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Memorandum

IPL Portfolio Evaluation

To: Kari Gehrke and Nick Ludwig, Interstate Power and Light Company

From: Jayden Wilson, Nathaniel Albers, and Zach Ross, Opinion Dynamics

Date: February 10, 2021

Re: Review of QA/QC Processes for IPL's Nonresidential Prescriptive Rebates Program

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Executive Summary

We assessed Interstate Power and Light Company (IPL)'s quality assurance/quality control (QA/QC) protocols for the Nonresidential Prescriptive Rebate (NRPR) Program to help IPL identify steps they can take to strengthen their NRPR QA/QC protocols and to verify that they are consistent with industry best practices. As part of this assessment, we reviewed IPL documents about their NRPR QA/QC protocols, interviewed representatives of IPL's third-party inspection firm, reviewed other utilities' QA/QC protocols, and reviewed best practice documentation from industry sources.

To contextualize our findings, we must note that there is no single definitive standard for QA/QC protocols that should be used for energy efficiency programs. Program administrators must carefully consider resource constraints, the primary goals of their QA/QC process, program-specific and jurisdiction-specific considerations, and programmatic history in assessing which best practices are appropriate for their programs.

With that in mind, our review indicates that the IPL NRPR Program is not implementing the same level of QA/QC processes as a number of comparable programs we reviewed. In addition, IPL's protocols appear to be often less defined than those we observed in other jurisdictions. We recommend that IPL consider the findings in this memo and determine if improvements to the NRPR QA/QC protocol are desirable.

Based on our research, we offer the following conclusions and recommendations IPL can use to strengthen their NRPR QA/QC processes if desired:

- **Conclusion 1: Other utility programs prioritize certain projects for QA/QC inspection based on criteria rather than random selection.** For example, several utilities prioritize high-cost incentive projects for inspection, use the QA/QC process to review individual contractor's work, and focus on projects in certain geographic areas. Using criteria other than just a percentage of projects selected at random allows IPL to identify the projects most likely to be problematic. For instance, selecting projects completed by inexperienced contractors for inspection would allow IPL to catch problems with a contractor's work and provide an opportunity to train that contractor to better comply with program rules in the future.
  - **Recommendation 1**: IPL could start using criteria such as contractor experience with the program, location, and incentive value to inform which projects they choose to inspect.

- **Conclusion 2: Third-party inspectors in other jurisdictions often have more insight into how and why a program selects projects for inspection.** For example, Ameren Illinois (AIC) and Consolidated Edison (Con Edison) involve the third-party inspector firm in selecting projects. Giving the third-party inspection firm the responsibility of selecting projects takes the utility out of the process, improving the independence of the third-party inspection process.
  - **Recommendation 2**: IPL could consider giving the responsibility of project selection to the third-party inspection firm or involve the third-party firm in project selection. This process should allow program staff and implementers, who may be privy to concerns about a contractor or end-user site, to provide input and insight about the projects chosen for inspection.
- **Conclusion 3: Most programs inspect at least five percent of projects.** As noted by the Office of Consumer Advocate (OCA), the prior evaluator, and the programs examined in this memo, most (if not all) other nonresidential prescriptive programs generally inspect at least five percent of projects.
  - **Recommendation 3**: In addition to focusing inspections based on certain criteria as noted in Conclusion #1, IPL could consider increasing the percentage of projects chosen for inspection from three percent to at least five percent, to better align with industry practices.
- **Conclusion 4: Inspections are still possible, even with the pandemic.** Con Edison and other utilities moved to virtual inspections because of the pandemic. This move ensured they could still uphold their QA/QC requirements while following COVID-19 safety protocols in their region.
  - **Recommendation 4:** During the COVID-19 pandemic, IPL could consider implementing a virtual inspection process by asking contractors to take detailed pictures of projects and/or having customers do video sharing inspections with the third-party inspection firm. Doing this would ensure all project types receive an inspection which in turn contributes to greater confidence that the NRPR Program is supporting eligible projects and reliably estimating savings.

Introduction and Background

In accordance with the Iowa Utilities Board Final Order approving IPL's 2019–2023 Energy Efficiency Plan,[1] we assessed IPL's QA/QC protocols for the NRPR Program to help IPL identify steps they can take to strengthen their NRPR QA/QC protocols and to verify that they are consistent with industry best practices. To make this assessment, we:

- Reviewed documentation about IPL's NRPR QA/QC protocols and interviewed a representative of the third-party QA/QC contractor, CLEAResult.
- Conducted a literature review about QA/QC protocols for similar programs in comparable jurisdictions by:
  - Reviewing available online documentation for similar programs
  - Leveraging our experience and knowledge of similar programs
  - Identifying best practice documentation about comparable QA/QC processes

[1] Final Order in IUB Docket EEP-2018-0003, March 26, 2019.

Methods

In the fall of 2020, we reviewed documents and materials provided by IPL about their NRPR QA/QC process to understand some key fundamentals about the process, including who conducts the QA/QC process, what percentage of projects are subject to a QA/QC inspection, what measures the program prioritizes for inspection, if any, and what the requirements are of the inspectors. Additionally, we interviewed representatives from the CLEAResult, the third-party inspection firm, about their experience conducting inspections.

We examined online sources such as those from the American Council for an Energy Efficient Economy (ACEEE), the Association for Energy Service Professionals (AESP), and the International Energy Program Evaluation Conference (IEPEC) to identify QA/QC best practice literature.

We collected documents and materials about QA/QC processes for commercial programs through online searching and leveraging our experience with similar programs across North America for references about their QA/QC processes for nonresidential prescriptive and similar programs. We identified four comparable programs—three nonresidential prescriptive programs and one nonresidential multifamily program that functions similarly to a nonresidential prescriptive program—to compare to the IPL process:

- Ameren Illinois Business Program – Standard
- Consolidated Edison Multifamily Program
- Ameren Missouri BizSavers® Standard Program
- PSEG Long Island Commercial Efficiency Program

These programs were the closest comparisons we could find to the IPL program and we acknowledge there are variations among the measures and services these programs include. Additionally, each of these utilities administers their program differently and each of these programs serve their own unique customer base. For example, Con Edison serves the large urban area of New York City whereas Ameren Missouri serves the urban area of St. Louis and the rural northeastern part of Missouri. Despite these differences, each of these programs provides insights IPL can use to assess what changes IPL could make to their QA/QC processes.

In the next section we summarize the IPL QA/QC processes and the criticisms of that process identified by the prior evaluator and the OCA.

IPL QA/QC Nonresidential Processes

Summary of QA/QC Inspection Process

The primary purpose of QA/QC inspections is to ensure projects are eligible to participate in the program and project data (e.g., measure type, quantity) are accurately input into program tracking systems thereby ensuring accurate savings estimates.

The IPL Nonresidential Energy Efficiency Program QA/QC protocols call for a third-party inspector to conduct on-site inspections of three percent of projects across five measure types: major commercial appliances, motors, HVAC equipment, refrigeration, and lighting measures.[2] Because of the COVID-19 pandemic and the safety protocols implemented at customer sites that limit occupants in buildings, the third-party inspection firm has only been able to inspect exterior equipment, like heat pump units and air conditioners, since the spring of 2020. When safety protocols change, the firm anticipates going back to inspecting interior and exterior equipment. IPL staff randomly selects three percent of projects and the associated measures for the third-party inspector to inspect each month. IPL staff use the unique project identifier (EAID) to select the sample of projects and they then provide that sample of projects to the third-party inspection firm. On average, IPL gives three to four projects to the third-party inspector per month. According to representatives of the third-party inspection firm, it would be helpful to receive a few more projects in their monthly sample in case they cannot schedule an inspection or gain permission to access a site within a given month. Having more sample points would make it easier for the inspectors to guarantee they can do all the QA/QC inspections they need to complete without having to ask IPL for replacement projects to review in the case they cannot schedule one from the original list provided.

According to the inspectors, about 10% of all inspections identify a problem, usually a data discrepancy like transposed serial numbers or some type of easily resolved administrative error. Only occasionally have inspections revealed major problems like uninstalled equipment. Because the firm receives their list of projects to inspect from IPL, the inspectors do not have insight into the rationale for how IPL selects projects.

Evaluation Criticism of IPL QA/QC Process

In the last several years, we are aware of two key critiques of the IPL QA/QC process. The first critique is from the 2016 process evaluation, which suggested the following:[3]

- IPL was not fully inspecting three percent of projects. Because the projects selected for inspection were based on a single measure at a site, inspectors often inspected only that one measure and did not inspect other measures at the site. For example, one site received incentives for a furnace and thermostat, yet the inspector only verified the furnace.
- IPL should expand the number of measures their third-party inspects post-installation.
- IPL should increase the percentage of projects selected for inspection from three percent to at least five percent to better align with industry best practices.

The second critique came from the Office of OCA, who recommended in October 2018 that IPL take the following steps to improve the QA/QC process:[4]

- Increase the percentage of projects subject to QA/QC inspection.
- Expand the list of measures QA/QC inspectors examine to include the measures responsible for most program savings.
- Use the QA/QC process to check the work of individual contractors.

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[2] 2019-2023 Energy Efficiency Plan. Interstate Power and Light Company. Application Exhibit 1. Docket No. EEP-2018-0003. Filed with Iowa Utilities Board on July 5, 2018

[3] IPL Energy Efficiency Programs. 2014. Nonresidential Energy Efficiency Program Evaluations. Docket EEP-2012-0001. Prepared by Itron. March 31, 2016

[4] Office of Consumer Advocate, Direct Testimony and Rebuttal Testimony to Interstate Power and Light Company. Filed with Iowa Utilities Board on October 2, 2018. EEP-2018-003

Key Takeaways

The QA/QC process for the IPL NRPR Program shows,

- IPL staff select projects for inspections and provide those projects to the third-party inspector;
- IPL randomly selects about three percent of all projects for inspection;
- Inspectors do not always inspect all measures at a site, just the measures specified by IPL;
- IPL does not use the QA/QC process to review the work of specific contractors; and
- Since the COVID-19 pandemic began in the spring of 2020, the third-party inspection firm has not inspected measures inside of buildings.

Findings from Other Jurisdictions

The subsequent section outlines what we learned about the QA/QC processes for the four comparison programs we examined. The level of detail we could gather about these other program processes varied and the program types varied somewhat—not all are strictly prescriptive commercial programs. We were able to identify detailed QA/QC processes for two of the programs—AIC and Con Edison—and less detailed processes for two other programs—Ameren Missouri and PSEG Long Island. Each section provides a brief overview of the program, a description of the QA/QC process, and any key takeaways about the QA/QC process. The last subsection provides a brief overview of QA/QC best practices identified by industry experts.

Ameren Illinois Energy Efficiency Business Program

Program Description

The AIC Energy Efficiency Business Program - Standard Initiative ("Standard Initiative") offers commercial and municipal customers fixed incentives for the installation of prescriptive energy efficiency measures. The Standard Initiative provides incentives for lighting, variable speed drives, HVAC equipment, steam traps, compressed air leak repair, and other measures. Commercial and municipal organizations can participate in this offering by completing an application or having their contractor complete the application on behalf of the customer. The program requires customers to meet several requirements for their projects including attaining a pre-approval letter from AIC for projects requesting more than $10,000 in incentives and completing projects within 120 days of equipment purchase date.

AIC uses an implementation firm to administer the Standard Initiative. The firm processes customer applications, manages a network of contractors, and markets the program. AIC implements a QA/QC process to ensure program compliance and accurate savings.[5]

[5] Ameren Illinois Energy Efficiency Business Program Quality Assurance Inspections Policy. February 27, 2019 and Ameren Illinois Energy Efficiency Programs. Standard HVAC/Water Heaters Application. App 2020, Rev 03. Accessed on December 17, 2020. https://amerenillinoissavings.com/portals/0/business/forms/pytr-hvac.pdf

QA/QC Process

Implementer staff conducts the QA/QC inspections for the Standard Initiative. In addition to requiring all applicants to obtain a pre-approval letter from AIC for all projects asking for more than $10,000 in incentives, the implementer conducts inspections throughout all phases of projects for a variety of reasons.

The implementer completes **pre-inspections** in the following instances:

- Applicants request more than $50,000 in incentives for a project.
- Applicants request more than $10,000 in incentives for a de-lamping project.
- A Technical Reviewer flags an application with errors or inconsistencies.

The implementer will conduct **inspections of projects that are in-process** when:

- A Technical Reviewer flags an application with errors or inconsistencies.
- An Energy Advisor recommends an inspection.

Post-installation inspections occur in many circumstances:

- Projects that reach certain incentives or savings thresholds receive an inspection.
  - Incentive thresholds are greater than $50,000 for an electric project or $25,000 for a gas project.
- Contractors or service providers that meet certain criteria receive an inspection.
  - The aggregate incentive amount of projects submitted by any contractor reaches the following incentive thresholds: $2,500; $10,000; $25,000; $50,000 and at each $50,000 increment up to $500,000 and at $250,000 increments thereafter.
  - Contractors that have not completed a project in last year will receive an inspection.
- Projects or contractors identified as potentially problematic by program staff or implementer, will receive an inspection.
  - Business Program Staff has concern with contractor's behavior or performance.
  - A Technical Reviewer identifies possible issues or concerns in the project application.
- The implementer randomly selects projects for inspection that don't meet any of the other criteria.
  - 5% of all projects without a designated program approved contractor receive an inspection.
  - 5% of all projects that don't meet any of the other criteria receive an inspection.

Key Takeaways

The AIC Business Program emphasizes the following in their QA/QC processes. The program,

- Pre-inspects projects that request certain dollar amounts in incentives;
- Has different inspection criteria for different project types;
- Allows for staff and implementers to flag projects for inspection at any phase of the project;

- Has inspection criteria related to contractor experience with the program; and
- Randomly selects 5%-10% of projects for inspection in addition to inspecting projects for other reasons.

Consolidated Edison Multifamily Program

Program Description

The Con Edison Multifamily Program offers a suite of direct-install measures (e.g., lighting and faucet aerators) at no cost to the building owner and the tenants, as well as prescriptive and custom rebates for upgrades such as efficient lighting; heating, ventilation, and air conditioning (HVAC); weatherization; and occupancy sensors. The program offers common area upgrades and in-unit upgrades for qualifying tenants within participating buildings.

Con Edison uses an implementer to administer the program. The implementer recruits contractors, maintains the customer service hotline, onboards participating contractors, conducts project oversight, verifies customer eligibility, conducts pre- and post-inspections, and schedules any necessary appointments with the customer. A subcontractor conducts the in-unit direct-install component of the program. The implementer coordinates with a third-party inspection firm to conduct pre- and post-inspections.

QA/QC Process

Con Edison uses a third-party contractor to conduct QA/QC inspections on a sample of Multifamily Program projects. The third-party QA/QC contractor conducts pre- and post-inspections on common area projects previously inspected by the program implementer, selecting a weekly sample of either 20% of the projects ready for inspection that week or two projects, whichever is greater. The third-party QA/QC contractor randomly selects projects for inspection in high participation regions of the jurisdiction (Manhattan, Queens, Brooklyn, and Bronx) and they inspect all projects in areas with little program activity in (Westchester and Staten Island).[6]

Third-party QA/QC contractor staff typically conduct pre-inspections alongside implementer inspectors to quicken the participation process and minimize the burden on the participant. This interaction has created relationships between third-party and implementer inspectors and allowed each to see the other team's perspective and to resolve any inspection disagreements more quickly than if they conducted inspections at separate times.

Third-party inspectors and implementer inspectors seek to verify the same information. Both inspectors ensure,

- Existing equipment is eligible for replacement;
- New equipment is eligible for incentives;
- Equipment specifications match work orders and invoices;
- Counts of equipment are accurate; and

[6] Consolidated Edison Multifamily Energy Efficiency Program Process Evaluation Final Report. March 27, 2020, Prepared by Opinion Dynamics and West Hill Energy and Computing.

- Locations of equipment are recorded accurately.

The third-party inspectors can rate projects three ways:

- Pass: All measure counts, locations, and specifications are program eligible.
- Minor fail: The inspectors found up to 5% of the scope of work is inaccurate. For example, the invoice states there were 100 light fixtures replaced and the inspector see 96 light fixtures.
- Major fail: The inspectors found more than 5% of the scope of work is inaccurate. For example, the invoice states there were 100 light fixtures replaced and the inspector sees only 80 light fixtures.

In both instances of failure, the contractor is given an opportunity to correct the reported error. The most common reasons a project fails inspections is an incorrect count of measures or incorrect wattages for lighting.

Third-party inspectors report their findings in a database that the implementer can access. This database allows the implementer and third-party to track a project and check the status of projects as they move through the process.

COVID-19 and Inspections

Con Edison implemented a virtual inspection process because of the COVID-19 pandemic. Instead of on-site inspections, Con Edison switched to having contractors take detailed pictures and videos of existing equipment and any newly installed equipment. In some cases, a representative of the third-party inspection firm "met" via FaceTime or another real-time video sharing platform with a contractor at a project site. The contractor would walk through the building and allow the inspector to see all project measures. We are evaluating this virtual inspection effort now and preliminary results suggest the virtual inspections were successful in documenting measures without unduly burdening contractors and customers. Furthermore, through our work with this utility, we learned that other New York programs and Connecticut-based commercial programs also moved to virtual inspections because of the pandemic.

Key Takeaways

The Con Edison Multifamily Program emphasizes the following in their QA/QC processes. The program,

- Uses two groups, the implementer and a third-party, to conduct pre- and post-inspections;
- Completes on-site inspection for 20% of all projects;
- Varies where they do inspections based on program activity across their service territory;
- Provides a score of all inspections, allowing the program to see how projects and contractors fare over time; and
- Adapted their inspection process to a virtual approach to account for the pandemic.

Ameren Missouri Biz Savers Standard Program

Program Description

The Ameren Missouri (AMO) BizSavers® Standard program offers commercial, industrial, and municipal customers incentives for the installation of prescriptive energy efficiency measures. The program provides incentives for lighting, variable frequency drives, heating and cooling measures, water heating, refrigeration, and other energy using equipment. Organizations can participate in the program by completing an application or having their contractor complete the application on their behalf. The objective of the program is to provide organizations awareness of energy efficiency opportunities, an incentive to encourage achieving these savings, and an expedited, simple solution for organizations interested in purchasing efficient technologies that will produce verifiable energy savings. The Standard program has two paths customers can take: The Fast Track process and the Pre-Approval process.

AMO uses an implementation firm to administer the program. The firm processes customer applications, manages a network of contractors, and markets the program. They also implement a QA/QC process to ensure program compliance and accurate savings.[7]

QA/QC Process

The AMO implementer conducts pre-inspections when a requested incentive is greater than $15,000. Projects receiving less than $15,000 in incentives can proceed through the Fast Track process and those requesting more than $15,000 must go through the Pre-Approval process. Additionally, customers requesting less than $15,000 must also seek pre-approval when requesting money for certain measures.

Fast Track Process

The Fast Track process allows customers that expect to receive less than $15,000 in incentives to install measures from the Standard Incentive List prior to applying. These customers must install their equipment, apply, and submit all applicable invoices.[8] The BizSavers® team then conducts a technical review of the application and invoices and either approves the application, asks for more information, or conducts an inspection of the project. Publicly available information about the QA/QC process did not specify details about what gets considered when selecting projects for inspections.

Pre-Approval Process

Projects receiving incentives greater than $15,000 or incentives for certain measures that are less than $15,000, must receive pre-approval from the BizSavers® team before installing equipment. The BizSavers® team will review the application and submit an offer letter to the customer. That offer letter requires the customer to report the estimated start date, project completion date, and date BizSavers® can expect to see the final application paperwork. The project can commence once all parties sign the offer letter. Customers must install their equipment, submit an application and all applicable invoices to the BizSavers® team, and note any changes that may have occurred since pre-approval. The BizSavers® team completes a technical review of all project applications and all projects receiving more than $15,000 in incentives receive inspections.

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[7] Ameren Missouri Standard Incentive Program Guidelines, Effective July 1, 2020. Accessed on December 17, 2020.https://www.ameren.com/-/media/missouri-site/files/energy-efficiency/business/guidelines-standard-v1-20190301.pdf?la=en-us-mo&hash=90ACBC197383B1426CE321153FEF46FB2EBF402F

[8] Invoices must include costs for labor, equipment unit prices, equipment specifications and disposal fees.

Key Takeaways

The AMO BizSavers® Standard Program emphasizes the following in their QA/QC processes. The program,

- Considers measure type when determining if a project should be inspected. For example, they may require more inspections of projects if the customer installed some measures through the Standard program and some measures through another Ameren Missouri program; and
- Inspects 100% of all projects requesting more than $15,000 in incentives.

PSEG Long Island Commercial Efficiency Program

Program Description

PSEG Long Island's Commercial Efficiency Program (CEP) provides commercial customers rebates for installation of energy saving measures and supports commercial customers by offering technical assistance rebates that offset the cost of engineering and design services related to energy saving projects.

PSEG uses an implementation firm to deliver the CEP program and this firm partners with installation contractors to deliver the program to customers. The implementation firm and the utility engage a third-party contractor to conduct QA/QC of projects.

QA/QC Process

All CEP projects receive approval at different phases of the project to ensure compliance with program requirements. All prescriptive projects over $10,000 require pre- and post-inspections and all custom projects, regardless of cost, require pre- and post-inspections.[9] A quality control third-party contractor reviews projects at random to ensure that projects meet eligibility criteria and follow program rules. Publicly available documents do not elaborate on what other circumstances may result in a project inspection.

Key Takeaways

The CEP emphasizes the following in their QA/QC processes. The program,

- Requires pre- and post-inspections for projects exceeding $10,000 in incentives;
- Requires pre- and post-inspections for all custom projects; and
- Uses a third-party firm to conduct all inspections and the third-party firm selects projects for inspection.

Literature Review

This section highlights best practices for QA/QC processes among residential programs that also apply to commercial programs because these processes ensure that the efficiency program, regardless of market sector, is delivering verifiable energy savings.

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[9] PSEG Long Island 2017 Energy Efficiency and Renewable Plan. December 21, 2016. Accessed on December 17, 2020. https://www.psegliny.com/aboutpseglongisland/legalandregulatory/-/media/6A41BF8608984A2CA0522FC343FA15BA.ashx

A review of a residential energy efficiency program in North Carolina[10] stated that a comprehensive QA/QC process should include:

- Adequate training of all contractors involved in the program, a signed agreement between contractors and the program administrator, and a process for reviewing and disciplining contractors.
- A desk review or inspection of 100% of all projects.
- A survey or assessment of end-users immediately after project completion.

The US Department of Energy's Better Buildings Program requires their grantees to inspect 5% to 10% of all projects and requires higher rates of inspection for contractors new to the program and those contractors that have underperformed in the past.[11] For example, contractors that have failed prior inspections or consistently fail to deliver accurate program paperwork to administrators should receive additional inspections and scrutiny. Additionally, this program includes satisfaction surveys with end-users immediately after project completion as part of the QA/QC process. They use these surveys as a method to identify poor contractor performance or poor performance of equipment or measures.

Key Takeaways

Industry best practices for QA/QC processes include,

- Ongoing training of contractors about program processes;
- Reviewing contractor performance on a regular basis;
- A desk review or an inspection of all projects, at a minimum; and
- Immediate feedback from end-users upon project completion.

Conclusions and Recommendations

Our review indicates that the IPL NRPR Program is not implementing the same level of QA/QC processes as a number of comparable programs we reviewed. In addition, IPL's protocols appear to be often less defined than those we observed in other jurisdictions. IPL could make several changes to their QA/QC processes to better align with best practices we observed in other programs, which we believe could help to further ensure project eligibility, accurate record keeping, and accurate savings estimates. We recommend that IPL consider the findings in this memo and determine if improvements to the NRPR QA/QC protocol are desirable.

