yes; limited
Previous Evaluation(s):	DEC/DEP Smart $aver® Prescriptive Program, July 16, 2020

EVALUATION METHODOLOGY

In support of the **gross impact evaluation**, we first reviewed program tracking data and developed a comprehensive database of program measures and ex ante savings. We then reviewed and adjusted, where warranted, ex ante per-unit "deemed" savings for a subset of measures. To verify measure installations, we conducted desk reviews and on-site visits for main channel projects and a survey and onsite visits for midstream lighting participants. Finally, we estimated ex post gross energy and demand savings, by delivery channel and technology, based on the quantity and per-unit deemed savings adjustments.

The **net impact evaluation** relied on participant and trade ally surveys to quantify free-ridership, participant spillover, and trade ally spillover. We estimated net-to-gross ratios for main channel lighting and non-lighting projects as well as for midstream lighting projects.

We applied measure installation and NTG results from the main channel and midstream research to savings from the Business Savings Store, the upstream channel, and midstream non-lighting projects.

We estimated **ex post net savings** by multiplying the net-to-gross ratios by the ex post gross savings.

The **process evaluation** relied on participant and trade ally surveys to investigate key areas of interest.

9. DSMore Table

The Excel spreadsheet containing measure-level inputs for Duke Energy Analytics is provided below. Per-measure savings values in the spreadsheet are based on the gross and net impact analyses reported above. The evaluation scope did not include updates to measure life assumptions.

NR Prescriptive_DEC-DEP2

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