[10] Barger, Nora. Clean Energy Solutions Inc. Ensuring Quality Work When the Work is Hard to See: The Importance of Quality/Assurance/Quality Control Protocols in Energy Efficiency Programs. 2012 ACEEE Summer Study on Energy Efficiency in Buildings

[11] Better Buildings: U.S. Department of Energy. Better Buildings Residential Network Peer Exchange Call Series: Keys to Successful Quality Assurance and Quality Control Programs. January 28, 2016.

We offer the following conclusions and recommendations IPL can use to strengthen their NRPR QA/QC processes if desired:

- **Conclusion 1: Other utility programs prioritize certain projects for QA/QC inspection based on criteria rather than random selection.** For example, several utilities prioritize high-cost incentive projects for inspection, use the QA/QC process to review individual contractor's work, and focus on projects in certain geographic areas. Using criteria other than just a percentage of projects selected at random allows IPL to identify the projects most likely to be problematic. For instance, selecting projects completed by inexperienced contractors for inspection would allow IPL to catch problems with a contractor's work and provide an opportunity to train that contractor to better comply with program rules in the future.
    - **Recommendation 1**: IPL could start using criteria such as contractor experience with the program, location, and incentive value to inform which projects they choose to inspect.
- **Conclusion 2: Third party inspectors in other jurisdictions often have more insight into how and why a program selects projects for inspection.** For example, AIC and Con Edison involve the third-party inspector firm in selecting projects. Giving the third-party inspection firm the responsibility of selecting projects takes the utility out of the process, improving the independence of the third-party inspection process.
    - **Recommendation 2**: IPL could consider giving the responsibility of project selection to the third-party inspection firm or involve the third-party firm in project selection. This process should allow program staff and implementers, who may be privy to concerns about a contractor or end-user site, to provide input and insight about the projects chosen for inspection.
- **Conclusion 3: Most programs inspect at least five percent of projects.** As noted by the OCA, the prior evaluator, and the programs examined in this memo, most (if not all) other nonresidential prescriptive programs generally inspect at least five percent of projects.
    - **Recommendation 3**: In addition to focusing inspections based on certain criteria as noted in Conclusion #1, IPL could consider increasing the percentage of projects chosen for inspection from three percent to at least five percent, to better align with industry practices.
- **Conclusion 4**: **Inspections are still possible, even with the pandemic.** Con Edison and other utilities moved to virtual inspections because of the pandemic. This move ensured they could still uphold their QA/QC requirements while following COVID-19 safety protocols in their region.
    - **Recommendation 4**: During the COVID-19 pandemic, IPL could consider implementing a virtual inspection process by asking contractors to take detailed pictures of projects and/or having customers do video sharing inspections with the third-party inspection firm. Doing this would ensure all project types receive an inspection which in turn contributes to greater confidence that the NRPR Program is supporting eligible projects and reliably estimating savings.

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Interstate Power and Light

Nonresidential Prescriptive Rebates Impact Evaluation Report

Draft
January 20, 2020

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1. Executive Summary

This report presents a summary of the findings and results from the impact evaluation of the 2019-2023 Interstate Power and Light (IPL) Nonresidential Prescriptive Rebates (NRPR) program. The NRPR program offers a range of services, including technical resources, appliance recycling, and financial incentives in the form of rebates, to encourage nonresidential customers to purchase high-efficiency electric and natural gas equipment and adopt energy-efficient behaviors. The program features rebates for a range of energy efficiency measures, including lighting; heating, ventilation, and air conditioning (HVAC); refrigeration; and motor measures.

The primary objectives of the impact evaluation were to quantify gross electric and natural gas savings impacts from the program during the evaluation period (April 1, 2019–March 31, 2020) and identify how IPL could improve program implementation and the estimation and tracking of program impacts moving forward.[1]

To complete the impact evaluation, the Opinion Dynamics evaluation team conducted program manager and implementer interviews, a program database review, and an engineering impact analysis. Presented in this report are the methods, findings, and recommendations resulting from the impact evaluation activities.

Table 1 presents NRPR program savings achieved in the evaluation period. The NRPR program achieved ex post gross savings of 23,985,783 kWh, 5,665.32 kW, and -9,668 therms. The 100% and 99% gross realization rates for electric energy and demand savings, respectively, indicate that the achieved, or ex post, savings are very similar to the total ex ante energy savings and demand savings estimated and tracked by the program. The realization rate for gas savings (83%) is inclusive of natural gas efficiency savings (32,286 therms) associated with gas furnace and boiler improvements, and negative heating penalty impacts (-41,954 therms) associated with lighting measures installed in buildings heated with natural gas supplied through IPL.

Table 1. Nonresidential Prescriptive Rebates Program Annual Savings

	Electric Energy Savings (kWh)	Electric Demand Savings (kW)	Gas Savings (Therms)[a]
Ex Ante Gross Savings	24,038,379	5,740.04	-11,638
Gross Realization Rate	100%	99%	83%
Ex Post Gross Savings	23,985,783	5,665.32	-9,668

[a] Ex ante savings include 33,160 therms of natural gas savings offset by -44,798 therms of increased consumption from lighting heating penalties. Ex post savings include 32,286 therms of natural gas savings offset by -41,954 therms from lighting heating penalties.

Based on the results of this evaluation, the evaluation team offers the following key findings and recommendations for the NRPR program moving forward:

- **Key Finding #1**: For LED standard lighting measures, the ex ante analysis applied baseline wattages that differ from those in the *Iowa Technical Reference Manual* (IA-TRM), which provides a lookup table for defining baseline wattage based on efficient lamp total lumen output. The evaluation observed two sources of discrepancy in roughly 4% of all LED standard lighting measures. First, the database reports the lumen per watt lamp efficiency in place of the total lumen output. Second, where total lumen output of the installed LED lamp is accurately reported in the database, the baseline wattage is misaligned with the IA-TRM lookup table.
  - **Recommendation**: Use the ENERGY STAR® model number, already tracked in Tool for Reporting Energy Efficiency Savings (TREES), to confirm the reported lumens is the total lumen output and

[1] The choice of evaluation period is discussed further in Section 2.

not the lumen per watt lamp efficiency. Additionally, confirm alignment with the IA-TRM lookup table. Ensuring this information is accurate and in alignment with IA-TRM guidance will improve program realization rate performance.

- **Key Finding #2**: Custom calculations for desuperheater, heat pump water heater, ductless heat pump and electric HVAC tune-up measures, which do not have a dedicated section in the IA-TRM *Volume 3: Nonresidential Measures*, leverage past residential studies and assumptions from *Volume 2: Residential Measures* from the IA-TRM.
  - **Recommendation**: Look to other TRMs, notably Illinois and Wisconsin, for more recent studies and assumptions specific to nonresidential applications of the identified measures.
- **Key Finding #3**: Ex ante estimates did not multiply per-unit savings by the total number of completed self-contained refrigeration tune-ups.
  - **Recommendation**: Update ex ante savings calculations for self-contained refrigeration tune-ups to multiply the per-unit savings by the measure quantity recorded in the program tracking database.

2. Introduction

Within the following sections, we present the results of the impact evaluation of the NRPR program in IPL's 2019-2023 energy efficiency and demand response portfolio. Across the Nonresidential portfolio, we defined an evaluation period beginning April 1, 2019, and ending March 31, 2020 ("evaluation period") for all programs. We selected this period for impact evaluation to represent one typical program year; IPL's 2019-2023 programs began implementation on April 1, 2019, and the ongoing COVID-19 pandemic is likely to cause nonrepresentative program effects during the 2020 program year. We selected an evaluation period that takes these factors into account yet covers a relatively representative program period lasting one year.

The following sections provide a high-level summary of program implementation, describe program participation in the evaluation period, detail our impact evaluation approach and methods, and report evaluation results, including ex post savings, findings, and recommendations.

2.1 Program Description

The NRPR program encourages nonresidential customers to purchase high-efficiency electric and natural gas equipment and adopt energy-efficient behaviors. The program offers a broad range of services, including technical resources, appliance recycling, and financial incentives in the form of rebates. The program features rebates for a range of energy efficiency measures, including lighting, HVAC, refrigeration, and motor measures. In the evaluation period, the program consisted primarily of lighting measures, motor controls, and tune-ups for HVAC and refrigeration equipment. Although the program is available to all nonresidential customers, the program's focus is to provide simple solutions for the non-managed customer group.[2]

Nonresidential IPL customers who purchase qualifying high-efficiency measures directly from equipment vendors and retailers are eligible for NRPR program rebates. To participate in the program, customers must submit (via mail, fax, or email) a program rebate application with documentation on the equipment purchase and installation to IPL's rebate processing center. Ideally, the vendors would check the program requirements to make sure the customers' equipment qualifies.

The NRPR program third-party implementer, Michaels Energy, handles intakes of all the NRPR forms. Michaels Energy confirms the data in the rebate application forms adhere to program rules, verifies all the documentations and equipment specifications are in order, and approves or rejects the rebates for payment. Participants then receive prescriptive rebates in the form of a check. A separate third-party inspection company, CLEAResult, conducts on-site verification for three percent of projects which include at least one major commercial appliance, HVAC, motor, refrigeration, or lighting measure.

Key Implementation Changes in Evaluation Period

- IPL discontinued most food service measures, tune-ups for boilers and furnaces, insulation, air sealing, water heaters, strip curtains for walk-in refrigerators, and other measures, which were not historically cost effective, at the beginning of the 2019-2023 plan cycle.
- IPL discontinued incentives for participating dealers at the beginning of the 2019-2023 plan cycle.

[2] Managed customers are large usage accounts which are assigned a dedicated key account manager who acts as a liaison between the customer and IPL in many matters, including participation in energy efficiency and demand response programs.

2.2 Participation Summary

Table 2 summarizes NRPR program participation during the evaluation period. The NRPR program supported 1,438 projects in the evaluation period with ex ante energy savings of 24,038,379 kWh, 5,740.04 kW of demand savings, and -11,638 therms of natural gas savings.

Table 2. Nonresidential Prescriptive Rebates Program Participation Summary

Measure Category/Track	Total Projects[a]	Ex Ante Gross Savings		
		kWh	kW	Therms
T8 LED Linear Replacement	454	6,664,328	2,132.71	-21,598
LED High Bay Fixture	182	4,906,944	1,501.75	-13,177
LED Exterior Fixture	270	4,715,107	0.00	0
LED Troffers	200	2,486,877	858.49	-3,221
LED Surface or Suspended Fixture	89	821,041	246.77	-1,938
LED Display Case	9	180,320	41.44	-2,185
LED Downlight Fixture	41	151,596	51.24	-1,241
LED Low Bay Fixture	9	37,934	13.62	0
LED Interior Directional Fixture	1	65	0.03	0
Subtotal – LED Fixture	**973**	**19,964,211**	**4,846.04**	**-43,359**
VFD (Process)	5	1,717,854	0.00	0
Refrigeration Compressor Tune-Up	7	736,295	81.03	0
Occupancy Sensor	30	516,435	287.69	-4
HVAC Tune-Up	148	448,949	290.84	0
LED Standard	51	431,996	114.61	-1,427
Ductless Heat Pump	17	69,715	6.79	0
Central Air Conditioner	88	60,172	38.45	0
Electric Chiller	1	25,946	61.36	0
Ground Source Heat Pump (GSHP)	3	23,032	4.38	0
LED Exit Sign	14	8,255	0.69	0
Air Source Heat Pump (ASHP)	6	7,537	0.49	0
Heat Pump Water Heater	1	7,338	0.84	0
Desuperheater	1	6,971	0.00	0
Daylighting Control	5	5,414	3.77	-8
Refrigerator/Freezer	1	5,409	0.60	0
Packaged Terminal Air Conditioner (PTAC)	2	2,827	1.67	0
Motor	1	24	0.79	0
Gas Furnace	120	0	0.00	29,007
Gas Boiler	7	0	0.00	4,153
Total	**1,438**	**24,038,379**	**5,740.04**	**-11,638**[b]

[a] Measure category project counts do not sum to the total projects because a project can contain more than one measure category.
[b] The total natural gas impacts includes 33,160 therm in energy savings and -44,798 therm in heating penalties.

LED Fixture measures account for 83% of the ex ante electric energy and 84% of demand savings. Natural gas savings from high-efficiency furnace and boiler equipment are offset by the heating penalties of high-efficiency lighting equipment.

Table 3 compares NRPR program participation from the most recent evaluation in 2014 against the participation during the current evaluation period.

Table 3. Comparison to 2014 Nonresidential Prescriptive Rebates Program Participation Summary

Measure Category/Track	2014 Ex Ante Gross Savings			Evaluation Period Ex Ante Gross Savings		
	kWh	kW	Therms	kWh	kW	Therms
Lighting-LED	3,174,710	527	N/A[a]	20,404,461	4,961.35	-44,786
VFDs	14,002,139	1,328	0	1,717,854	0	0
Other[b]	2,922,413	649	49,209	1,394,215	487.23	4,153
Lighting Controls	1,336,963	247	N/A[a]	521,849	291.46	-12
Furnaces	N/A	N/A	58,707	0	0	29,007
Lighting-T5/T8[c]	3,541,938	673	N/A[a]	0	0	0
Insulation[c]	N/A	N/A	283,001	0	0	0
Total	**24,978,163**	**3,424**	**390,917**	**24,038,379**	**5,740.04**	**- 11,638**

[a] Heating penalties are not reported in the 2014 report, but are included in the evaluation period program tracking data. Total natural gas savings in the evaluation period, less heating penalties, is 33,160 therms.

[b] In 2014, “Other” measures are defined as “low-impact” measures, without great insight to the specific measures. In the evaluation period, this category includes mostly HVAC measures with refrigeration and motors.

[c] The program discontinued insulation and fluorescent lighting measures at the beginning of the 2019-2023 plan cycle.

The total program ex ante electric energy savings from the current evaluation period are comparable with the total energy savings reported in 2014.[3] However, the source of energy savings differs significantly between program years. In 2014, variable frequency drive (VFD) measures contributed the greatest portion of ex ante electric energy (56%) and demand (39%) to overall program savings. Those proportions are contrasted in the current evaluation year where VFDs contributed 7% to electric energy and zero to demand savings. Lighting measures, including controls, were the second largest contributor in the 2014 program with 32% of the electric energy and 42% of electric demand savings. While the NRPR program discontinued fluorescent lighting measures (e.g., linear, high bay), it expanded its LED offerings with the addition of linear LEDs and LED exit signs such that lighting measures, including controls, account for 93% of electric energy and 95% of demand savings in the evaluation period.

Finally, in 2014, 72% of ex ante therm savings were from insulation measures, which were discontinued at the beginning of the 2019-2023 plan cycle. The remaining 13% of ex ante therm savings in 2014 derived from gas furnace measures. In the current evaluation period, natural gas measures, namely gas furnace and boiler measures, contribute 87% and 13% to positive, i.e., excluding heating penalties, ex ante therm savings, respectively. The notable difference between 2014 and the current evaluation period is the inclusion of natural gas heating penalties associated with high-efficiency lighting and lighting control improvements reported in the current evaluation but omitted in 2014.[4] Heating penalties (-44,798 therms) more than offset the positive ex ante savings from furnace and boiler measures resulting in the net negative therm savings.

[3] IPL Energy Efficiency Programs 2014 Nonresidential Prescriptive Rebate Program Evaluation (March 2016).
[4] The 2014 evaluation report recommended IPL apply heating penalties moving forward. Ibid, Attachment B, page 13.

3. Impact Evaluation Approach and Methods

The evaluation team developed ex post estimates of the gross electric energy, electric demand, and natural gas impacts from the NRPR program. Impact evaluation activities, outlined in Table 4, included verification of program tracking data and verification of engineering calculations as part of estimating program savings.

Table 4. Impact Evaluation Activities

Evaluation Activity	Details
Program Manager & Implementer Interviews	▪ Interviewed program and implementation staff to gather staff perspectives on the performance of the program and to highlight any key areas where insight is needed from evaluation.
Program Database Review	▪ Reviewed program tracking system to ensure that data required for the evaluation are being collected and data are complete.
Impact Analysis	▪ Reviewed project documentation and calculations to account for analytical errors, incorrect assumptions, etc. ▪ Verified that ex ante savings use correct IA-TRM values and algorithms. ▪ Developed ex post savings using IA-TRM values and algorithms and any updated evaluation-estimated parameters.

Program Manager & Implementer Interviews

To support our evaluation, we conducted interviews with program and implementation staff to cover program performance and other topics relevant to our impact and process research objectives. We completed two interviews: one with IPL staff covering all Nonresidential Programs and one with Michaels Energy staff specific to the NRPR and Custom Solutions programs. While these interviews were predominantly process-focused, they also allow us to explore ongoing efforts of program administrators and implementers, providing insight and context to the impact evaluation results.

We conducted the interview with IPL staff on October 15, 2020 and with Michaels Energy staff on November 3, 2020. We recorded and transcribed both interviews.

Program Database Review

The evaluation team reviewed the program tracking database for the evaluation period to identify any database inconsistencies, such as duplicate records or misalignments between the IA-TRM and the data tracked in the TREES program database. The team first compared the total savings claimed between April 1, 2019 through December 31, 2019 within the TREES tracking database against the 2019 reported ex ante savings. The team found that savings totals aligned between the two sources and verified that the TREES database includes all completed projects through the program.[5] The evaluation team compared fields populated in the TREES database against the required parameters necessary for calculating savings from the IA-TRM.

Based on the database review findings, the evaluation team requested and received additional measure-level data where necessary. When unavailable, we applied IA-TRM default assumptions to calculate engineering ex post savings.

[5] Interstate Power and Light Co. (IPL) an Alliant Energy Company. (May 1, 2020). ANNUAL REPORT for 2019 Energy Efficiency Plan. Docket number EEP-2018-0003. Retrievable at: https://wcc.efs.iowa.gov/cs/groups/external/documents/docket/mday/mdi4/~edisp/2028335.pdf

From the database review, we determined that a population-level engineering analysis was possible, eliminating the need to conduct desk reviews on a sample of projects and extrapolate the results of those reviews to the population of projects and measures. Population-level analysis is only possible when high-quality, comprehensive, and complete data are available at the measure level. From our review, the TREES database met those criteria.

Impact Analysis

The evaluation team conducted an engineering analysis on the entire program population to estimate ex post gross impacts for each measure in the NRPR program tracking database. We relied on savings algorithms from the IA-TRM and measure-specific program tracking data, and we used default assumptions when measure-specific characteristics were not available in the program tracking database. Since the evaluation period includes projects in two different program years, the projects completed in 2019 relied on IA-TRM V3.0 while those completed in 2020 relied on IA-TRM V4.0. Based on discussions with IPL and Michaels Energy, we used the “date_installed” field in the program tracking database to determine which IA-TRM version to apply.[6]

Five program measures were not documented in either version of the non-residential IA-TRM. For these five measures, the evaluation team used either the residential volume of the IA-TRM or a custom approach.[7] These measures include:

- **Desuperheaters:** Relied on residential volume of IA-TRM to inform nonresidential calculations
- **Refrigeration Tune-ups (Self-Contained and Remote):** Relied on a mix of secondary resources (e.g., Department of Energy [DOE], Public Service Commission [PSC] of Wisconsin)
- **Heat Pump Water Heaters (HPWH):** Relied on residential volume of IA-TRM to inform nonresidential calculations
- **Ductless Heat Pumps:** Relied on Variable Refrigerator Flow (VRF) modeling savings estimates from the Regional Technical Forum (RTF) weather adjusted using ratio of heating and cooling degree days for Des Moines, IA and Spokane, WA.
- **HVAC Tune-Ups**: Relied on the International Code Council’s 2012 International Energy Conservation Codes for baseline efficiencies of different equipment and the IA-TRM V3.0 and IA-TRM V4.0 for effective full load hours and coincidence factors.[8]

The evaluation team reviewed ex ante savings calculations and assumptions for the measures listed above. We made one minor adjustment to annual operating hours for remote refrigeration tune-ups (from 8,760 to 8,766 for consistency with the annual operating hours applied for self-contained refrigeration tune-ups). See Appendix A for detailed methods for program measures that deviate from the IA-TRM.

[6] A measure’s installation date in the TREES database determines the appropriate IA-TRM version to apply. Measures installed within the 2019 calendar year use the IA-TRM V3.0, while measures installed in the 2020 calendar year apply the IA-TRM V4.0

[7] For 2019 program reporting year, documentation provided as excel file entitled: *2019 Non-TRM Program Impact Algorithms_v5.* For 2020, excel file entitled: *2020 Non-TRM Program Impact Algorithms_v1.*

[8] International Code Council (2015). 2012 International Energy Conservation *Code* (5th Edition). Retrievable at: https://codes.iccsafe.org/content/IECC2012P5

4. Results

4.1 Program Savings Summary

Table 5 presents ex post gross NRPR savings achieved in the evaluation period. The NRPR program achieved ex post gross savings of 23,985,783 kWh, 5,665.32 kW, and -9,668 therms. Natural gas therms savings include heating penalties associated with lighting measures. Excluding heating penalties, the NRPR program achieved 32,286 therms of savings, all coming from HVAC measures.

Table 5. Nonresidential Prescriptive Rebates Program Annual Savings

	Electric Energy Savings (kWh)	Electric Demand Savings (kW)	Gas Savings (Therms)[a]
Ex Ante Gross Savings	24,038,379	5,740.04	-11,638
Gross Realization Rate	100%	99%	83%
Ex Post Gross Savings	23,985,783	5,665.32	-9,668

[a] Ex ante savings include positive 33,160 therms of natural gas savings offset by -44,798 therms from lighting heating penalties. Ex post savings include 32,286 therms of natural gas savings offset by -41,954 therms from lighting heating penalties.

4.2 Program Savings Details

The NRPR program incentivizes a variety of measures across lighting, refrigeration, HVAC, and motor end-uses. Lighting measures, including LEDs, controls, and exit signs, account for the majority (86%) of the program's total ex post gross electric energy savings. Gas furnaces and gas boilers contribute 88% and 12%, respectively, to the program's total positive (i.e., excludes heating penalties) ex post gross gas savings. The tables below present measure-level electric energy, demand, and gas savings followed by a discussion of key drivers of discrepancies between reported ex ante gross savings and ex post gross savings.

Table 6 presents electric energy realization rates, by measure, for the NRPR program in the evaluation period. LED fixtures, which include a range of LEDs such as linear, high bay and display case lamps, represent the top energy saving measure category, accounting for 82% of program electric energy savings followed by VFDs, contributing 7% to program savings. The remaining 16 measures make up the remaining 11% of program electric energy savings.

Most measures exhibit strong realization rates (close to 100%) indicating a relatively high degree of accuracy in ex ante savings calculations. The only significant exception is motors, where we observe a gross realization rate of 203%. This measure, however, is also the smallest overall contributor to program energy savings during the evaluation period. Overall, the NRPR program achieved a 100% gross realization rate for electric energy.

Table 6. Nonresidential Prescriptive Rebates Program Electric Energy Savings by Measure

Measure Category	Ex Ante Gross Savings (kWh)	Gross Realization Rate	Ex Post Gross Savings (kWh)
T8 LED Linear Replacement	6,664,328	100%	6,664,328
LED Exterior Fixture	4,715,107	100%	4,715,107
LED High Bay Fixture	4,906,944	95%	4,661,596
LED Troffers	2,486,877	100%	2,486,254
LED Surface or Suspended Fixture	821,041	100%	819,894
LED Display Case	180,320	113%	204,046

Measure Category	Ex Ante Gross Savings (kWh)	Gross Realization Rate	Ex Post Gross Savings (kWh)
LED Downlight Fixture	151,596	100%	151,596
LED Low Bay Fixture	37,934	100%	37,934
LED Interior Directional Fixture	65	100%	65
Subtotal – LED Fixture	**19,964,211**	**99%**	**19,740,820**
VFD (Process)	1,717,854	100%	1,717,854
Refrigeration Compressor Tune-Up	736,295	125%	922,593
Occupancy Sensor	516,435	100%	516,273
HVAC Tune-Up	448,949	96%	432,933
LED Standard	431,996	100%	430,374
Ductless Heat Pump	69,715	103%	71,539
Central Air Conditioner	60,172	100%	60,370
Electric Chiller	25,946	100%	25,946
Ground Source Heat Pump (GSHP)	23,032	100%	23,032
LED Exit Sign	8,255	102%	8,395
Heat Pump Water Heater	7,338	100%	7,330
Air Source Heat Pump (ASHP)	7,537	97%	7,294
Desuperheater	6,971	100%	6,966
Refrigerator/Freezer	5,409	107%	5,775
Daylighting Control	5,414	100%	5,414
Packaged Terminal Air Conditioner (PTAC)	2,827	100%	2,827
Motor	24	203%	48
Total	**24,038,379**	**100%**	**23,985,783**

Table 7 presents electric demand savings and realization rates, by measure, for the NRPR program in the evaluation period. Similar to the distribution of energy savings, LED fixtures account for 84% of electric demand savings, followed by occupancy sensor and HVAC tune-up measures, each contributing 5% to program demand savings. Another 5.6% of electric demand savings derive from LED standard, refrigeration compressor tune-up, electric chiller, and central air conditioner measures, while the remaining nine measures account for the remaining 0.4% of total demand savings. Overall, the NRPR program achieved a 99% gross realization rate for electric demand.

Table 7. Nonresidential Prescriptive Rebates Program Electric Demand Savings by Measure

Measure Category	Ex Ante Gross Savings (kW)	Gross Realization Rate	Ex Post Gross Savings (kW)
T8 LED Linear Replacement	2,132.71	100%	2,132.70
LED High Bay Fixture	1,501.75	95%	1,426.66
LED Troffers	858.49	100%	858.81
LED Surface or Suspended Fixture	246.77	100%	247.38
LED Downlight Fixture	51.24	100%	51.23
LED Display Case	41.44	106%	43.76
LED Low Bay Fixture	13.62	100%	13.62
LED Interior Directional Fixture	0.03	99%	0.03

Measure Category	Ex Ante Gross Savings (kW)	Gross Realization Rate	Ex Post Gross Savings (kW)
Subtotal – LED Fixture	**4,846.04**	**99%**	**4,774.20**
Occupancy Sensor	287.69	100%	287.62
HVAC Tune-Up	290.84	92%	267.96
LED Standard	114.61	99%	113.72
Refrigeration Compressor Tune-Up	81.03	125%	101.46
Electric Chiller	61.36	100%	61.36
Central Air Conditioner	38.45	100%	38.59
Ductless Heat Pump	6.79	117%	6.91
Ground Source Heat Pump (GSHP)	4.38	100%	4.38
Daylighting Control	3.77	100%	3.77
Packaged Terminal Air Conditioner (PTAC)	1.67	100%	1.67
LED Exit Sign	0.69	168%	1.16
Air Source Heat Pump (ASHP)	0.49	213%	1.04
Heat Pump Water Heater	0.84	100%	0.84
Refrigerator/Freezer	0.60	107%	0.64
Motor	0.79	2%	0.01
Total	**5,740.04**	**99%**	**5,665.32**

Table 8 presents savings from energy efficiency measures that contribute positive natural gas energy efficiency savings to the NRPR program in addition to the natural gas heating penalties derived from lighting measures installed in natural gas heated buildings supplied through IPL. Natural gas impacts are subtotaled in Table 8 to make clear the performance of natural gas energy efficiency measures and the impact of lighting heating penalties on the NRPR program. During the evaluation period, the NRPR program incented gas furnace and gas boiler measures. Both measures achieved strong realization rates, 98% and 96% respectively. Gas furnace measures contribute 88% to program energy efficiency therm savings. Gas heating penalties totaled -42,051 therms. LED fixtures account for 97% of NRPR heating penalties, in large part due to the volume of measures incented; 93% of all lighting measures incented through the NRPR program.

Table 8. Nonresidential Prescriptive Rebates Program Natural Gas Heating Penalties by Measure

Measure Category	Ex Ante Gross Savings (Therms)	Gross Realization Rate	Ex Post Gross Savings (Therms)
Gas Furnace	29,007	98%	28,310
Gas Boiler	4,153	96%	3,976
Subtotal – Gas Savings Measures	**33,160**	**97%**	**32,286**
T8 LED Linear Replacement	-21,598	100%	-21,598
LED High Bay Fixture	-13,177	95%	-12,518
LED Troffers	-3,221	100%	-3,220
LED Surface or Suspended Fixture	-1,938	100%	-1,938
LED Downlight Fixture	-1,241	104%	-1,241
LED Low Bay Fixture	0	N/A	0
LED Display Case	-2,185	0%	0
Subtotal – LED Fixture Gas Heating Penalty	**-43,359**	**93%**	**-40,516**

Measure Category	Ex Ante Gross Savings (Therms)	Gross Realization Rate	Ex Post Gross Savings (Therms)
LED Standard	-1,427	98%	-1,405
LED Exit Sign	0	N/A	-22
Daylighting Control	-8	100%	-8
Occupancy Sensor	-4	100%	-4
Subtotal – Gas Heating Penalty Measures	**-44,798**	**94%**	**-41,594**
Total	**-11,638**	**83%**	**-9,668**

Overall, the Nonresidential Prescriptive Rebates Program achieved realization rates of 100%, 99%, and 83% (includes all heating penalties) for electric energy, electric demand, and therm savings, respectively.[9,10] The positive realization rate is a result of the ex ante analysis also reporting negative natural gas savings, similarly a result of heating penalties offsetting positive natural gas savings from furnace and boiler measures.

Primary contributors to deviations in realization rates at the measure level are outlined and discussed below.

Electric Measures

- LED Fixture: The gross realization rate for LED fixtures is 99% for electric energy, 99% for electric demand, and 93% for natural gas heating penalties.
  - For LED high bay fixtures, totaling 29% of all LED fixtures (n=8,294), the ex ante analysis applied an in-service rate (ISR) of 100% in contradiction to the IA-TRM, which specifies an ISR of 95% for these lighting types. The ex post analysis applies the 95% ISR from the IA-TRM to all LED high bay fixtures, resulting in decreased electric and demand savings.
  - For LED display case fixtures, totaling 0.2% of all LED fixtures (n=32), the ex ante analysis applied building-specific interactive factors to all refrigerated case lighting measures from the IA-TRM instead of the deemed values for refrigerated cases. The ex post analysis applied the refrigerated case interactive factors (1.29) from the IA-TRM resulting in increased electric savings and decreased demand savings.
- Refrigeration Compressor Tune-Up: The gross realization rate for refrigeration compressor tune-ups is 125% for electric energy and 125% for demand.
  - For 100% of self-contained compressor tune-ups (n=239), the ex ante analysis did not multiply savings by measure quantity. The ex post analysis multiplies savings by the total number of completed tune-ups provided in the program tracking database, increasing electric and demand savings. Realization rates for the self-contained compressor tune-up measure is 1,992% for electric energy and 1,991% for demand. Comparatively, the remote compressor tune-up measure exhibits 100% realization rates for electric energy and demand, and account for 79% of savings in the refrigeration compressor tune-up measure group.
- Standard LEDs: The gross realization rate for standard LEDs is 100% for electric energy, 98% for demand, and 98% for natural gas heating penalties.
  - The reported lumen output for 2% of standard LEDs (n=148) ranged between 60 and 77 lumens, well below the minimum threshold of 250 lumens stated in the IA-TRM baseline wattage tables. Further examination revealed that the reported total lumen output is actually the lumen per watt

[9] The program achieved a 97% gas savings realization rate for measures that result in positive therm savings.
[10] The program achieved a 94% gas savings realization rate for heating penalties from lighting measures.

efficiency of the LED lamp. As a result, ex ante underestimates the baseline wattage for these measures, because higher total lumen output values return a higher baseline wattage from the IA-TRM tables. For these measures, the evaluation team calculated the total lumen output from the efficiency value and lamp wattage, and applied the IA-TRM tables, resulting in a slight increase in electric energy (0.3%), demand (0.5%), and therm (1%) savings.

    - For another 2% of standard LEDs (n=115), excluding those reporting the lumen per watt efficiency in place of total lumens (see previous bullet), the ex ante analysis applied a baseline wattage out of alignment with the baseline wattage lookup table found in IA-TRM "Section 3.4.3 LED Lamp Standard." In all cases, ex ante analysis used the baseline wattage from an adjacent lumen tier. For example, a LED lamp output of 650 lumens results in a baseline wattage assumption of 19.4 Watts, corresponding with the 310-749 lumen tier. However, in this example, ex ante reported a baseline wattage of 29.5 Watts, associated with the lumen tier of 750-1,049 lumens. The ex post analysis applied the baseline wattage from the IA-TRM lookup tables, based on lumens reported in the program tracking data, resulting in a minimal (0.7%) decrease in total electric energy and demand savings, and a 3% decrease in total therm savings for the LED Standard Lamp measure group.

- HVAC Tune-Ups: The gross realization rate for electric HVAC tune-ups is 96% for electric energy and 92% for demand.
    - For 9% of electric HVAC tune-ups (n=46), the evaluation team is unable to determine the source of discrepancy between ex ante and ex post analysis results. All 46 tune-ups are on air-source heat pumps (ASHP) completed at education building types. However, the impact of this discrepancy on the HVAC tune-ups measure is low, accounting for the 4% deviation in electric energy realization rate.
    - For 1% of electric HVAC tune-ups (n=5), the program tracking data does not include information on existing heating equipment, suggesting no previously existing heating equipment. However, the electric tune-up measures are for ASHP and one geothermal heat pump, contradicting the program tracking data. Ex ante analysis does not include heating-side savings for these measures, while the ex post analysis applies baseline assumptions for heating efficiency. This discrepancy results in a slight increase in electric energy savings.
    - For 2% of electric HVAC tune-ups (n=10), the ex ante analysis did not apply coincidence factors in demand savings calculations. The ex post analysis applies coincidence factors from the tables found in IA-TRM "Section 3.3 Heating, Ventilation, and Air Conditioning (HVAC)" that characterize coincidence factors by building type and climate zone. This accounts for all of the discrepancy in electric demand savings.
- Ductless Heat Pumps: The gross realization rate for ductless heat pumps is 103% for electric energy and 102% for demand.
    - For 13% of ductless heat pumps (n=3), the ex ante analysis applied cooling capacities that differ from the capacity recorded in the program tracking database. The evaluation team utilized the *Air Conditioning, Heating, and Refrigeration Institute (AHRI) Directory of Certified Product Performance* to confirm the cooling capacities in the tracking database, resulting in a slightly higher realization rate for electric energy and demand savings.[11]

[11] Air Conditioning, Heating, and Refrigeration Institute (AHRI) Directory of Certified Product Performance is accessible at the following website: https://www.ahridirectory.org/Search/SearchHome

- LED Exit Signs: The gross realization rate for LED exit signs is 102% for electric energy and 168% for demand.
  - For 95% of LED exit signs (n=147), the evaluation team was unable to resolve discrepancies between reported ex ante and ex post demand savings. Demand realization rates are all above 100%, ranging between 101% and 161%, suggesting a discrepancy in the application of demand waste heat factors (WHFd), especially given the limited variables in this parameter.
- Air Source Heat Pumps (ASHP): The gross realization rate for ASHPs is 97% for electric energy and 213% for demand.
  - The evaluation team was unable to identify the discrepancies between reported ex ante and ex post savings estimates for all ASHPs (n=6) without supporting ex ante algorithms and underlining assumptions. ASHPs contribute less than 0.5% to the NRPR ex post energy and demand savings.
- Refrigerators and Freezers: The gross realization rate for refrigerators and freezers is 107% for electric energy and 107% for demand.
  - The evaluation team was unable to identify the discrepancies between reported ex ante and ex post savings estimates for the one rebated refrigerator without supporting ex ante algorithms and underlining assumptions. Refrigerators and freezers contribute less than 0.5% to the NRPR ex post energy and demand savings.
- Motors: The gross realization rates for motors is 203% for electric energy and 2% for electric demand.
  - For the one motor project, the program tracking database indicates an annual runtime of 24 hours. It is probable the database recorded daily operating hours instead of annual hours. Without supporting documentation to defend this assumption, the ex post analysis instead applied defaults from the IA-TRM (2,745 annual hours), resulting in an increase to ex post electric energy savings. This does not impact demand savings since the algorithm for calculating demand does not factor in annual operating hours.
  - The ex ante calculation uses inconsistent units for baseline and efficient motor efficiency values, resulting in a calculation error. The baseline motor efficiencies are recorded as a percentage (e.g., 70%) while installed motor efficiencies are recorded as an integer (e.g., 88). The ex post analysis applies both baseline and installed motor efficiencies as percentages per the IA-TRM reducing ex post electric savings.

Gas Measures

- Gas Furnace: The gross realization rates for gas furnaces is 98% for natural gas.
  - For 22% of gas furnaces (n=47), ex ante applied full load hours for buildings located in Mason City, equal to 1,284 hours. The ex post analysis leveraged information in the program tracking data, including building type and zip code to identify the appropriate full load hours. When program tracking data is unclear, the ex post analysis applied the “Nonresidential Average” building type. This discrepancy resulted in a slight decrease in therm energy savings.
- Gas Boiler: The gross realization rates for gas boilers is 96% for natural gas.
  - For 20% of gas boilers (n=2), the program tracking database does not provide the installed boiler capacity. Ex post analysis calculates an average capacity from the boiler records with known capacities, and applies it to unknown cases, resulting in higher gas savings.

- For 80% of gas boilers (n=8), the evaluation team was unable to resolve discrepancies between reported ex ante and ex post savings estimates. Across these eight records, realization rates range between 88% and 94%.

5. Findings and Recommendations

Based on the results of this evaluation, the evaluation team offers the following key findings and recommendations for the Nonresidential Prescriptive Rebates Program:

- **Key Finding #1**: For LED standard lighting measures, the ex ante analysis applied baseline wattages that differ from those in the IA-TRM, which provides a lookup table for defining baseline wattage based on efficient lamp total lumen output. The evaluation observed two sources of discrepancy in roughly 4% of all LED standard lighting measures. First, the database reports the lumen per watt lamp efficiency in place of the total lumen output. Second, where total lumen output of the installed LED lamp is accurately reported in the database, the baseline wattage is misaligned with the IA-TRM lookup table.
  - **Recommendation**: Use the ENERGY STAR® model number, already tracked in TREES, to confirm the reported lumens is the total lumen output and not the lumen per watt lamp efficiency. Additionally, confirm alignment with the IA-TRM lookup table. Ensuring this information is accurate and in alignment with IA-TRM guidance will improve program realization rate performance.
- **Key Finding #2**: Custom calculations for desuperheater, heat pump water heater, ductless heat pump and electric HVAC tune-up measures, which do not have a dedicated section in the *Iowa Technical Reference Manual* (IA-TRM) *Volume 3: Nonresidential Measures*, leverage past residential studies and assumptions from *Volume 2: Residential Measures* from the IA-TRM.
  - **Recommendation**: Look to other TRMs, notably Illinois and Wisconsin, for more recent studies and assumptions specific to nonresidential applications of the identified measures.
- **Key Finding #3**: Ex ante estimates did not multiply per-unit savings by the total number of completed self-contained refrigeration tune-ups.
  - **Recommendation**: Update ex ante savings calculations for self-contained refrigeration tune-ups to multiply the per-unit savings by the measure quantity recorded in the program tracking database.

Appendix A. Detailed Methodology

The evaluation team relied on the *Iowa Technical Reference Manual* (IA-TRM) for all measures for which the TRM provides savings algorithms and assumptions. Table 9 identifies the referenced section within the IA-TRM to evaluate each measure in the Nonresidential Prescriptive Rebates Program. We applied the IA-TRM V3.0 to measures completed in 2019 and V4.0 to measures completed in 2020.[12] For the five measures supported by the IPL NRPR program that are not included in the IA-TRM, the evaluation team applied a custom-based approach.[13]

Table 9. Nonresidential Prescriptive Rebates Program Measures Evaluated

Measure Category	IA-TRM Section	IA-TRM Section Name
Gas Boiler	Section 3.3.1	Boiler
Gas Furnace	Section 3.3.2	Furnace
Air Source Heat Pump (ASHP)	Section 3.3.4	Heat Pump Systems
Ground Source Heat Pump (GSHP)	Section 3.3.5	Geothermal Source Heat Pump
Central Air Conditioner	Section 3.3.6	Single-Package and Split System Unitary Air Conditioners
Electric Chiller	Section 3.3.7	Electric Chiller
Packaged Terminal Air Conditioner (PTAC)	Section 3.3.8	Package Terminal Air Conditioner (PTAC) and Package Terminal Heat Pump (PTHP)
LED Standard	Section 3.4.3	LED Lamp Standard
LED Fixture	Section 3.4.5	LED Fixtures
LED Fixture (Exterior)	Section 3.4.5	LED Fixtures
Linear LEDs	Section 3.4.5	LED Fixtures
LED Fixture	Section 3.4.8	Metal Halide
LED Exit Sign	Section 3.4.9	Commercial LED Exit Sign
Occupancy Sensor	Section 3.4.12	Occupancy Sensor
Daylighting Control	Section 3.4.13	Daylighting Control
VFD (Process)	Section 3.5.1	Variable Frequency Drives for Process
Motor	Section 3.5.3	Motors
Refrigerator/Freezer	Section 3.6.2	Commercial Solid and Glass Door Refrigerators & Freezers

Table 10 summarizes the measures incented through the NRPR program that are not associated with an IA-TRM section and custom calculations,[14] which leverage IA-TRM sections for specific measure assumptions. Custom calculation methods are discussed in detail in the following section, "Custom Engineering Savings Methods."

[12] The evaluation team used the installed date in the TREES database to determine the appropriate IA-TRM version to apply. Measures installed within the 2019 calendar year use the IA-TRM V3.0, while measures installed in the 2020 calendar year apply the IA-TRM V4.0.

[13] Measures that relied on a custom-based approach include: desuperheaters, refrigeration tune-ups (self-contained and remote), heat pump water heaters, ductless heat pumps, and HVAC tune-ups.

[14] Custom calculation workbooks include the *2019 Non-TRM Program Impact Algorithms_v5* and *2020 Non-TRM Program Impact Algorithms_v1.*

Table 10. Nonresidential Prescriptive Rebates Program Measures Evaluated through Custom Calculations[15]

Measure Category	IA-TRM Section	IA-TRM Section Name
Desuperheater	Non-TRM measure Section 2.4.6 Section 3.2.3	Custom Calculation Workbook Geothermal Source Heat Pump & Gas Hot Water Heater Gas Water Heater
Refrigeration Compressor Tune-Up	Non-TRM measure Section 3.8.7	Custom Calculation Workbook Scroll Refrigeration Compressor
Heat Pump Water Heater	Non-TRM measure Section 2.3.2 Section 3.2.3 Section 3.2.6	Custom Calculation Workbook Heat Pump Water Heaters Gas Water Heater Drainwater Heat Recovery
Ductless Heat Pump	Non-TRM measure Section 3.3.4	Custom Calculation Workbook Heat Pump Systems
HVAC Tune-Up	Non-TRM measure Section 3.3.4 Section 3.3.6 Section 3.3.7	Custom Calculation Workbook Heat Pump Systems Single-Package and Split System Unitary Air Conditioners Electric Chiller

Custom Engineering Savings Methods

The IA-TRM does not include sections detailing measure savings algorithms and assumptions for the following measures offered through the program: desuperheaters, refrigeration tune-ups (self-contained and remote), heat pump water heaters, ductless heat pumps, and electric HVAC tune-ups.

For these measures, the NRPR implementation team developed methods to estimate ex ante savings that either rely on the residential volume of the IA-TRM or other supporting documentation. Combined, these non-TRM measures account for less than 4% of NRPR program energy savings and less than 2% of total program demand savings during the evaluation period.

The evaluation team reviewed documentation detailing these non-TRM savings methods and assumptions. The following sections describe the algorithms and underlining assumptions for each non-TRM measure. Where the evaluation team determined an adjustment to ex ante methods and/or assumptions necessary, we provide a brief discussion on the reason and method for adjusting parameter assumptions. For all other measures, the ex ante savings assumptions and algorithms are deemed accurate for ex post savings.

Desuperheater

The NRPR program completed one desuperheater project that accounts for less than 1% of the program energy savings during the evaluation period. All equations and assumptions are outlined in Table 11 and Table 12.

The ex ante approach for estimating savings from desuperheaters relied on algorithms from the residential volume of the IA-TRM (Section 2.4.6) and saving assumptions from both the residential and nonresidential volumes, where applicable, to inform nonresidential calculations. The evaluation team determined the ex ante algorithms and assumptions are high-quality and defensible, and therefore applied them in ex post calculations.

[15] Assumptions, including effective full load hours and equipment efficiencies, are leveraged from the IA-TRM in support of custom calculations.

Table 11. Algorithms for Desuperheater Measures[16]

Algorithms	
kWh Savings	= ((Tout – Tin) × HotWaterUseGallon × yWater × (1/EFbase) × 1.0 × %DHWDisp) / 3412
kW Savings	= N/A
Therm Savings	= ((Tout – Tin) × HotWaterUseGallon × yWater × (1/EFbase) × 1.0 × %DHWDisp) / 100,000

Table 12. Input Assumptions for Desuperheater Measures[17]

Parameter	Default Value	Description	Source
Tout	140 F	Outlet water temperature in degrees Fahrenheit	IA-TRM Nonresidential Volume Section 3.2 Hot Water
Tin	56.5 F	Inlet water temperature in degrees Fahrenheit	IA-TRM Nonresidential Volume Section 3.2 Hot Water
HotWaterUseGallon	Calculated	Estimated annual hot water consumption in gallons Calculated by multiplying capacity by Consumption/Capacity	IA-TRM Nonresidential Volume Section 3.2 Hot Water
Capacity	Actual; If unknown, assume 50 gallons	Usable capacity of hot water storage tank in gallons	
Consumption/Capacity	Lookup Table	Estimate of consumption per gallon of usable tank capacity by building type	IA-TRM Nonresidential Volume Section 3.2 Hot Water
yWater	8.33 lb/gal	Specific weight capacity of water	
EFbase	0.92 Electric 0.80 Gas	Rated efficiency of baseline water heater	IA-TRM Nonresidential Volume Section 3.2 Hot Water for 50-gallon tank
%DHWDisp	44%	Percentage of total hot water load provided by the ground source heat pump (GSHP)	IA-TRM Residential Volume Section 2.4.6 Geothermal Source Heat Pump

Self-Contained Refrigeration Tune-Up

The NRPR program completed seven refrigeration compressor tune-ups that account for less than 1% of the program electric energy savings and demand savings during the evaluation period. All equations and assumptions are outlined in Table 13 and Table 14.

The ex ante approach for estimating savings from self-contained refrigeration tune-ups relied on algorithms and assumptions from a mix of secondary resources (e.g., Department of Energy [DOE], Public Service Commission [PSC] of Wisconsin) to inform nonresidential impacts. The evaluation team determined the ex ante algorithms and assumptions are high-quality and defensible, and therefore applied them in ex post calculations.

[16] Algorithms and assumptions are sourced from excel documentation files entitled: *2019 Non-TRM Program Impact Algorithms_v5* and *2020 Non-TRM Program Impact Algorithms_v1.*
[17] Ibid.

Table 13. Algorithms for Self-Contained Refrigeration Tune-Up[18]

Algorithms	
kWh Savings	= kWh savings/HP × CompHP
kW Savings	= (kWh savings / HOU) × CF
Therm Savings	= N/A

Table 14. Input Assumptions for Self-Contained Refrigeration Tune-Up[19]

Parameter	Default Value	Description	Source
kWh savings/HP	Cooler 488 kWh/hp Freezer 527 kWh/hp	Annual electric savings per compressor horsepower	
CompHP	Actual	Compressor horsepower	
HOU	8,766	Annual operating hours Assumed continuous operation to maintain refrigerated case temperatures	
CF	96.4%	Summer peak coincidence factor	IA-TRM Section 3.8.7 Scroll Refrigeration Compressor

Remote Refrigeration Tune-Up

The NRPR program completed 35 refrigeration compressor tune-up projects that account for 3% of the program energy savings and less than 2% of the program demand savings during the evaluation period. All equations and assumptions are outlined in Table 15 and Table 16.

The ex ante approach for estimating savings from remote refrigeration tune-ups relied on algorithms and assumptions from a mix of secondary resources, notably DOE and PSC of Wisconsin, to inform nonresidential impacts.[20]

We made one minor adjustment to ex ante assumptions for annual operating hours from 8,760 to 8,766 for consistency with the annual operating hours applied to self-contained refrigeration tune-ups. This adjustment minimally increased savings estimates.

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[18] Algorithms and assumptions are sourced from excel documentation files entitled: *2019 Non-TRM Program Impact Algorithms_v5* and *2020 Non-TRM Program Impact Algorithms_v1.*

[19] Ibid.

[20] Average savings factors (SF) are calculated from two sources: 1) Verisae (2011) "Lessons in Energy & Maintenance Management from One of the Best in the Grocery Business: A New Perspective for Grocery Retail: Case Study of Fresh & Easy Neighborhood Markets" and 2) PSC of Wisconsin. (2010). Focus on Energy Evaluation, Business Programs: Deemed Savings Manual V1.0. Retrievable at: https://www.focusonenergy.com/sites/default/files/bpdeemedsavingsmanuav10_evaluationreport.pdf

Table 15. Algorithms for Remote Refrigeration Tune-Up Measures[21]

Algorithms	
kWh Savings	= (12/EERbase) × Capacity × HOU × DutyCycle × SF
kW Savings	= (kWh savings/HOU) × CF
Therm Savings	= N/A

Table 16. Input Assumptions for Remote Refrigeration Tune-Up Measures[22]

Parameter	Default Value	Description	Source
EERbase	Cooler 10.12 Btu/W Freezer 4.32 Btu/W	Energy efficiency ratio of standard baseline system efficiency	Energy Savings Potential and Research & Development Opportunities for Commercial Refrigeration, U.S. Department of Energy, 2009. Table 3-14
Capacity	Actual	Capacity of refrigeration system in tons	
HOU	8,766	Annual operating hours. Assumed continuous operation to maintain refrigerated case temperatures	
DutyCycle	Cooler 66% Freezer 70%	Compressor duty cycle	Energy Savings Potential and Research & Development Opportunities for Commercial Refrigeration, U.S. Department of Energy, 2009. Table 3-17 and 3-18
SF	6.0%	Assumed percentage of savings from tune-up	Average percentage across several sources including DOE, PSC of Wisconsin, Wisconsin FOE program
CF	96.4%	Summer peak coincidence factor	IA-TRM Section 3.8.7 Scroll Refrigeration Compressor

Heat Pump Water Heater

The NRPR program completed one HPWH project that accounts for less than 1% of program energy and demand savings during the evaluation period. All equations and assumptions are outlined in Table 17 and Table 18.

The ex ante approach for estimating savings from heat pump water heaters relied on algorithms from the residential volume of the IA-TRM (Section 2.3.2). Saving assumptions incorporate a mix of residential and nonresidential assumptions, where applicable, to inform nonresidential calculations. The evaluation team determined the ex ante algorithms and assumptions are high-quality and defensible, and therefore applied them in ex post calculations.

Table 17. Algorithms for Heat Pump Water Heater Measures[23]

Algorithms	
kWh Savings	= ((1/UEFbase – 1/UEFee) × (Tout – Tin) × HotWaterUseGallon × yWater × 1.0) / 3412

[21] Algorithms and assumptions are sourced from excel documentation files entitled: *2019 Non-TRM Program Impact Algorithms_v5* and *2020 Non-TRM Program Impact Algorithms_v1.*
[22] Ibid
[23] Ibid.

Algorithms	
kW Savings	= (kWh savings / HOU) × CF
Therm Savings	= N/A

Table 18. Input Assumptions for Heat Pump Water Heater Measures[24]

Parameter	Default Value	Description	Source
UEFbase	0.92	Rated efficiency of baseline water heater	IA-TRM Nonresidential Volume Section 3.2 Hot Water for 50-gallon tank
UEFee	Actual	Rated efficiency of heat pump water heater	
Tout	140 F	Outlet water temperature in degrees Fahrenheit	IA-TRM Nonresidential Volume Section 3.2 Hot Water
Tin	56.5 F	Inlet water temperature in degrees Fahrenheit	IA-TRM Nonresidential Volume Section 3.2 Hot Water
HotWaterUseGallon	Calculated	Estimated annual hot water consumption in gallons Calculated by multiplying capacity by Consumption/Capacity	IA-TRM Nonresidential Volume Section 3.2 Hot Water
Capacity	Actual Default: 50 gallons	Usable capacity of hot water storage tank in gallons	
Consumption/Capacity	Lookup Table	Estimate of consumption per gallon of usable tank capacity by building type	IA-TRM Nonresidential Volume Section 3.2 Hot Water
yWater	8.33 lb/gal	Specific weight capacity of water	
HOU	8,766	Annual operating hours	
CF	1.0	Summer peak coincidence factor	IA-TRM Section 3.2.6 Drainwater Heat Recovery

Ductless Heat Pump

The NRPR program completed 17 DHP projects that account for less than 1% of program energy and demand savings during the evaluation period. All equations and assumptions are outlined in Table 19 and Table 20.

The IA-TRM includes algorithms and savings assumptions for residential ductless heat pumps. However, in nonresidential applications the VRF systems connect to multiple indoor units through a common set of refrigerant lines instead of a set of refrigerant lines dedicated to each indoor unit. The ex ante savings approach for estimating saving from ductless heat pumps relied on VRF modeling savings estimates from the RTF, a technical advisory committee that develops evaluation standards for the Pacific Northwest. The implementer adjusted the RTF-modeled savings estimates for IPL service territory using the ratio of heating and cooling degree days for Des Moines, IA and Spokane, WA.

[24] Ibid

Table 19. Algorithms for Ductless Heat Pumps (VRF Systems)[25]

Algorithms	
kWh Savings	= ElectricSavings/Ton × Tons
kW Savings	= (Capacity × (1/EERbase – 1/EERee)) / 1,000) × CF
Therm Savings	= N/A

Table 20. Input Assumptions for Ductless Heat Pumps (VRF Systems)[26]

Parameter	Default Value	Description	Source
Electric Savings/Ton	1,839 kWh/Ton	Deemed savings (kWh) per ton of cooling capacity	VRF modeled savings estimate from the Regional Technical Forum (RTF) weather adjusted using HDD and CDD for Des Moines, IA and Spokane, WA
Tons	Actual	Cooling capacity of system in tons 1 ton = 12,000 Btu	
Capacity	Actual	Cooling capacity of system in Btu/hr	
EERbase	Lookup table	Energy efficiency ratio (EER) of baseline equipment	DOE Federal Regulations for Heat Pumps: Table §431.97 varies by baseline equipment type
EERee	Actual	Energy efficiency ratio (EER) of energy efficient equipment	
CF	Lookup Table	Summer peak coincidence factor by building type	IA-TRM Nonresidential Volume Section 3.3 Heating, Ventilation, and Air Conditioning (HVAC)

Electric HVAC Tune-Ups

The NRPR program completed 148 HVAC tune-up projects that account for less than 2% of program electric energy and less than 5% of program demand savings during the evaluation period. HVAC tune-ups are completed on a variety of equipment, including heat pump technologies, central air conditioners, and chillers. The equations and assumptions outlined in Table 21 and Table 22 cover all equipment types.

The ex ante approach for estimating savings from electric HVAC tune-ups utilizes the *International Code Council's 2012 International Energy Conservation Code* for code baseline efficiencies of different equipment and the IA-TRM V3.0 and IA-TRM V4.0 for effective full load hours and coincidence factors, specific to the IPL territory. The evaluation team compared the savings factors cited in the ex ante calculation workbook to other TRMs in the region, specifically Illinois and Wisconsin, finding similar values.[27,28] The evaluation team determined the ex ante algorithms and assumptions are reasonable, and therefore applied them in ex post calculations.

[25] Algorithms and assumptions are sourced from excel documentation files entitled: *2019 Non-TRM Program Impact Algorithms_v5* and *2020 Non-TRM Program Impact Algorithms_v1.*
[26] Ibid
[27] Illinois Statewide Technical Reference Manual for Energy Efficiency Version 7.0, Volume 2: Commercial and Industrial Measures, 4.4.1 Air Conditioner Tune-Up (pp. 140-142) retrievable at: https://s3.amazonaws.com/ilsag/IL-TRM_Effective_010119_v7.0_Vol_2_C_and_I_092818_Final.pdf
[28] Wisconsin Focus on Energy 2019 Technical Reference Manual, Cooling System Tune-Up (pp. 285-288) retrievable at: https://www.focusonenergy.com/sites/default/files/2019_TRM_Final_Update_0.pdf

Table 21. Algorithms for HVAC Tune-Up Measures[29]

Algorithms	
kWh Savings	Unitary air conditioning tune-up (<65,000 BTUH): = (1/SEERbase) × EFLHcool × CAPtons × 12 × SFcool Unitary air conditioning tune-up (≥65,000 BTUH): = (1/IEERbase) × EFLHcool × CAPtons × 12 × SFcool Air source heat pump tune-up; Geothermal heat pump tune-up (<65,000 BTUH): = [(1/SEERbase) × EFLHcool × SFcool) + (1/HSPFbase) × EFLHheat × SFheat)] × CAPtons × 12 Air source heat pump tune-up; Geothermal heat pump tune-up (≥65,000 BTUH): = [(1/IEERbase) × EFLHcool × SFcool) + (1/(COPbase × 3.412) × EFLHheat × SFheat)] × CAPtons × 12 Chiller tune-up (Air cooled): = (12/IPLVbase) × EFLHcool × CAPtons × SFcool Chiller tune-up (Water cooled): = (IPLVbase) × EFLHcool × CAPtons × SFcool
kW Savings	Unitary air conditioning tune-up (<65,000 BTUH): = (CAPtons × (SFcool / EERbase)) × 12 × CF Unitary air conditioning tune-up (≥65,000 BTUH): = (CAPtons × (SFcool / IEERbase)) × 12 × CF Air source heat pump tune-up; Geothermal heat pump tune-up (<65,000 BTUH): = (CAPtons × (SFcool / EERbase)) × 12 × CF Air source heat pump tune-up; Geothermal heat pump tune-up (≥65,000 BTUH): = (CAPtons × (SFcool / IEERbase)) × 12 × CF Chiller tune-up (Air cooled): = (12/FullLoadbase) × CAPtons × SFcool Chiller tune-up (Water cooled): = (FullLoadbase) × CAPtons × SFcool
Therm Savings	All Equipment = N/A

Table 22. Input Assumptions for HVAC Tune-Up Measures[30]

Parameter	Default Value	Description	Source
CAPtons	Actual	Capacity of cooling system in tons	
SEERbase	13	Seasonal Energy Efficiency Ratio of baseline efficiency system	2012 International Energy Conservation Code (IECC)[31]
HSPFbase	8.2	Heating Seasonal Performance Factor of baseline efficiency system	2012 IECC
IEERbase	See Table 23	Integrated energy efficiency Ratio of baseline efficiency system	2012 IECC

[29] Algorithms and assumptions are sourced from excel documentation files entitled: *2019 Non-TRM Program Impact Algorithms_v5* and *2020 Non-TRM Program Impact Algorithms_v1.*
[30] Ibid.
[31] International Code Council (2015). 2012 International Energy Conservation Code (5th Edition). Retrievable at: https://codes.iccsafe.org/content/IECC2012P5

Parameter	Default Value	Description	Source
COPbase	See Table 24	Coefficient of Performance of baseline efficiency system	2012 IECC
EERbase	11.18	Energy Efficiency Ratio of existing cooling system (kBtu/hr-kW)	Calculated from SEERbase[32]
IPLVbase	See Table 25	Integrated Part-Load Value efficiency (in kW/ton or EER) of standard baseline efficiency system	2012 IECC
FullLoadbase	See Table 26	Full-Load efficiency (in kW/ton or EER) of standard baseline efficiency system	2012 IECC
EFLHcool	IA-TRM Lookup table	Equivalent Full Load Hours of cooling	IA-TRM Section 3.3 HVAC
EFLHheat		Equivalent Full Load Hours of heating	
SFcool	7.5% (Unitary air conditioning, ASHP, Geothermal heat pump) 8% (Chiller)	Savings factor for cooling	Cadmus (2005) Energy Savings Impact of Improving the Installation of Residential Central Air Conditioners[33] and California Statewide Commercial Energy Efficiency Potential Study 2002, Volume 1[34]
SFheat	2.3% (ASHP, Geothermal heat pump)	Savings factor for heating	Regional Technical Forum (2005), Analysis of Heat Pump Installation Practices and Performance[35]
CF	IA-TRM Lookup table	Summer System Peak Coincidence Factor	IA-TRM Section 3.3 HVAC

Table 23. Summary of IEERbase Values by Equipment Type and Size

Size (kBTU/hr)	Unitary Air Conditioning	Air Source Heat Pump	Geothermal Heat Pump
≥65 and <135	12.7	12.0	17.1
≥135 and <240	12.2	11.4	
≥240 and <760	11.4	10.4	

Table 24. Summary of COPbase Values by Equipment Type and Size

Size (kBTU/hr)	Air Source Heat Pump	Geothermal Heat Pump
≥65 and <135	3.3	3.6
≥135 and <240	3.2	
≥240 and <760	3.2	

Table 25. Summary of IPLVbase Values by Equipment Type and Size

Chiller Type	Size (Tons)	IPLVBase (EER or kW/Ton)	IPLV Unit
Air Cooled	<150	12.50	EER
	≥150	12.75	EER

32 EER is calculated from the following formula: EER = (-0.02 * SEER^2) + (1.12 * SEER)
33 Cadmus. (2005). Energy Savings Impact of Improving the Installation of Residential Central Air Conditioners.
34 Pacific Gas & Electric. (2002). California Statewide Commercial Sector Energy Efficiency Potential Study (Volume 2), Prepared by XENERGY Inc. Retrievable at: http://www.calmac.org/publications/CA_EEPotV1.pdf
35 Regional Technical Forum. (2005). Analysis of Heat Pump Installation Practices and Performance. Retrievable at: https://library.cee1.org/system/files/library/1938/1123.pdf

Chiller Type	Size (Tons)	IPLVBase (EER or kW/Ton)	IPLV Unit
Water Cooled - Positive Displacement / Reciprocating	<150	0.615	kW/ton
	≥150 and <300	0.580	kW/ton
	≥300	0.540	kW/ton
Water Cooled - Centrifugal	<300	0.596	kW/ton
	≥300 and <600	0.549	kW/ton
	≥600	0.539	kW/ton

Table 26. Summary of FullLoadbase Values by Equipment Type and Size

Chiller Type	Size (Tons)	FullLoadBase (EER or kW/Ton)	FullLoad Unit
Air Cooled	<150	9.562	EER
	≥150	9.562	EER
Water Cooled - Positive Displacement / Reciprocating	<150	0.775	kW/ton
	≥150 and <300	0.680	kW/ton
	≥300	0.620	kW/ton
Water Cooled - Centrifugal	<300	0.634	kW/ton
	≥300 and <600	0.576	kW/ton
	≥600	0.570	kW/ton

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Interstate Power and Light Company

Nonresidential Prescriptive Rebates Impact Evaluation Report

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Opinion Dynamics

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1. Executive Summary

This report presents a summary of the findings and results from the impact evaluation of the 2019-2023 Interstate Power and Light Company (IPL) Nonresidential Prescriptive Rebates (NRPR) program. The NRPR program offers a range of services, including technical resources, appliance recycling, and financial incentives in the form of rebates, to encourage nonresidential customers to purchase high-efficiency electric and natural gas equipment and adopt energy-efficient behaviors. The program features rebates for a range of energy efficiency measures, including lighting; heating, ventilation, and air conditioning (HVAC); refrigeration; and motor measures.

The primary objectives of the impact evaluation were to quantify gross electric and natural gas savings impacts from the program during the evaluation period (April 1, 2019–March 31, 2020) and identify how IPL could improve program implementation and the estimation and tracking of program impacts moving forward.[1]

To complete the impact evaluation, the Opinion Dynamics evaluation team conducted program manager and implementer interviews, a program database review, and an engineering impact analysis. Presented in this report are the methods, findings, and recommendations resulting from the impact evaluation activities.

Table 1 presents NRPR program savings achieved in the evaluation period. The NRPR program achieved ex post gross savings of 23,985,783 kWh, 5,665.32 kW, and -9,668 therms. The 100% and 99% gross realization rates for electric energy and demand savings, respectively, indicate that the achieved, or ex post, savings are very similar to the total ex ante energy savings and demand savings estimated and tracked by the program. The realization rate for gas savings (83%) is inclusive of natural gas efficiency savings (32,286 therms) associated with gas furnace and boiler improvements, and negative heating penalty impacts (-41,954 therms) associated with lighting measures installed in buildings heated with natural gas supplied through IPL.

Table 1. Nonresidential Prescriptive Rebates Program Annual Savings

	Electric Energy Savings (kWh)	Electric Demand Savings (kW)	Gas Savings (Therms)[a]
Ex Ante Gross Savings	24,038,379	5,740.04	-11,638
Gross Realization Rate	100%	99%	83%
Ex Post Gross Savings	23,985,783	5,665.32	-9,668

[a] Ex ante savings include 33,160 therms of natural gas savings offset by -44,798 therms of increased consumption from lighting heating penalties. Ex post savings include 32,286 therms of natural gas savings offset by -41,954 therms from lighting heating penalties.

Based on the results of this evaluation, the evaluation team offers the following key findings and recommendations for the NRPR program moving forward:

- **Key Finding #1**: For LED standard lighting measures, the ex ante analysis applied baseline wattages that differ from those in the *Iowa Technical Reference Manual* (IA-TRM), which provides a lookup table for defining baseline wattage based on efficient lamp total lumen output. The evaluation observed two sources of discrepancy in roughly 4% of all LED standard lighting measures. First, the database reports the lumen per watt lamp efficiency in place of the total lumen output. Second, where total lumen output of the installed LED lamp is accurately reported in the database, the baseline wattage is misaligned with the IA-TRM lookup table.
  - **Recommendation**: Use the ENERGY STAR® model number, already tracked in Tool for Reporting Energy Efficiency Savings (TREES), to confirm the reported lumens is the total lumen output and

[1] The choice of evaluation period is discussed further in Section 2.

not the lumen per watt lamp efficiency. Additionally, confirm alignment with the IA-TRM lookup table. Ensuring this information is accurate and in alignment with IA-TRM guidance will improve program realization rate performance.

- **Key Finding #2**: Custom calculations for desuperheater, heat pump water heater, ductless heat pump and electric HVAC tune-up measures, which do not have a dedicated section in the IA-TRM *Volume 3: Nonresidential Measures*, leverage past residential studies and assumptions from *Volume 2: Residential Measures* from the IA-TRM.
  - **Recommendation**: Look to other TRMs, notably Illinois and Wisconsin, for more recent studies and assumptions specific to nonresidential applications of the identified measures.
- **Key Finding #3**: Ex ante estimates did not multiply per-unit savings by the total number of completed self-contained refrigeration tune-ups.
  - **Recommendation**: Update ex ante savings calculations for self-contained refrigeration tune-ups to multiply the per-unit savings by the measure quantity recorded in the program tracking database.

2. Introduction

Within the following sections, we present the results of the impact evaluation of the NRPR program in IPL's 2019-2023 energy efficiency and demand response portfolio. Across the Nonresidential portfolio, we defined an evaluation period beginning April 1, 2019, and ending March 31, 2020 ("evaluation period") for all programs. We selected this period for impact evaluation to represent one typical program year; IPL's 2019-2023 programs began implementation on April 1, 2019, and the ongoing COVID-19 pandemic is likely to cause nonrepresentative program effects during the 2020 program year. We selected an evaluation period that takes these factors into account yet covers a relatively representative program period lasting one year.

The following sections provide a high-level summary of program implementation, describe program participation in the evaluation period, detail our impact evaluation approach and methods, and report evaluation results, including ex post savings, findings, and recommendations.

2.1 Program Description

The NRPR program encourages nonresidential customers to purchase high-efficiency electric and natural gas equipment and adopt energy-efficient behaviors. The program offers a broad range of services, including technical resources, appliance recycling, and financial incentives in the form of rebates. The program features rebates for a range of energy efficiency measures, including lighting, HVAC, refrigeration, and motor measures. In the evaluation period, the program consisted primarily of lighting measures, motor controls, and tune-ups for HVAC and refrigeration equipment. Although the program is available to all nonresidential customers, the program's focus is to provide simple solutions for the non-managed customer group.[2]

Nonresidential IPL customers who purchase qualifying high-efficiency measures directly from equipment vendors and retailers are eligible for NRPR program rebates. To participate in the program, customers must submit (via mail, fax, or email) a program rebate application with documentation on the equipment purchase and installation to IPL's rebate processing center. Ideally, the vendors would check the program requirements to make sure the customers' equipment qualifies.

The NRPR program third-party implementer, Michaels Energy, handles intakes of all the NRPR forms. Michaels Energy confirms the data in the rebate application forms adhere to program rules, verifies all the documentations and equipment specifications are in order, and approves or rejects the rebates for payment. Participants then receive prescriptive rebates in the form of a check. A separate third-party inspection company, CLEAResult, conducts on-site verification for three percent of projects which include at least one major commercial appliance, HVAC, motor, refrigeration, or lighting measure.

Key Implementation Changes in Evaluation Period

- IPL discontinued most food service measures, tune-ups for boilers and furnaces, insulation, air sealing, water heaters, strip curtains for walk-in refrigerators, and other measures, which were not historically cost effective, at the beginning of the 2019-2023 plan cycle.
- IPL discontinued incentives for participating dealers at the beginning of the 2019-2023 plan cycle.

[2] Managed customers are large usage accounts which are assigned a dedicated key account manager who acts as a liaison between the customer and IPL in many matters, including participation in energy efficiency and demand response programs.

2.2 Participation Summary

Table 2 summarizes NRPR program participation during the evaluation period. The NRPR program supported 1,438 projects in the evaluation period with ex ante energy savings of 24,038,379 kWh, 5,740.04 kW of demand savings, and -11,638 therms of natural gas savings.

Table 2. Nonresidential Prescriptive Rebates Program Participation Summary

Measure Category/Track	Total Projects[a]	Ex Ante Gross Savings		
		kWh	kW	Therms
T8 LED Linear Replacement	454	6,664,328	2,132.71	-21,598
LED High Bay Fixture	182	4,906,944	1,501.75	-13,177
LED Exterior Fixture	270	4,715,107	0.00	0
LED Troffers	200	2,486,877	858.49	-3,221
LED Surface or Suspended Fixture	89	821,041	246.77	-1,938
LED Display Case	9	180,320	41.44	-2,185
LED Downlight Fixture	41	151,596	51.24	-1,241
LED Low Bay Fixture	9	37,934	13.62	0
LED Interior Directional Fixture	1	65	0.03	0
Subtotal – LED Fixture	**973**	**19,964,211**	**4,846.04**	**-43,359**
VFD (Process)	5	1,717,854	0.00	0
Refrigeration Compressor Tune-Up	7	736,295	81.03	0
Occupancy Sensor	30	516,435	287.69	-4
HVAC Tune-Up	148	448,949	290.84	0
LED Standard	51	431,996	114.61	-1,427
Ductless Heat Pump	17	69,715	6.79	0
Central Air Conditioner	88	60,172	38.45	0
Electric Chiller	1	25,946	61.36	0
Ground Source Heat Pump (GSHP)	3	23,032	4.38	0
LED Exit Sign	14	8,255	0.69	0
Air Source Heat Pump (ASHP)	6	7,537	0.49	0
Heat Pump Water Heater	1	7,338	0.84	0
Desuperheater	1	6,971	0.00	0
Daylighting Control	5	5,414	3.77	-8
Refrigerator/Freezer	1	5,409	0.60	0
Packaged Terminal Air Conditioner (PTAC)	2	2,827	1.67	0
Motor	1	24	0.79	0
Gas Furnace	120	0	0.00	29,007
Gas Boiler	7	0	0.00	4,153
Total	**1,438**	**24,038,379**	**5,740.04**	**-11,638**[b]

[a] Measure category project counts do not sum to the total projects because a project can contain more than one measure category.
[b] The total natural gas impacts includes 33,160 therm in energy savings and -44,798 therm in heating penalties.

LED Fixture measures account for 83% of the ex ante electric energy and 84% of demand savings. Natural gas savings from high-efficiency furnace and boiler equipment are offset by the heating penalties of high-efficiency lighting equipment.

Table 3 compares NRPR program participation from the most recent evaluation in 2014 against the participation during the current evaluation period.

Table 3. Comparison to 2014 Nonresidential Prescriptive Rebates Program Participation Summary

Measure Category/Track	2014 Ex Ante Gross Savings			Evaluation Period Ex Ante Gross Savings		
	kWh	kW	Therms	kWh	kW	Therms
Lighting-LED	3,174,710	527	N/A[a]	20,404,461	4,961.35	-44,786
VFDs	14,002,139	1,328	0	1,717,854	0	0
Other[b]	2,922,413	649	49,209	1,394,215	487.23	4,153
Lighting Controls	1,336,963	247	N/A[a]	521,849	291.46	-12
Furnaces	N/A	N/A	58,707	0	0	29,007
Lighting-T5/T8[c]	3,541,938	673	N/A[a]	0	0	0
Insulation[c]	N/A	N/A	283,001	0	0	0
Total	**24,978,163**	**3,424**	**390,917**	**24,038,379**	**5,740.04**	**- 11,638**

[a] Heating penalties are not reported in the 2014 report, but are included in the evaluation period program tracking data. Total natural gas savings in the evaluation period, less heating penalties, is 33,160 therms.

[b] In 2014, “Other” measures are defined as “low-impact” measures, without great insight to the specific measures. In the evaluation period, this category includes mostly HVAC measures with refrigeration and motors.

[c] The program discontinued insulation and fluorescent lighting measures at the beginning of the 2019-2023 plan cycle.

The total program ex ante electric energy savings from the current evaluation period are comparable with the total energy savings reported in 2014.[3] However, the source of energy savings differs significantly between program years. In 2014, variable frequency drive (VFD) measures contributed the greatest portion of ex ante electric energy (56%) and demand (39%) to overall program savings. Those proportions are contrasted in the current evaluation year where VFDs contributed 7% to electric energy and zero to demand savings. Lighting measures, including controls, were the second largest contributor in the 2014 program with 32% of the electric energy and 42% of electric demand savings. While the NRPR program discontinued fluorescent lighting measures (e.g., linear, high bay), it expanded its LED offerings with the addition of linear LEDs and LED exit signs such that lighting measures, including controls, account for 93% of electric energy and 95% of demand savings in the evaluation period.

Finally, in 2014, 72% of ex ante therm savings were from insulation measures, which were discontinued at the beginning of the 2019-2023 plan cycle. The remaining 13% of ex ante therm savings in 2014 derived from gas furnace measures. In the current evaluation period, natural gas measures, namely gas furnace and boiler measures, contribute 87% and 13% to positive, i.e., excluding heating penalties, ex ante therm savings, respectively. The notable difference between 2014 and the current evaluation period is the inclusion of natural gas heating penalties associated with high-efficiency lighting and lighting control improvements reported in the current evaluation but omitted in 2014.[4] Heating penalties (-44,798 therms) more than offset the positive ex ante savings from furnace and boiler measures resulting in the net negative therm savings.

[3] IPL Energy Efficiency Programs 2014 Nonresidential Prescriptive Rebate Program Evaluation (March 2016).
[4] The 2014 evaluation report recommended IPL apply heating penalties moving forward. Ibid, Attachment B, page 13.

3. Impact Evaluation Approach and Methods

The evaluation team developed ex post estimates of the gross electric energy, electric demand, and natural gas impacts from the NRPR program. Impact evaluation activities, outlined in Table 4, included verification of program tracking data and verification of engineering calculations as part of estimating program savings.

Table 4. Impact Evaluation Activities

Evaluation Activity	Details
Program Manager & Implementer Interviews	▪ Interviewed program and implementation staff to gather staff perspectives on the performance of the program and to highlight any key areas where insight is needed from evaluation.
Program Database Review	▪ Reviewed program tracking system to ensure that data required for the evaluation are being collected and data are complete.
Impact Analysis	▪ Reviewed project documentation and calculations to account for analytical errors, incorrect assumptions, etc. ▪ Verified that ex ante savings use correct IA-TRM values and algorithms. ▪ Developed ex post savings using IA-TRM values and algorithms and any updated evaluation-estimated parameters.

Program Manager & Implementer Interviews

To support our evaluation, we conducted interviews with program and implementation staff to cover program performance and other topics relevant to our impact and process research objectives. We completed two interviews: one with IPL staff covering all Nonresidential Programs and one with Michaels Energy staff specific to the NRPR and Custom Solutions programs. While these interviews were predominantly process-focused, they also allow us to explore ongoing efforts of program administrators and implementers, providing insight and context to the impact evaluation results.

We conducted the interview with IPL staff on October 15, 2020 and with Michaels Energy staff on November 3, 2020. We recorded and transcribed both interviews.

Program Database Review

The evaluation team reviewed the program tracking database for the evaluation period to identify any database inconsistencies, such as duplicate records or misalignments between the IA-TRM and the data tracked in the TREES program database. The team first compared the total savings claimed between April 1, 2019 through December 31, 2019 within the TREES tracking database against the 2019 reported ex ante savings. The team found that savings totals aligned between the two sources and verified that the TREES database includes all completed projects through the program.[5] The evaluation team compared fields populated in the TREES database against the required parameters necessary for calculating savings from the IA-TRM.

Based on the database review findings, the evaluation team requested and received additional measure-level data where necessary. When unavailable, we applied IA-TRM default assumptions to calculate engineering ex post savings.

[5] Interstate Power and Light Co. (IPL) an Alliant Energy Company. (May 1, 2020). ANNUAL REPORT for 2019 Energy Efficiency Plan. Docket number EEP-2018-0003. Retrievable at: https://wcc.efs.iowa.gov/cs/groups/external/documents/docket/mday/mdi4/~edisp/2028335.pdf

From the database review, we determined that a population-level engineering analysis was possible, eliminating the need to conduct desk reviews on a sample of projects and extrapolate the results of those reviews to the population of projects and measures. Population-level analysis is only possible when high-quality, comprehensive, and complete data are available at the measure level. From our review, the TREES database met those criteria.

Impact Analysis

The evaluation team conducted an engineering analysis on the entire program population to estimate ex post gross impacts for each measure in the NRPR program tracking database. We relied on savings algorithms from the IA-TRM and measure-specific program tracking data, and we used default assumptions when measure-specific characteristics were not available in the program tracking database. Since the evaluation period includes projects in two different program years, the projects completed in 2019 relied on IA-TRM V3.0 while those completed in 2020 relied on IA-TRM V4.0. Based on discussions with IPL and Michaels Energy, we used the “date_installed” field in the program tracking database to determine which IA-TRM version to apply.[6]

Five program measures were not documented in either version of the non-residential IA-TRM. For these five measures, the evaluation team used either the residential volume of the IA-TRM or a custom approach.[7] These measures include:

- **Desuperheaters:** Relied on residential volume of IA-TRM to inform nonresidential calculations
- **Refrigeration Tune-ups (Self-Contained and Remote):** Relied on a mix of secondary resources (e.g., Department of Energy [DOE], Public Service Commission [PSC] of Wisconsin)
- **Heat Pump Water Heaters (HPWH):** Relied on residential volume of IA-TRM to inform nonresidential calculations
- **Ductless Heat Pumps:** Relied on Variable Refrigerator Flow (VRF) modeling savings estimates from the Regional Technical Forum (RTF) weather adjusted using ratio of heating and cooling degree days for Des Moines, IA and Spokane, WA.
- **HVAC Tune-Ups**: Relied on the International Code Council’s 2012 International Energy Conservation Codes for baseline efficiencies of different equipment and the IA-TRM V3.0 and IA-TRM V4.0 for effective full load hours and coincidence factors.[8]

The evaluation team reviewed ex ante savings calculations and assumptions for the measures listed above. We made one minor adjustment to annual operating hours for remote refrigeration tune-ups (from 8,760 to 8,766 for consistency with the annual operating hours applied for self-contained refrigeration tune-ups). See Appendix A for detailed methods for program measures that deviate from the IA-TRM.

[6] A measure’s installation date in the TREES database determines the appropriate IA-TRM version to apply. Measures installed within the 2019 calendar year use the IA-TRM V3.0, while measures installed in the 2020 calendar year apply the IA-TRM V4.0

[7] For 2019 program reporting year, documentation provided as excel file entitled: *2019 Non-TRM Program Impact Algorithms_v5.* For 2020, excel file entitled: *2020 Non-TRM Program Impact Algorithms_v1.*

[8] International Code Council (2015). 2012 International Energy Conservation *Code* (5th Edition). Retrievable at: https://codes.iccsafe.org/content/IECC2012P5

4. Results

4.1 Program Savings Summary

Table 5 presents ex post gross NRPR savings achieved in the evaluation period. The NRPR program achieved ex post gross savings of 23,985,783 kWh, 5,665.32 kW, and -9,668 therms. Natural gas therms savings include heating penalties associated with lighting measures. Excluding heating penalties, the NRPR program achieved 32,286 therms of savings, all coming from HVAC measures.

Table 5. Nonresidential Prescriptive Rebates Program Annual Savings

	Electric Energy Savings (kWh)	Electric Demand Savings (kW)	Gas Savings (Therms)[a]
Ex Ante Gross Savings	24,038,379	5,740.04	-11,638
Gross Realization Rate	100%	99%	83%
Ex Post Gross Savings	23,985,783	5,665.32	-9,668

[a] Ex ante savings include positive 33,160 therms of natural gas savings offset by -44,798 therms from lighting heating penalties. Ex post savings include 32,286 therms of natural gas savings offset by -41,954 therms from lighting heating penalties.

4.2 Program Savings Details

The NRPR program incentivizes a variety of measures across lighting, refrigeration, HVAC, and motor end-uses. Lighting measures, including LEDs, controls, and exit signs, account for the majority (86%) of the program's total ex post gross electric energy savings. Gas furnaces and gas boilers contribute 88% and 12%, respectively, to the program's total positive (i.e., excludes heating penalties) ex post gross gas savings. The tables below present measure-level electric energy, demand, and gas savings followed by a discussion of key drivers of discrepancies between reported ex ante gross savings and ex post gross savings.

Table 6 presents electric energy realization rates, by measure, for the NRPR program in the evaluation period. LED fixtures, which include a range of LEDs such as linear, high bay and display case lamps, represent the top energy saving measure category, accounting for 82% of program electric energy savings followed by VFDs, contributing 7% to program savings. The remaining 16 measures make up the remaining 11% of program electric energy savings.

Most measures exhibit strong realization rates (close to 100%) indicating a relatively high degree of accuracy in ex ante savings calculations. The only significant exception is motors, where we observe a gross realization rate of 203%. This measure, however, is also the smallest overall contributor to program energy savings during the evaluation period. Overall, the NRPR program achieved a 100% gross realization rate for electric energy.

Table 6. Nonresidential Prescriptive Rebates Program Electric Energy Savings by Measure

Measure Category	Ex Ante Gross Savings (kWh)	Gross Realization Rate	Ex Post Gross Savings (kWh)
T8 LED Linear Replacement	6,664,328	100%	6,664,328
LED Exterior Fixture	4,715,107	100%	4,715,107
LED High Bay Fixture	4,906,944	95%	4,661,596
LED Troffers	2,486,877	100%	2,486,254
LED Surface or Suspended Fixture	821,041	100%	819,894
LED Display Case	180,320	113%	204,046

Measure Category	Ex Ante Gross Savings (kWh)	Gross Realization Rate	Ex Post Gross Savings (kWh)
LED Downlight Fixture	151,596	100%	151,596
LED Low Bay Fixture	37,934	100%	37,934
LED Interior Directional Fixture	65	100%	65
Subtotal – LED Fixture	**19,964,211**	**99%**	**19,740,820**
VFD (Process)	1,717,854	100%	1,717,854
Refrigeration Compressor Tune-Up	736,295	125%	922,593
Occupancy Sensor	516,435	100%	516,273
HVAC Tune-Up	448,949	96%	432,933
LED Standard	431,996	100%	430,374
Ductless Heat Pump	69,715	103%	71,539
Central Air Conditioner	60,172	100%	60,370
Electric Chiller	25,946	100%	25,946
Ground Source Heat Pump (GSHP)	23,032	100%	23,032
LED Exit Sign	8,255	102%	8,395
Heat Pump Water Heater	7,338	100%	7,330
Air Source Heat Pump (ASHP)	7,537	97%	7,294
Desuperheater	6,971	100%	6,966
Refrigerator/Freezer	5,409	107%	5,775
Daylighting Control	5,414	100%	5,414
Packaged Terminal Air Conditioner (PTAC)	2,827	100%	2,827
Motor	24	203%	48
Total	**24,038,379**	**100%**	**23,985,783**

Table 7 presents electric demand savings and realization rates, by measure, for the NRPR program in the evaluation period. Similar to the distribution of energy savings, LED fixtures account for 84% of electric demand savings, followed by occupancy sensor and HVAC tune-up measures, each contributing 5% to program demand savings. Another 5.6% of electric demand savings derive from LED standard, refrigeration compressor tune-up, electric chiller, and central air conditioner measures, while the remaining nine measures account for the remaining 0.4% of total demand savings. Overall, the NRPR program achieved a 99% gross realization rate for electric demand.

Table 7. Nonresidential Prescriptive Rebates Program Electric Demand Savings by Measure

Measure Category	Ex Ante Gross Savings (kW)	Gross Realization Rate	Ex Post Gross Savings (kW)
T8 LED Linear Replacement	2,132.71	100%	2,132.70
LED High Bay Fixture	1,501.75	95%	1,426.66
LED Troffers	858.49	100%	858.81
LED Surface or Suspended Fixture	246.77	100%	247.38
LED Downlight Fixture	51.24	100%	51.23
LED Display Case	41.44	106%	43.76
LED Low Bay Fixture	13.62	100%	13.62
LED Interior Directional Fixture	0.03	99%	0.03

Measure Category	Ex Ante Gross Savings (kW)	Gross Realization Rate	Ex Post Gross Savings (kW)
Subtotal – LED Fixture	**4,846.04**	**99%**	**4,774.20**
Occupancy Sensor	287.69	100%	287.62
HVAC Tune-Up	290.84	92%	267.96
LED Standard	114.61	99%	113.72
Refrigeration Compressor Tune-Up	81.03	125%	101.46
Electric Chiller	61.36	100%	61.36
Central Air Conditioner	38.45	100%	38.59
Ductless Heat Pump	6.79	117%	6.91
Ground Source Heat Pump (GSHP)	4.38	100%	4.38
Daylighting Control	3.77	100%	3.77
Packaged Terminal Air Conditioner (PTAC)	1.67	100%	1.67
LED Exit Sign	0.69	168%	1.16
Air Source Heat Pump (ASHP)	0.49	213%	1.04
Heat Pump Water Heater	0.84	100%	0.84
Refrigerator/Freezer	0.60	107%	0.64
Motor	0.79	2%	0.01
Total	**5,740.04**	**99%**	**5,665.32**

Table 8 presents savings from energy efficiency measures that contribute positive natural gas energy efficiency savings to the NRPR program in addition to the natural gas heating penalties derived from lighting measures installed in natural gas heated buildings supplied through IPL. Natural gas impacts are subtotaled in Table 8 to make clear the performance of natural gas energy efficiency measures and the impact of lighting heating penalties on the NRPR program. During the evaluation period, the NRPR program incented gas furnace and gas boiler measures. Both measures achieved strong realization rates, 98% and 96% respectively. Gas furnace measures contribute 88% to program energy efficiency therm savings. Gas heating penalties totaled -42,051 therms. LED fixtures account for 97% of NRPR heating penalties, in large part due to the volume of measures incented; 93% of all lighting measures incented through the NRPR program.

Table 8. Nonresidential Prescriptive Rebates Program Natural Gas Heating Penalties by Measure

Measure Category	Ex Ante Gross Savings (Therms)	Gross Realization Rate	Ex Post Gross Savings (Therms)
Gas Furnace	29,007	98%	28,310
Gas Boiler	4,153	96%	3,976
Subtotal – Gas Savings Measures	**33,160**	**97%**	**32,286**
T8 LED Linear Replacement	-21,598	100%	-21,598
LED High Bay Fixture	-13,177	95%	-12,518
LED Troffers	-3,221	100%	-3,220
LED Surface or Suspended Fixture	-1,938	100%	-1,938
LED Downlight Fixture	-1,241	104%	-1,241
LED Low Bay Fixture	0	N/A	0
LED Display Case	-2,185	0%	0
Subtotal – LED Fixture Gas Heating Penalty	**-43,359**	**93%**	**-40,516**

Measure Category	Ex Ante Gross Savings (Therms)	Gross Realization Rate	Ex Post Gross Savings (Therms)
LED Standard	-1,427	98%	-1,405
LED Exit Sign	0	N/A	-22
Daylighting Control	-8	100%	-8
Occupancy Sensor	-4	100%	-4
Subtotal – Gas Heating Penalty Measures	**-44,798**	**94%**	**-41,594**
Total	**-11,638**	**83%**	**-9,668**

Overall, the Nonresidential Prescriptive Rebates Program achieved realization rates of 100%, 99%, and 83% (includes all heating penalties) for electric energy, electric demand, and therm savings, respectively.[9,10] The positive realization rate is a result of the ex ante analysis also reporting negative natural gas savings, similarly a result of heating penalties offsetting positive natural gas savings from furnace and boiler measures.

Primary contributors to deviations in realization rates at the measure level are outlined and discussed below.

Electric Measures

- LED Fixture: The gross realization rate for LED fixtures is 99% for electric energy, 99% for electric demand, and 93% for natural gas heating penalties.
  - For LED high bay fixtures, totaling 29% of all LED fixtures (n=8,294), the ex ante analysis applied an in-service rate (ISR) of 100% in contradiction to the IA-TRM, which specifies an ISR of 95% for these lighting types. The ex post analysis applies the 95% ISR from the IA-TRM to all LED high bay fixtures, resulting in decreased electric and demand savings.
  - For LED display case fixtures, totaling 0.2% of all LED fixtures (n=32), the ex ante analysis applied building-specific interactive factors to all refrigerated case lighting measures from the IA-TRM instead of the deemed values for refrigerated cases. The ex post analysis applied the refrigerated case interactive factors (1.29) from the IA-TRM resulting in increased electric savings and decreased demand savings.
- Refrigeration Compressor Tune-Up: The gross realization rate for refrigeration compressor tune-ups is 125% for electric energy and 125% for demand.
  - For 100% of self-contained compressor tune-ups (n=239), the ex ante analysis did not multiply savings by measure quantity. The ex post analysis multiplies savings by the total number of completed tune-ups provided in the program tracking database, increasing electric and demand savings. Realization rates for the self-contained compressor tune-up measure is 1,992% for electric energy and 1,991% for demand. Comparatively, the remote compressor tune-up measure exhibits 100% realization rates for electric energy and demand, and account for 79% of savings in the refrigeration compressor tune-up measure group.
- Standard LEDs: The gross realization rate for standard LEDs is 100% for electric energy, 98% for demand, and 98% for natural gas heating penalties.
  - The reported lumen output for 2% of standard LEDs (n=148) ranged between 60 and 77 lumens, well below the minimum threshold of 250 lumens stated in the IA-TRM baseline wattage tables. Further examination revealed that the reported total lumen output is actually the lumen per watt

[9] The program achieved a 97% gas savings realization rate for measures that result in positive therm savings.
[10] The program achieved a 94% gas savings realization rate for heating penalties from lighting measures.

efficiency of the LED lamp. As a result, ex ante underestimates the baseline wattage for these measures, because higher total lumen output values return a higher baseline wattage from the IA-TRM tables. For these measures, the evaluation team calculated the total lumen output from the efficiency value and lamp wattage, and applied the IA-TRM tables, resulting in a slight increase in electric energy (0.3%), demand (0.5%), and therm (1%) savings.

    - For another 2% of standard LEDs (n=115), excluding those reporting the lumen per watt efficiency in place of total lumens (see previous bullet), the ex ante analysis applied a baseline wattage out of alignment with the baseline wattage lookup table found in IA-TRM "Section 3.4.3 LED Lamp Standard." In all cases, ex ante analysis used the baseline wattage from an adjacent lumen tier. For example, a LED lamp output of 650 lumens results in a baseline wattage assumption of 19.4 Watts, corresponding with the 310-749 lumen tier. However, in this example, ex ante reported a baseline wattage of 29.5 Watts, associated with the lumen tier of 750-1,049 lumens. The ex post analysis applied the baseline wattage from the IA-TRM lookup tables, based on lumens reported in the program tracking data, resulting in a minimal (0.7%) decrease in total electric energy and demand savings, and a 3% decrease in total therm savings for the LED Standard Lamp measure group.

- HVAC Tune-Ups: The gross realization rate for electric HVAC tune-ups is 96% for electric energy and 92% for demand.
    - For 9% of electric HVAC tune-ups (n=46), the evaluation team is unable to determine the source of discrepancy between ex ante and ex post analysis results. All 46 tune-ups are on air-source heat pumps (ASHP) completed at education building types. However, the impact of this discrepancy on the HVAC tune-ups measure is low, accounting for the 4% deviation in electric energy realization rate.
    - For 1% of electric HVAC tune-ups (n=5), the program tracking data does not include information on existing heating equipment, suggesting no previously existing heating equipment. However, the electric tune-up measures are for ASHP and one geothermal heat pump, contradicting the program tracking data. Ex ante analysis does not include heating-side savings for these measures, while the ex post analysis applies baseline assumptions for heating efficiency. This discrepancy results in a slight increase in electric energy savings.
    - For 2% of electric HVAC tune-ups (n=10), the ex ante analysis did not apply coincidence factors in demand savings calculations. The ex post analysis applies coincidence factors from the tables found in IA-TRM "Section 3.3 Heating, Ventilation, and Air Conditioning (HVAC)" that characterize coincidence factors by building type and climate zone. This accounts for all of the discrepancy in electric demand savings.
- Ductless Heat Pumps: The gross realization rate for ductless heat pumps is 103% for electric energy and 102% for demand.
    - For 13% of ductless heat pumps (n=3), the ex ante analysis applied cooling capacities that differ from the capacity recorded in the program tracking database. The evaluation team utilized the *Air Conditioning, Heating, and Refrigeration Institute (AHRI) Directory of Certified Product Performance* to confirm the cooling capacities in the tracking database, resulting in a slightly higher realization rate for electric energy and demand savings.[11]

[11] Air Conditioning, Heating, and Refrigeration Institute (AHRI) Directory of Certified Product Performance is accessible at the following website: https://www.ahridirectory.org/Search/SearchHome

- LED Exit Signs: The gross realization rate for LED exit signs is 102% for electric energy and 168% for demand.
  - For 95% of LED exit signs (n=147), the evaluation team was unable to resolve discrepancies between reported ex ante and ex post demand savings. Demand realization rates are all above 100%, ranging between 101% and 161%, suggesting a discrepancy in the application of demand waste heat factors (WHFd), especially given the limited variables in this parameter.
- Air Source Heat Pumps (ASHP): The gross realization rate for ASHPs is 97% for electric energy and 213% for demand.
  - The evaluation team was unable to identify the discrepancies between reported ex ante and ex post savings estimates for all ASHPs (n=6) without supporting ex ante algorithms and underlining assumptions. ASHPs contribute less than 0.5% to the NRPR ex post energy and demand savings.
- Refrigerators and Freezers: The gross realization rate for refrigerators and freezers is 107% for electric energy and 107% for demand.
  - The evaluation team was unable to identify the discrepancies between reported ex ante and ex post savings estimates for the one rebated refrigerator without supporting ex ante algorithms and underlining assumptions. Refrigerators and freezers contribute less than 0.5% to the NRPR ex post energy and demand savings.
- Motors: The gross realization rates for motors is 203% for electric energy and 2% for electric demand.
  - For the one motor project, the program tracking database indicates an annual runtime of 24 hours. It is probable the database recorded daily operating hours instead of annual hours. Without supporting documentation to defend this assumption, the ex post analysis instead applied defaults from the IA-TRM (2,745 annual hours), resulting in an increase to ex post electric energy savings. This does not impact demand savings since the algorithm for calculating demand does not factor in annual operating hours.
  - The ex ante calculation uses inconsistent units for baseline and efficient motor efficiency values, resulting in a calculation error. The baseline motor efficiencies are recorded as a percentage (e.g., 70%) while installed motor efficiencies are recorded as an integer (e.g., 88). The ex post analysis applies both baseline and installed motor efficiencies as percentages per the IA-TRM reducing ex post electric savings.

Gas Measures

- Gas Furnace: The gross realization rates for gas furnaces is 98% for natural gas.
  - For 22% of gas furnaces (n=47), ex ante applied full load hours for buildings located in Mason City, equal to 1,284 hours. The ex post analysis leveraged information in the program tracking data, including building type and zip code to identify the appropriate full load hours. When program tracking data is unclear, the ex post analysis applied the “Nonresidential Average” building type. This discrepancy resulted in a slight decrease in therm energy savings.
- Gas Boiler: The gross realization rates for gas boilers is 96% for natural gas.
  - For 20% of gas boilers (n=2), the program tracking database does not provide the installed boiler capacity. Ex post analysis calculates an average capacity from the boiler records with known capacities, and applies it to unknown cases, resulting in higher gas savings.

- For 80% of gas boilers (n=8), the evaluation team was unable to resolve discrepancies between reported ex ante and ex post savings estimates. Across these eight records, realization rates range between 88% and 94%.

5. Findings and Recommendations

Based on the results of this evaluation, the evaluation team offers the following key findings and recommendations for the Nonresidential Prescriptive Rebates Program:

- **Key Finding #1**: For LED standard lighting measures, the ex ante analysis applied baseline wattages that differ from those in the IA-TRM, which provides a lookup table for defining baseline wattage based on efficient lamp total lumen output. The evaluation observed two sources of discrepancy in roughly 4% of all LED standard lighting measures. First, the database reports the lumen per watt lamp efficiency in place of the total lumen output. Second, where total lumen output of the installed LED lamp is accurately reported in the database, the baseline wattage is misaligned with the IA-TRM lookup table.
  - **Recommendation**: Use the ENERGY STAR® model number, already tracked in TREES, to confirm the reported lumens is the total lumen output and not the lumen per watt lamp efficiency. Additionally, confirm alignment with the IA-TRM lookup table. Ensuring this information is accurate and in alignment with IA-TRM guidance will improve program realization rate performance.
- **Key Finding #2**: Custom calculations for desuperheater, heat pump water heater, ductless heat pump and electric HVAC tune-up measures, which do not have a dedicated section in the *Iowa Technical Reference Manual* (IA-TRM) *Volume 3: Nonresidential Measures*, leverage past residential studies and assumptions from *Volume 2: Residential Measures* from the IA-TRM.
  - **Recommendation**: Look to other TRMs, notably Illinois and Wisconsin, for more recent studies and assumptions specific to nonresidential applications of the identified measures.
- **Key Finding #3**: Ex ante estimates did not multiply per-unit savings by the total number of completed self-contained refrigeration tune-ups.
  - **Recommendation**: Update ex ante savings calculations for self-contained refrigeration tune-ups to multiply the per-unit savings by the measure quantity recorded in the program tracking database.

Appendix A. Detailed Methodology

The evaluation team relied on the *Iowa Technical Reference Manual* (IA-TRM) for all measures for which the TRM provides savings algorithms and assumptions. Table 9 identifies the referenced section within the IA-TRM to evaluate each measure in the Nonresidential Prescriptive Rebates Program. We applied the IA-TRM V3.0 to measures completed in 2019 and V4.0 to measures completed in 2020.[12] For the five measures supported by the IPL NRPR program that are not included in the IA-TRM, the evaluation team applied a custom-based approach.[13]

Table 9. Nonresidential Prescriptive Rebates Program Measures Evaluated

Measure Category	IA-TRM Section	IA-TRM Section Name
Gas Boiler	Section 3.3.1	Boiler
Gas Furnace	Section 3.3.2	Furnace
Air Source Heat Pump (ASHP)	Section 3.3.4	Heat Pump Systems
Ground Source Heat Pump (GSHP)	Section 3.3.5	Geothermal Source Heat Pump
Central Air Conditioner	Section 3.3.6	Single-Package and Split System Unitary Air Conditioners
Electric Chiller	Section 3.3.7	Electric Chiller
Packaged Terminal Air Conditioner (PTAC)	Section 3.3.8	Package Terminal Air Conditioner (PTAC) and Package Terminal Heat Pump (PTHP)
LED Standard	Section 3.4.3	LED Lamp Standard
LED Fixture	Section 3.4.5	LED Fixtures
LED Fixture (Exterior)	Section 3.4.5	LED Fixtures
Linear LEDs	Section 3.4.5	LED Fixtures
LED Fixture	Section 3.4.8	Metal Halide
LED Exit Sign	Section 3.4.9	Commercial LED Exit Sign
Occupancy Sensor	Section 3.4.12	Occupancy Sensor
Daylighting Control	Section 3.4.13	Daylighting Control
VFD (Process)	Section 3.5.1	Variable Frequency Drives for Process
Motor	Section 3.5.3	Motors
Refrigerator/Freezer	Section 3.6.2	Commercial Solid and Glass Door Refrigerators & Freezers

Table 10 summarizes the measures incented through the NRPR program that are not associated with an IA-TRM section and custom calculations,[14] which leverage IA-TRM sections for specific measure assumptions. Custom calculation methods are discussed in detail in the following section, "Custom Engineering Savings Methods."

[12] The evaluation team used the installed date in the TREES database to determine the appropriate IA-TRM version to apply. Measures installed within the 2019 calendar year use the IA-TRM V3.0, while measures installed in the 2020 calendar year apply the IA-TRM V4.0.

[13] Measures that relied on a custom-based approach include: desuperheaters, refrigeration tune-ups (self-contained and remote), heat pump water heaters, ductless heat pumps, and HVAC tune-ups.

[14] Custom calculation workbooks include the *2019 Non-TRM Program Impact Algorithms_v5* and *2020 Non-TRM Program Impact Algorithms_v1.*

Table 10. Nonresidential Prescriptive Rebates Program Measures Evaluated through Custom Calculations[15]

Measure Category	IA-TRM Section	IA-TRM Section Name
Desuperheater	Non-TRM measure Section 2.4.6 Section 3.2.3	Custom Calculation Workbook Geothermal Source Heat Pump & Gas Hot Water Heater Gas Water Heater
Refrigeration Compressor Tune-Up	Non-TRM measure Section 3.8.7	Custom Calculation Workbook Scroll Refrigeration Compressor
Heat Pump Water Heater	Non-TRM measure Section 2.3.2 Section 3.2.3 Section 3.2.6	Custom Calculation Workbook Heat Pump Water Heaters Gas Water Heater Drainwater Heat Recovery
Ductless Heat Pump	Non-TRM measure Section 3.3.4	Custom Calculation Workbook Heat Pump Systems
HVAC Tune-Up	Non-TRM measure Section 3.3.4 Section 3.3.6 Section 3.3.7	Custom Calculation Workbook Heat Pump Systems Single-Package and Split System Unitary Air Conditioners Electric Chiller

Custom Engineering Savings Methods

The IA-TRM does not include sections detailing measure savings algorithms and assumptions for the following measures offered through the program: desuperheaters, refrigeration tune-ups (self-contained and remote), heat pump water heaters, ductless heat pumps, and electric HVAC tune-ups.

For these measures, the NRPR implementation team developed methods to estimate ex ante savings that either rely on the residential volume of the IA-TRM or other supporting documentation. Combined, these non-TRM measures account for less than 4% of NRPR program energy savings and less than 2% of total program demand savings during the evaluation period.

The evaluation team reviewed documentation detailing these non-TRM savings methods and assumptions. The following sections describe the algorithms and underlining assumptions for each non-TRM measure. Where the evaluation team determined an adjustment to ex ante methods and/or assumptions necessary, we provide a brief discussion on the reason and method for adjusting parameter assumptions. For all other measures, the ex ante savings assumptions and algorithms are deemed accurate for ex post savings.

Desuperheater

The NRPR program completed one desuperheater project that accounts for less than 1% of the program energy savings during the evaluation period. All equations and assumptions are outlined in Table 11 and Table 12.

The ex ante approach for estimating savings from desuperheaters relied on algorithms from the residential volume of the IA-TRM (Section 2.4.6) and saving assumptions from both the residential and nonresidential volumes, where applicable, to inform nonresidential calculations. The evaluation team determined the ex ante algorithms and assumptions are high-quality and defensible, and therefore applied them in ex post calculations.

[15] Assumptions, including effective full load hours and equipment efficiencies, are leveraged from the IA-TRM in support of custom calculations.

Table 11. Algorithms for Desuperheater Measures[16]

Algorithms	
kWh Savings	= ((Tout – Tin) × HotWaterUseGallon × yWater × (1/EFbase) × 1.0 × %DHWDisp) / 3412
kW Savings	= N/A
Therm Savings	= ((Tout – Tin) × HotWaterUseGallon × yWater × (1/EFbase) × 1.0 × %DHWDisp) / 100,000

Table 12. Input Assumptions for Desuperheater Measures[17]

Parameter	Default Value	Description	Source
Tout	140 F	Outlet water temperature in degrees Fahrenheit	IA-TRM Nonresidential Volume Section 3.2 Hot Water
Tin	56.5 F	Inlet water temperature in degrees Fahrenheit	IA-TRM Nonresidential Volume Section 3.2 Hot Water
HotWaterUseGallon	Calculated	Estimated annual hot water consumption in gallons Calculated by multiplying capacity by Consumption/Capacity	IA-TRM Nonresidential Volume Section 3.2 Hot Water
Capacity	Actual; If unknown, assume 50 gallons	Usable capacity of hot water storage tank in gallons	
Consumption/Capacity	Lookup Table	Estimate of consumption per gallon of usable tank capacity by building type	IA-TRM Nonresidential Volume Section 3.2 Hot Water
yWater	8.33 lb/gal	Specific weight capacity of water	
EFbase	0.92 Electric 0.80 Gas	Rated efficiency of baseline water heater	IA-TRM Nonresidential Volume Section 3.2 Hot Water for 50-gallon tank
%DHWDisp	44%	Percentage of total hot water load provided by the ground source heat pump (GSHP)	IA-TRM Residential Volume Section 2.4.6 Geothermal Source Heat Pump

Self-Contained Refrigeration Tune-Up

The NRPR program completed seven refrigeration compressor tune-ups that account for less than 1% of the program electric energy savings and demand savings during the evaluation period. All equations and assumptions are outlined in Table 13 and Table 14.

The ex ante approach for estimating savings from self-contained refrigeration tune-ups relied on algorithms and assumptions from a mix of secondary resources (e.g., Department of Energy [DOE], Public Service Commission [PSC] of Wisconsin) to inform nonresidential impacts. The evaluation team determined the ex ante algorithms and assumptions are high-quality and defensible, and therefore applied them in ex post calculations.

[16] Algorithms and assumptions are sourced from excel documentation files entitled: *2019 Non-TRM Program Impact Algorithms_v5* and *2020 Non-TRM Program Impact Algorithms_v1.*
[17] Ibid.

Table 13. Algorithms for Self-Contained Refrigeration Tune-Up[18]

Algorithms	
kWh Savings	= kWh savings/HP × CompHP
kW Savings	= (kWh savings / HOU) × CF
Therm Savings	= N/A

Table 14. Input Assumptions for Self-Contained Refrigeration Tune-Up[19]

Parameter	Default Value	Description	Source
kWh savings/HP	Cooler 488 kWh/hp Freezer 527 kWh/hp	Annual electric savings per compressor horsepower	
CompHP	Actual	Compressor horsepower	
HOU	8,766	Annual operating hours Assumed continuous operation to maintain refrigerated case temperatures	
CF	96.4%	Summer peak coincidence factor	IA-TRM Section 3.8.7 Scroll Refrigeration Compressor

Remote Refrigeration Tune-Up

The NRPR program completed 35 refrigeration compressor tune-up projects that account for 3% of the program energy savings and less than 2% of the program demand savings during the evaluation period. All equations and assumptions are outlined in Table 15 and Table 16.

The ex ante approach for estimating savings from remote refrigeration tune-ups relied on algorithms and assumptions from a mix of secondary resources, notably DOE and PSC of Wisconsin, to inform nonresidential impacts.[20]

We made one minor adjustment to ex ante assumptions for annual operating hours from 8,760 to 8,766 for consistency with the annual operating hours applied to self-contained refrigeration tune-ups. This adjustment minimally increased savings estimates.

[18] Algorithms and assumptions are sourced from excel documentation files entitled: *2019 Non-TRM Program Impact Algorithms_v5* and *2020 Non-TRM Program Impact Algorithms_v1.*
[19] Ibid.
[20] Average savings factors (SF) are calculated from two sources: 1) Verisae (2011) "Lessons in Energy & Maintenance Management from One of the Best in the Grocery Business: A New Perspective for Grocery Retail: Case Study of Fresh & Easy Neighborhood Markets" and 2) PSC of Wisconsin. (2010). Focus on Energy Evaluation, Business Programs: Deemed Savings Manual V1.0. Retrievable at: https://www.focusonenergy.com/sites/default/files/bpdeemedsavingsmanuav10_evaluationreport.pdf

Table 15. Algorithms for Remote Refrigeration Tune-Up Measures[21]

Algorithms	
kWh Savings	= (12/EERbase) × Capacity × HOU × DutyCycle × SF
kW Savings	= (kWh savings/HOU) × CF
Therm Savings	= N/A

Table 16. Input Assumptions for Remote Refrigeration Tune-Up Measures[22]

Parameter	Default Value	Description	Source
EERbase	Cooler 10.12 Btu/W Freezer 4.32 Btu/W	Energy efficiency ratio of standard baseline system efficiency	Energy Savings Potential and Research & Development Opportunities for Commercial Refrigeration, U.S. Department of Energy, 2009. Table 3-14
Capacity	Actual	Capacity of refrigeration system in tons	
HOU	8,766	Annual operating hours. Assumed continuous operation to maintain refrigerated case temperatures	
DutyCycle	Cooler 66% Freezer 70%	Compressor duty cycle	Energy Savings Potential and Research & Development Opportunities for Commercial Refrigeration, U.S. Department of Energy, 2009. Table 3-17 and 3-18
SF	6.0%	Assumed percentage of savings from tune-up	Average percentage across several sources including DOE, PSC of Wisconsin, Wisconsin FOE program
CF	96.4%	Summer peak coincidence factor	IA-TRM Section 3.8.7 Scroll Refrigeration Compressor

Heat Pump Water Heater

The NRPR program completed one HPWH project that accounts for less than 1% of program energy and demand savings during the evaluation period. All equations and assumptions are outlined in Table 17 and Table 18.

The ex ante approach for estimating savings from heat pump water heaters relied on algorithms from the residential volume of the IA-TRM (Section 2.3.2). Saving assumptions incorporate a mix of residential and nonresidential assumptions, where applicable, to inform nonresidential calculations. The evaluation team determined the ex ante algorithms and assumptions are high-quality and defensible, and therefore applied them in ex post calculations.

Table 17. Algorithms for Heat Pump Water Heater Measures[23]

Algorithms	
kWh Savings	= ((1/UEFbase – 1/UEFee) × (Tout – Tin) × HotWaterUseGallon × yWater × 1.0) / 3412

[21] Algorithms and assumptions are sourced from excel documentation files entitled: *2019 Non-TRM Program Impact Algorithms_v5* and *2020 Non-TRM Program Impact Algorithms_v1.*
[22] Ibid
[23] Ibid.

Algorithms	
kW Savings	= (kWh savings / HOU) × CF
Therm Savings	= N/A

Table 18. Input Assumptions for Heat Pump Water Heater Measures[24]

Parameter	Default Value	Description	Source
UEFbase	0.92	Rated efficiency of baseline water heater	IA-TRM Nonresidential Volume Section 3.2 Hot Water for 50-gallon tank
UEFee	Actual	Rated efficiency of heat pump water heater	
Tout	140 F	Outlet water temperature in degrees Fahrenheit	IA-TRM Nonresidential Volume Section 3.2 Hot Water
Tin	56.5 F	Inlet water temperature in degrees Fahrenheit	IA-TRM Nonresidential Volume Section 3.2 Hot Water
HotWaterUseGallon	Calculated	Estimated annual hot water consumption in gallons Calculated by multiplying capacity by Consumption/Capacity	IA-TRM Nonresidential Volume Section 3.2 Hot Water
Capacity	Actual Default: 50 gallons	Usable capacity of hot water storage tank in gallons	
Consumption/Capacity	Lookup Table	Estimate of consumption per gallon of usable tank capacity by building type	IA-TRM Nonresidential Volume Section 3.2 Hot Water
yWater	8.33 lb/gal	Specific weight capacity of water	
HOU	8,766	Annual operating hours	
CF	1.0	Summer peak coincidence factor	IA-TRM Section 3.2.6 Drainwater Heat Recovery

Ductless Heat Pump

The NRPR program completed 17 DHP projects that account for less than 1% of program energy and demand savings during the evaluation period. All equations and assumptions are outlined in Table 19 and Table 20.

The IA-TRM includes algorithms and savings assumptions for residential ductless heat pumps. However, in nonresidential applications the VRF systems connect to multiple indoor units through a common set of refrigerant lines instead of a set of refrigerant lines dedicated to each indoor unit. The ex ante savings approach for estimating saving from ductless heat pumps relied on VRF modeling savings estimates from the RTF, a technical advisory committee that develops evaluation standards for the Pacific Northwest. The implementer adjusted the RTF-modeled savings estimates for IPL service territory using the ratio of heating and cooling degree days for Des Moines, IA and Spokane, WA.

[24] Ibid

Table 19. Algorithms for Ductless Heat Pumps (VRF Systems)[25]

Algorithms	
kWh Savings	= ElectricSavings/Ton × Tons
kW Savings	= (Capacity × (1/EERbase – 1/EERee)) / 1,000) × CF
Therm Savings	= N/A

Table 20. Input Assumptions for Ductless Heat Pumps (VRF Systems)[26]

Parameter	Default Value	Description	Source
Electric Savings/Ton	1,839 kWh/Ton	Deemed savings (kWh) per ton of cooling capacity	VRF modeled savings estimate from the Regional Technical Forum (RTF) weather adjusted using HDD and CDD for Des Moines, IA and Spokane, WA
Tons	Actual	Cooling capacity of system in tons 1 ton = 12,000 Btu	
Capacity	Actual	Cooling capacity of system in Btu/hr	
EERbase	Lookup table	Energy efficiency ratio (EER) of baseline equipment	DOE Federal Regulations for Heat Pumps: Table §431.97 varies by baseline equipment type
EERee	Actual	Energy efficiency ratio (EER) of energy efficient equipment	
CF	Lookup Table	Summer peak coincidence factor by building type	IA-TRM Nonresidential Volume Section 3.3 Heating, Ventilation, and Air Conditioning (HVAC)

Electric HVAC Tune-Ups

The NRPR program completed 148 HVAC tune-up projects that account for less than 2% of program electric energy and less than 5% of program demand savings during the evaluation period. HVAC tune-ups are completed on a variety of equipment, including heat pump technologies, central air conditioners, and chillers. The equations and assumptions outlined in Table 21 and Table 22 cover all equipment types.

The ex ante approach for estimating savings from electric HVAC tune-ups utilizes the *International Code Council's 2012 International Energy Conservation Code* for code baseline efficiencies of different equipment and the IA-TRM V3.0 and IA-TRM V4.0 for effective full load hours and coincidence factors, specific to the IPL territory. The evaluation team compared the savings factors cited in the ex ante calculation workbook to other TRMs in the region, specifically Illinois and Wisconsin, finding similar values.[27,28] The evaluation team determined the ex ante algorithms and assumptions are reasonable, and therefore applied them in ex post calculations.

[25] Algorithms and assumptions are sourced from excel documentation files entitled: *2019 Non-TRM Program Impact Algorithms_v5* and *2020 Non-TRM Program Impact Algorithms_v1.*
[26] Ibid
[27] Illinois Statewide Technical Reference Manual for Energy Efficiency Version 7.0, Volume 2: Commercial and Industrial Measures, 4.4.1 Air Conditioner Tune-Up (pp. 140-142) retrievable at: https://s3.amazonaws.com/ilsag/IL-TRM_Effective_010119_v7.0_Vol_2_C_and_I_092818_Final.pdf
[28] Wisconsin Focus on Energy 2019 Technical Reference Manual, Cooling System Tune-Up (pp. 285-288) retrievable at: https://www.focusonenergy.com/sites/default/files/2019_TRM_Final_Update_0.pdf

Table 21. Algorithms for HVAC Tune-Up Measures[29]

Algorithms	
kWh Savings	Unitary air conditioning tune-up (<65,000 BTUH): = (1/SEERbase) × EFLHcool × CAPtons × 12 × SFcool Unitary air conditioning tune-up (≥65,000 BTUH): = (1/IEERbase) × EFLHcool × CAPtons × 12 × SFcool Air source heat pump tune-up; Geothermal heat pump tune-up (<65,000 BTUH): = [(1/SEERbase) × EFLHcool × SFcool) + (1/HSPFbase) × EFLHheat × SFheat)] × CAPtons × 12 Air source heat pump tune-up; Geothermal heat pump tune-up (≥65,000 BTUH): = [(1/IEERbase) × EFLHcool × SFcool) + (1/(COPbase × 3.412) × EFLHheat × SFheat)] × CAPtons × 12 Chiller tune-up (Air cooled): = (12/IPLVbase) × EFLHcool × CAPtons × SFcool Chiller tune-up (Water cooled): = (IPLVbase) × EFLHcool × CAPtons × SFcool
kW Savings	Unitary air conditioning tune-up (<65,000 BTUH): = (CAPtons × (SFcool / EERbase)) × 12 × CF Unitary air conditioning tune-up (≥65,000 BTUH): = (CAPtons × (SFcool / IEERbase)) × 12 × CF Air source heat pump tune-up; Geothermal heat pump tune-up (<65,000 BTUH): = (CAPtons × (SFcool / EERbase)) × 12 × CF Air source heat pump tune-up; Geothermal heat pump tune-up (≥65,000 BTUH): = (CAPtons × (SFcool / IEERbase)) × 12 × CF Chiller tune-up (Air cooled): = (12/FullLoadbase) × CAPtons × SFcool Chiller tune-up (Water cooled): = (FullLoadbase) × CAPtons × SFcool
Therm Savings	All Equipment = N/A

Table 22. Input Assumptions for HVAC Tune-Up Measures[30]

Parameter	Default Value	Description	Source
CAPtons	Actual	Capacity of cooling system in tons	
SEERbase	13	Seasonal Energy Efficiency Ratio of baseline efficiency system	2012 International Energy Conservation Code (IECC)[31]
HSPFbase	8.2	Heating Seasonal Performance Factor of baseline efficiency system	2012 IECC
IEERbase	See Table 23	Integrated energy efficiency Ratio of baseline efficiency system	2012 IECC

[29] Algorithms and assumptions are sourced from excel documentation files entitled: *2019 Non-TRM Program Impact Algorithms_v5* and *2020 Non-TRM Program Impact Algorithms_v1.*
[30] Ibid.
[31] International Code Council (2015). 2012 International Energy Conservation Code (5th Edition). Retrievable at: https://codes.iccsafe.org/content/IECC2012P5

Parameter	Default Value	Description	Source
COPbase	See Table 24	Coefficient of Performance of baseline efficiency system	2012 IECC
EERbase	11.18	Energy Efficiency Ratio of existing cooling system (kBtu/hr-kW)	Calculated from SEERbase[32]
IPLVbase	See Table 25	Integrated Part-Load Value efficiency (in kW/ton or EER) of standard baseline efficiency system	2012 IECC
FullLoadbase	See Table 26	Full-Load efficiency (in kW/ton or EER) of standard baseline efficiency system	2012 IECC
EFLHcool	IA-TRM Lookup table	Equivalent Full Load Hours of cooling	IA-TRM Section 3.3 HVAC
EFLHheat		Equivalent Full Load Hours of heating	
SFcool	7.5% (Unitary air conditioning, ASHP, Geothermal heat pump) 8% (Chiller)	Savings factor for cooling	Cadmus (2005) Energy Savings Impact of Improving the Installation of Residential Central Air Conditioners[33] and California Statewide Commercial Energy Efficiency Potential Study 2002, Volume 1[34]
SFheat	2.3% (ASHP, Geothermal heat pump)	Savings factor for heating	Regional Technical Forum (2005), Analysis of Heat Pump Installation Practices and Performance[35]
CF	IA-TRM Lookup table	Summer System Peak Coincidence Factor	IA-TRM Section 3.3 HVAC

Table 23. Summary of IEERbase Values by Equipment Type and Size

Size (kBTU/hr)	Unitary Air Conditioning	Air Source Heat Pump	Geothermal Heat Pump
≥65 and <135	12.7	12.0	17.1
≥135 and <240	12.2	11.4	
≥240 and <760	11.4	10.4	

Table 24. Summary of COPbase Values by Equipment Type and Size

Size (kBTU/hr)	Air Source Heat Pump	Geothermal Heat Pump
≥65 and <135	3.3	3.6
≥135 and <240	3.2	
≥240 and <760	3.2	

Table 25. Summary of IPLVbase Values by Equipment Type and Size

Chiller Type	Size (Tons)	IPLVBase (EER or kW/Ton)	IPLV Unit
Air Cooled	<150	12.50	EER
	≥150	12.75	EER

32 EER is calculated from the following formula: EER = $(-0.02 * SEER^2) + (1.12 * SEER)$

33 Cadmus. (2005). Energy Savings Impact of Improving the Installation of Residential Central Air Conditioners.

34 Pacific Gas & Electric. (2002). California Statewide Commercial Sector Energy Efficiency Potential Study (Volume 2), Prepared by XENERGY Inc. Retrievable at: http://www.calmac.org/publications/CA_EEPotV1.pdf

35 Regional Technical Forum. (2005). Analysis of Heat Pump Installation Practices and Performance. Retrievable at: https://library.cee1.org/system/files/library/1938/1123.pdf

Chiller Type	Size (Tons)	IPLVBase (EER or kW/Ton)	IPLV Unit
Water Cooled - Positive Displacement / Reciprocating	<150	0.615	kW/ton
	≥150 and <300	0.580	kW/ton
	≥300	0.540	kW/ton
Water Cooled - Centrifugal	<300	0.596	kW/ton
	≥300 and <600	0.549	kW/ton
	≥600	0.539	kW/ton

Table 26. Summary of FullLoadbase Values by Equipment Type and Size

Chiller Type	Size (Tons)	FullLoadBase (EER or kW/Ton)	FullLoad Unit
Air Cooled	<150	9.562	EER
	≥150	9.562	EER
Water Cooled - Positive Displacement / Reciprocating	<150	0.775	kW/ton
	≥150 and <300	0.680	kW/ton
	≥300	0.620	kW/ton
Water Cooled - Centrifugal	<300	0.634	kW/ton
	≥300 and <600	0.576	kW/ton
	≥600	0.570	kW/ton

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Opinion Dynamics

IPL APPLIANCE CYCLING PROGRAM

2020 Participant Survey Results

February 2, 2021

Survey Methods

- **Target Population:** 2020 participants in Appliance Cycling (AC) Program
- **Number of Completes:** 1,237
- **Survey Dates:** December 2–15, 2020
- **Outreach Mode:** E-mail
- **Survey Mode:** Online
- **Response Rate:** 14%
    - Emailed 10,754 customers survey invitations. Sent two email reminders to encourage participation.
        - 14% of customers who started the survey (225 out of 1,634) said they were not participants in the Appliance Cycling (AC) Program and were thanked for their time and had their surveys terminated
        - 718 emails were undeliverable

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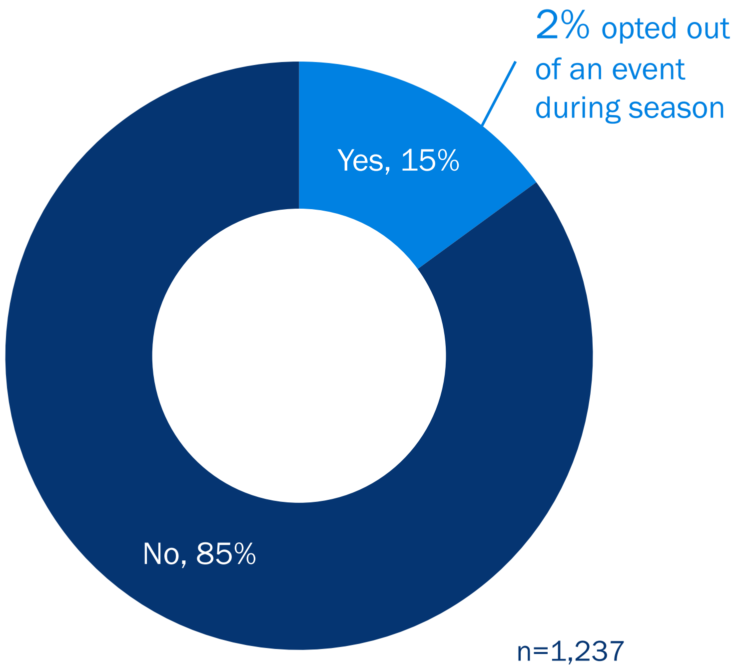
Experience with Appliance Cycling Program

Awareness of Cycling Events

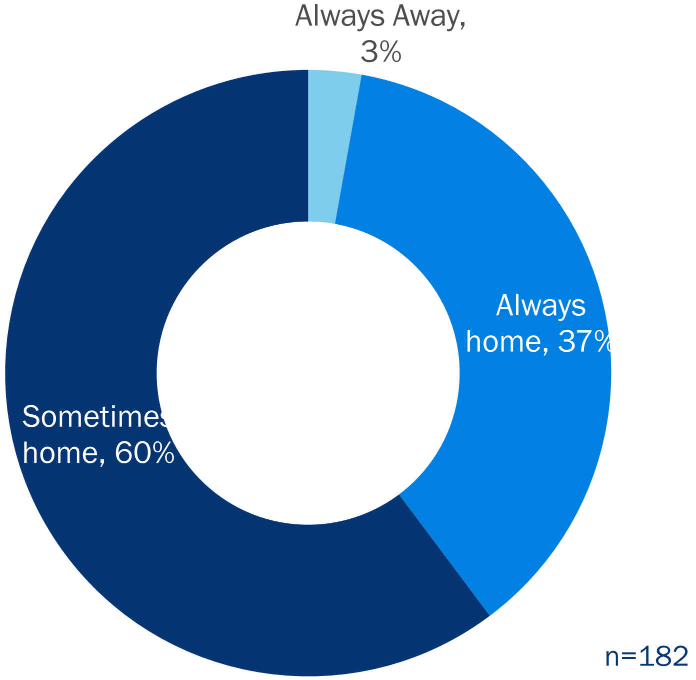
- Even though 70% of participants reported spending a "great deal" or "somewhat more" time at home during the summer of 2020, most were not aware of cycling events when they were occurring.

- Of the customers who noticed the cycling events, nearly all were home at least sometimes during the events. Slightly over one-third were always home. The number at home may have been higher in 2020 due to the COVID pandemic.

Q1: Were you generally aware when cycling events were occurring this past summer?



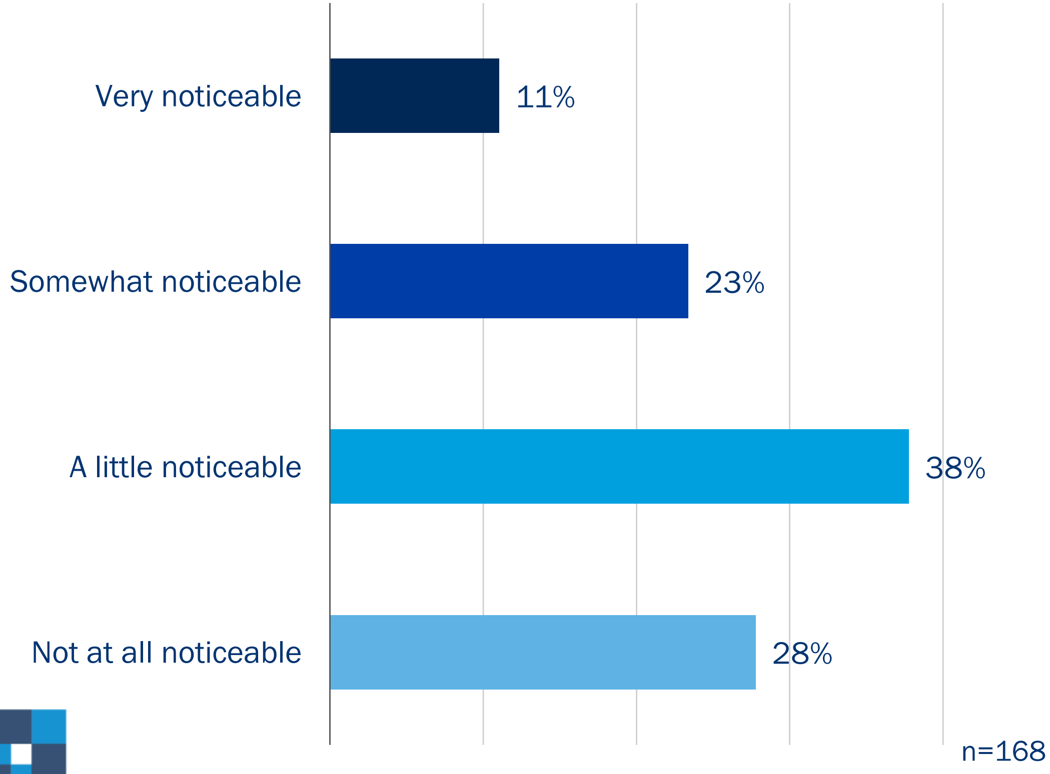
Q2 & Q3: Where were you or your family members during the events?



Change in Temperature and Comfort During Cycling Events

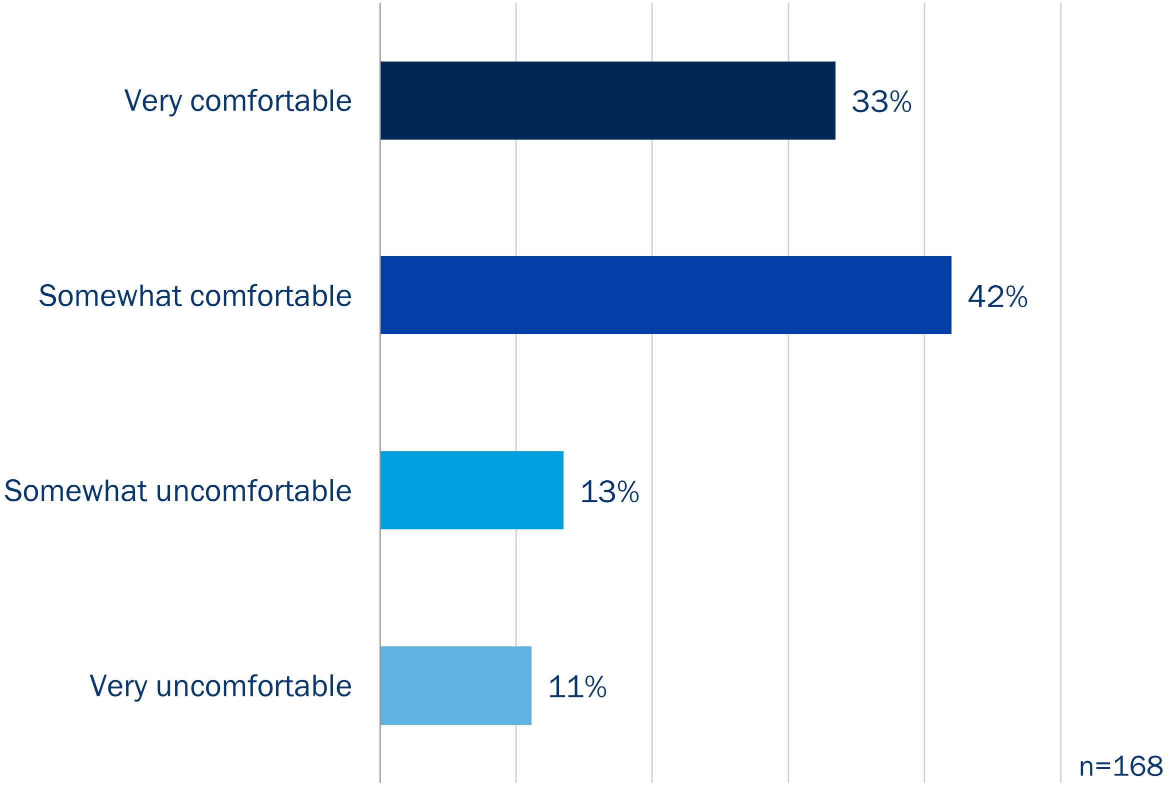
- A majority of participants who were aware of events said the indoor temperature change was not very noticeable

Q4: When cycling events were occurring, how noticeable was the change in indoor temperature from your set temperature?



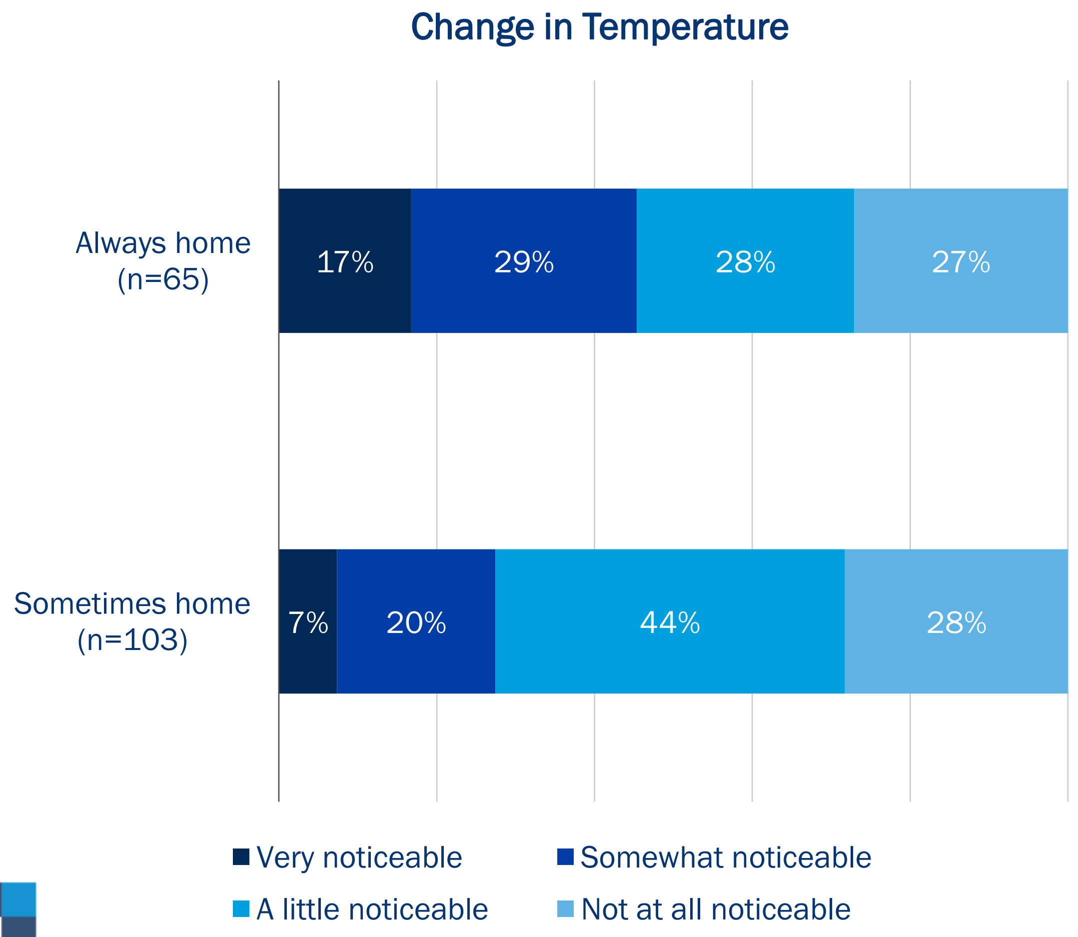
- Most participants found their home temperature to be comfortable during events

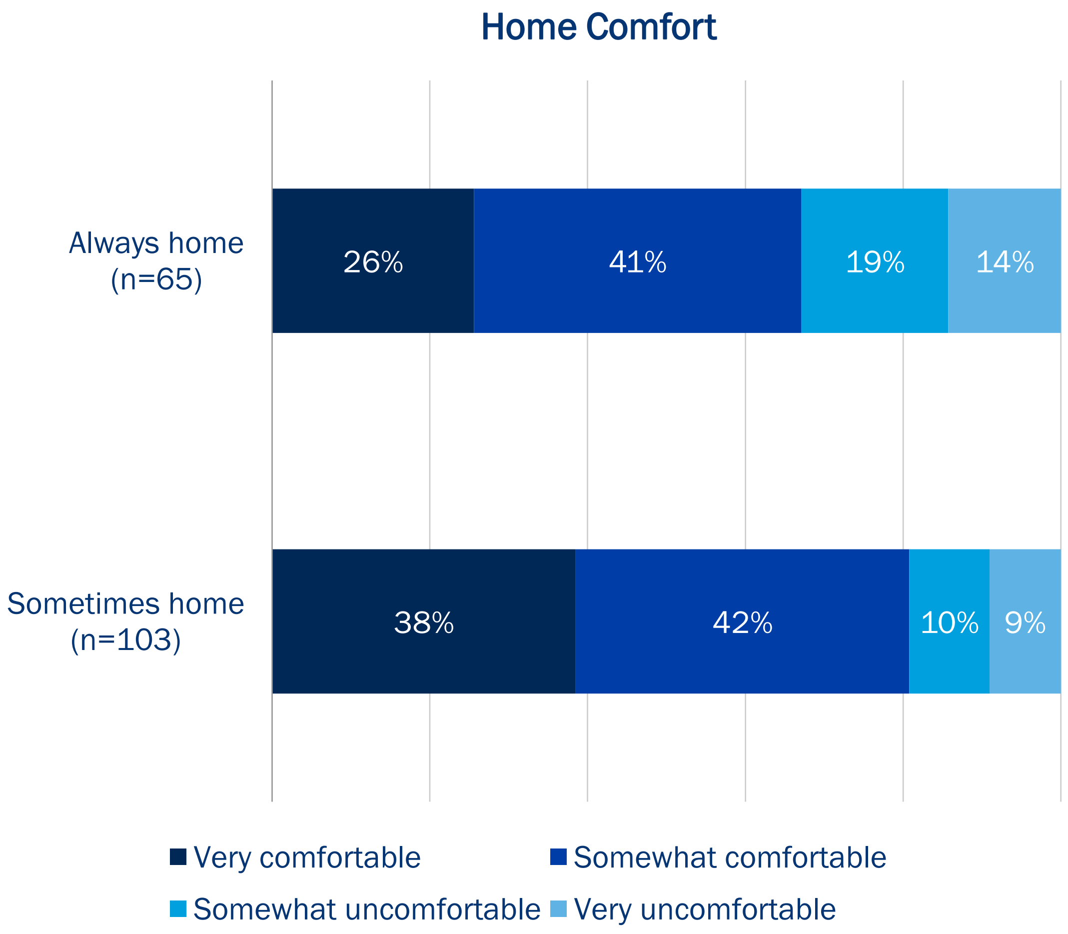
Q5: How comfortable did the temperature feel to you personally during cycling events?



Change in Temperature and Comfort During Cycling Events

- Customers who were always home during events found the change in temperature more noticeable and were less comfortable than those home some of the time.

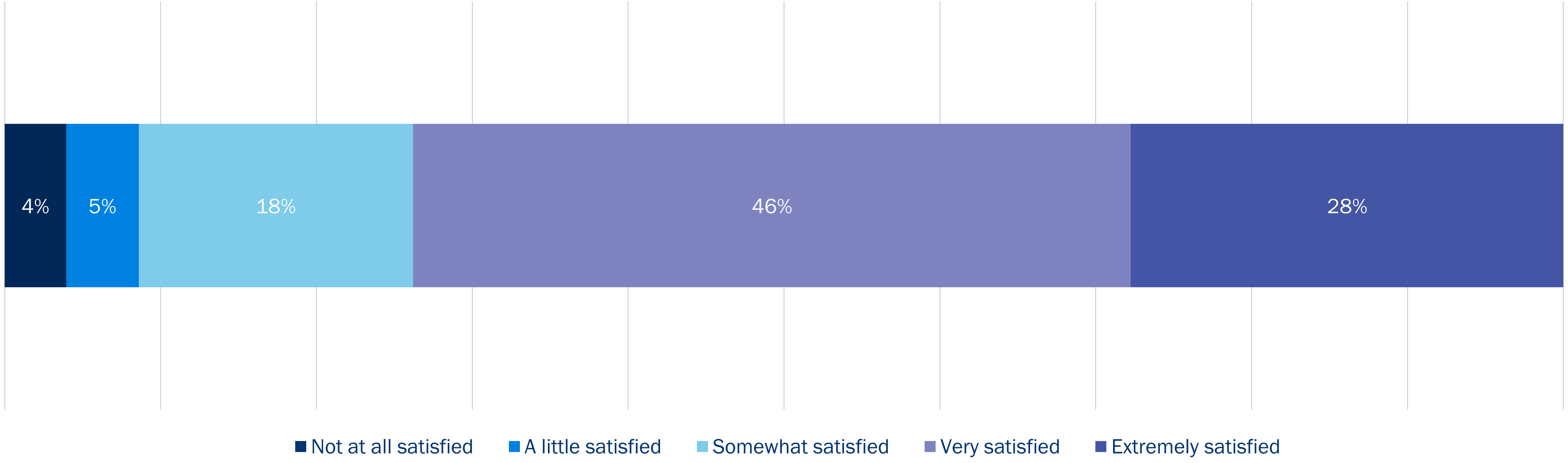




Satisfaction with Cycling Events

- Most customers who were aware of the cycling events occurring were very or extremely satisfied with their experience.

Q13: How satisfied are you with your experience participating in cycling events?



n=182

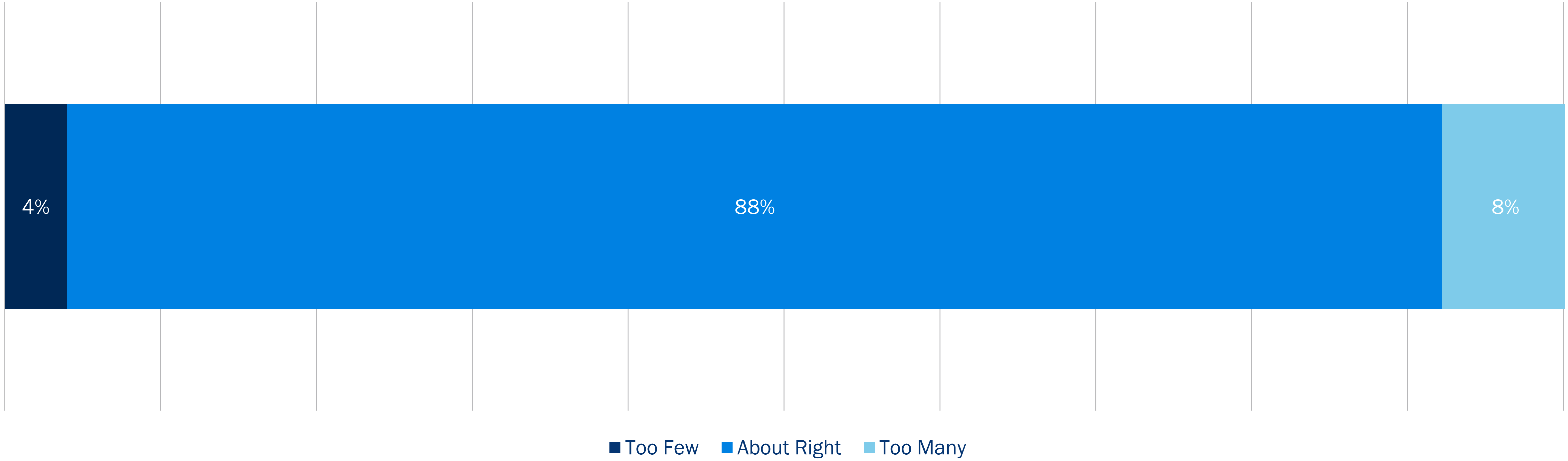
Satisfaction with Cycling Events

- Customers who were always home during events were somewhat less satisfied with their experience during events than those who were sometimes home.

Opinion of Number of Cycling Events

- Nearly all customers who were aware of the events occurring felt the number of events was "about right".

Q9: Do you think the total number of events you were asked to participate in was…?

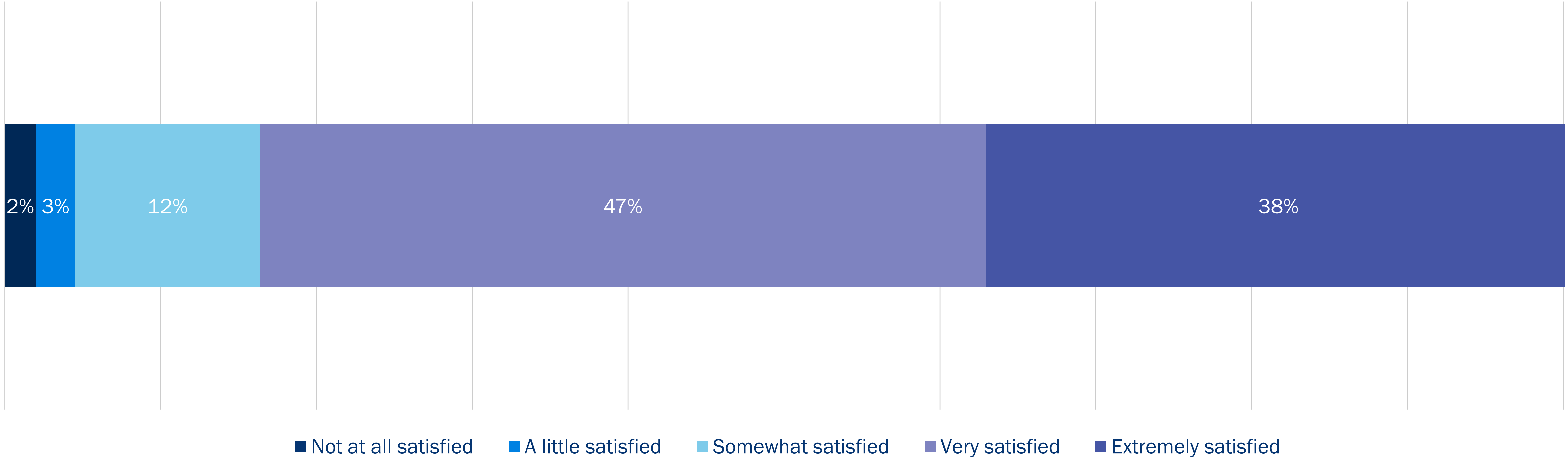


n=182

Satisfaction with Appliance Cycling Program

- The AC Cycling Program has high customer satisfaction. A large majority of program participants were very or extremely satisfied with their experience with the program overall.

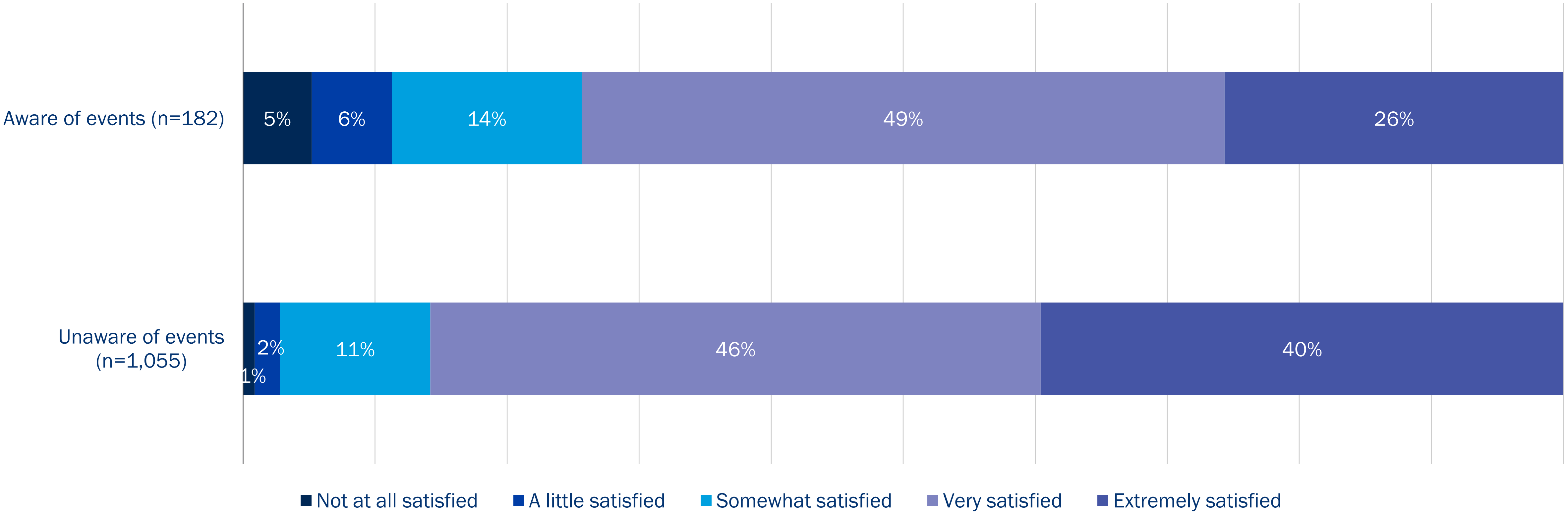
Q15: Thinking about your overall experience with Alliant Energy's Appliance Cycling program, how satisfied or dissatisfied are you with your experience?



n=1,237

Satisfaction with Appliance Cycling Program

- Experiencing cycling events somewhat lowers satisfaction. Customers who were aware of the cycling events occurring were slightly less satisfied with the program overall than customers who were unaware of the events.



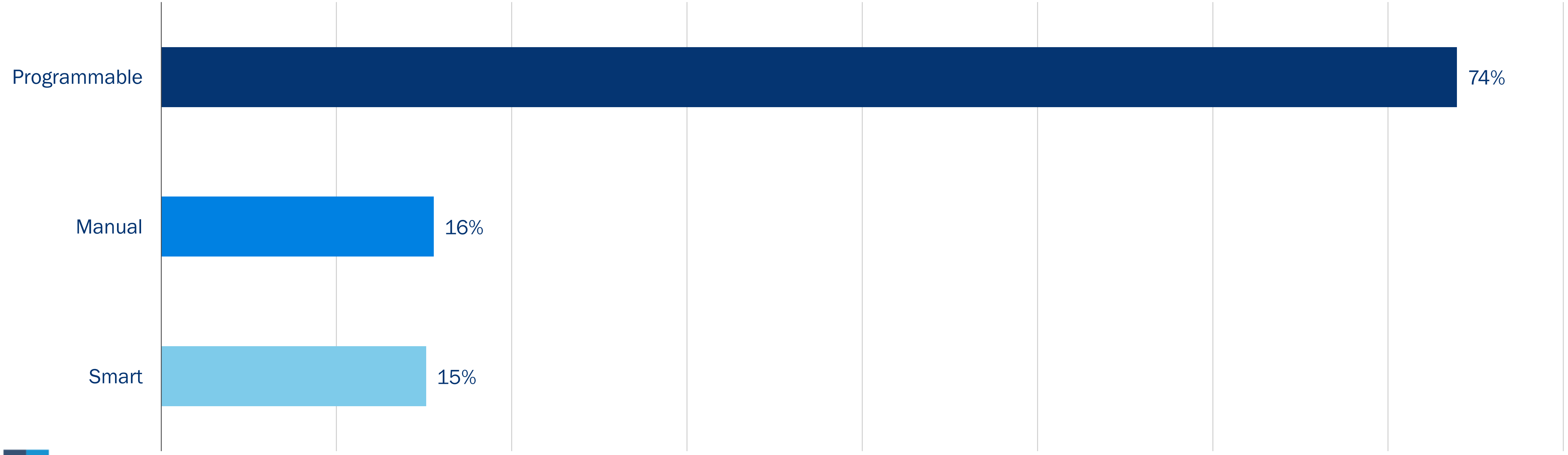
Opinion Dynamics

Thermostat and Heating System Characteristics

Types of Thermostats in Use in Customer Homes

- Smart thermostat use among AC Cycling program participants is low. Only 15% currently have at least one smart thermostat in their homes. A large majority have a programmable thermostat.

Q17: Please indicate how many of each thermostat you currently use in home?

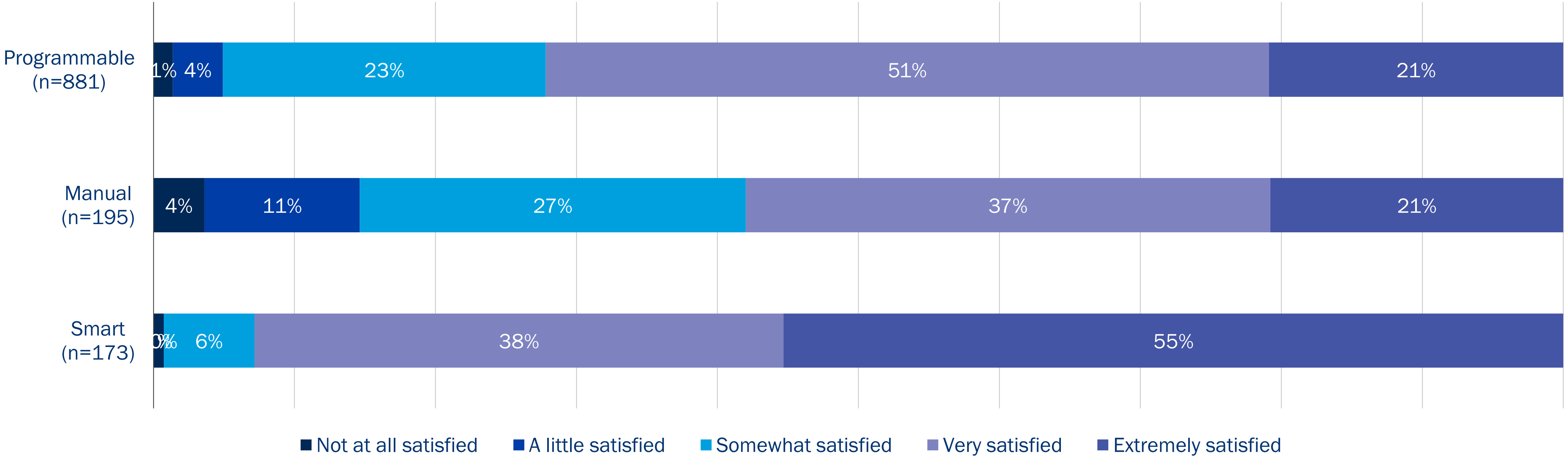


n=1,191

Satisfaction with Existing Thermostats

- Customers who have smart thermostats are highly satisfied with their thermostats though over half of other customers are very or extremely satisfied with their current thermostat. Customers with manual thermostats are the least satisfied.

Q19: How satisfied are you with your current thermostat(s)?

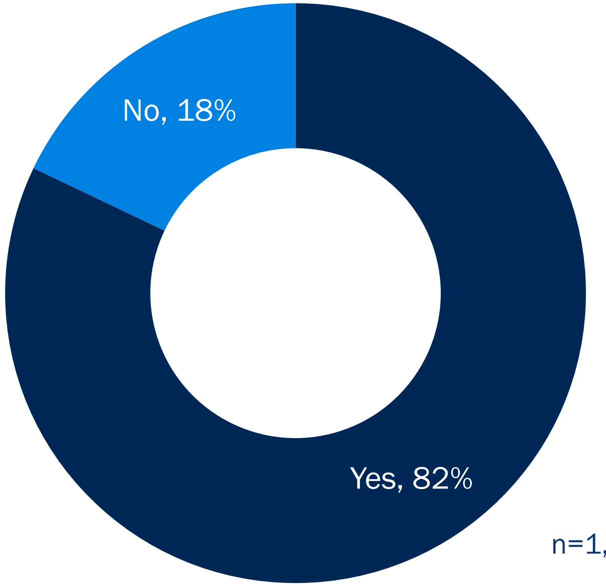


Opinion Dynamics

Smart Thermostat Awareness and Interest

- Most participants who do not currently have a smart thermostat have heard of them.

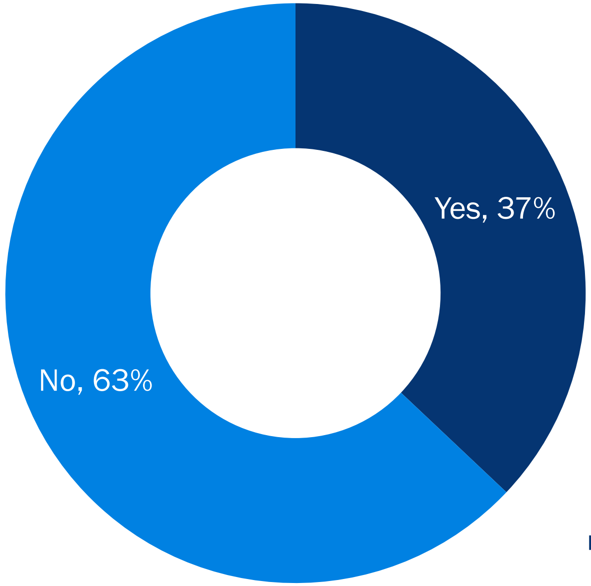
Q21: Before today, have you heard of smart thermostats? These thermostats connect to the internet and allow the user to adjust the temperature through smartphones or tablets. These thermostats also offer an option for programmed temperature settings.



n=1,064

- Slightly over one-third of participants who are aware of smart thermostats have considered replacing their existing thermostat with a smart thermostat.

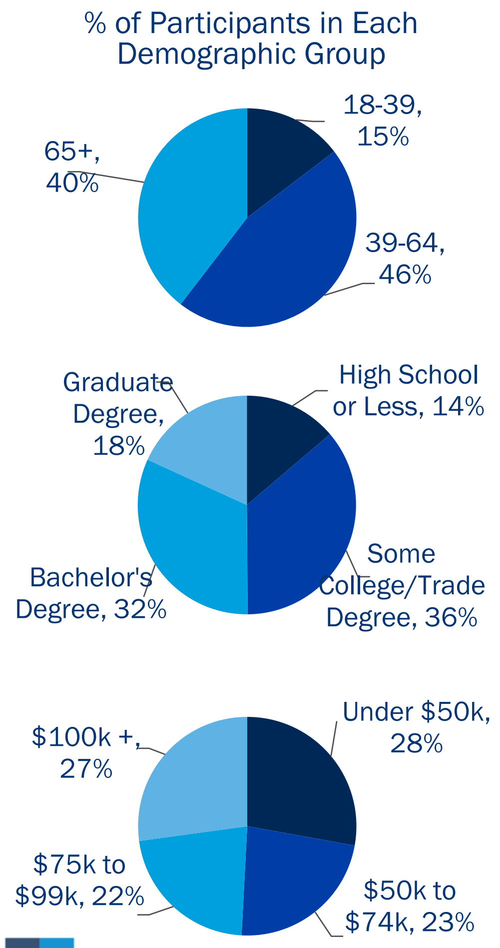
Q22: Have you considered replacing your existing thermostat(s) with a smart thermostat?

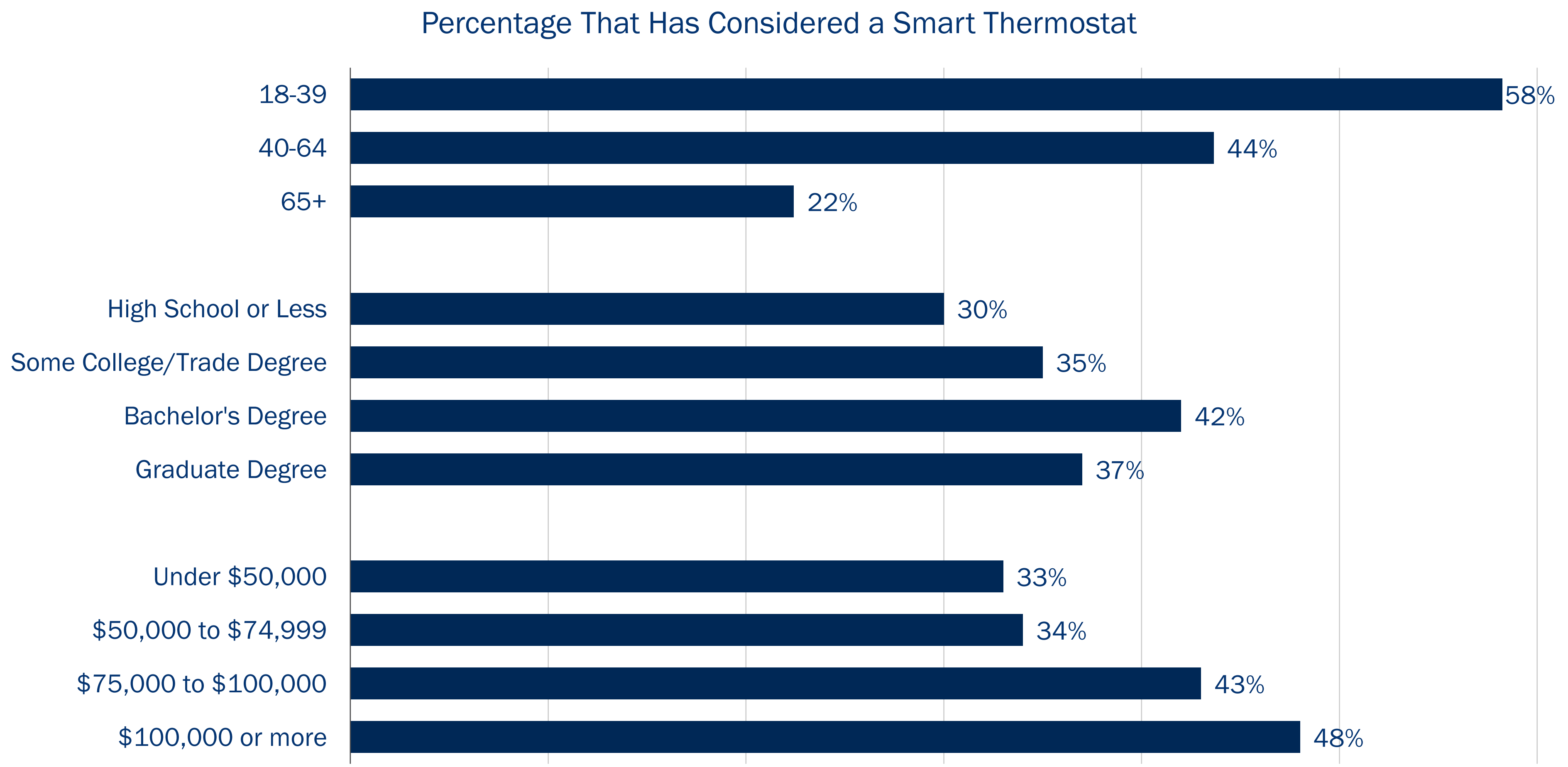


n=835

Smart Thermostat Interest

- Younger customers and those with higher educations and incomes are more likely to have considered replacing their existing thermostat with a smart thermostat. These groups make up half of participants or less.

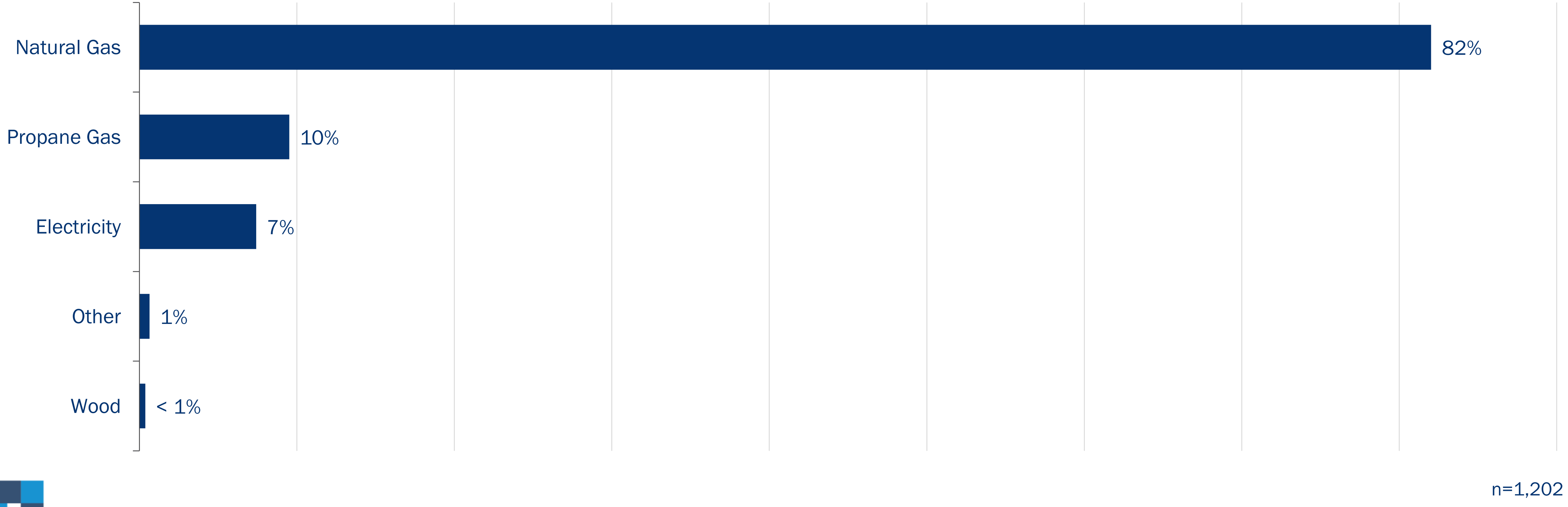




Heating Fuel Used

- A large majority of participants heat their homes with natural gas followed by propane and electricity.

Q34: What fuel does your [insert heating system] use?



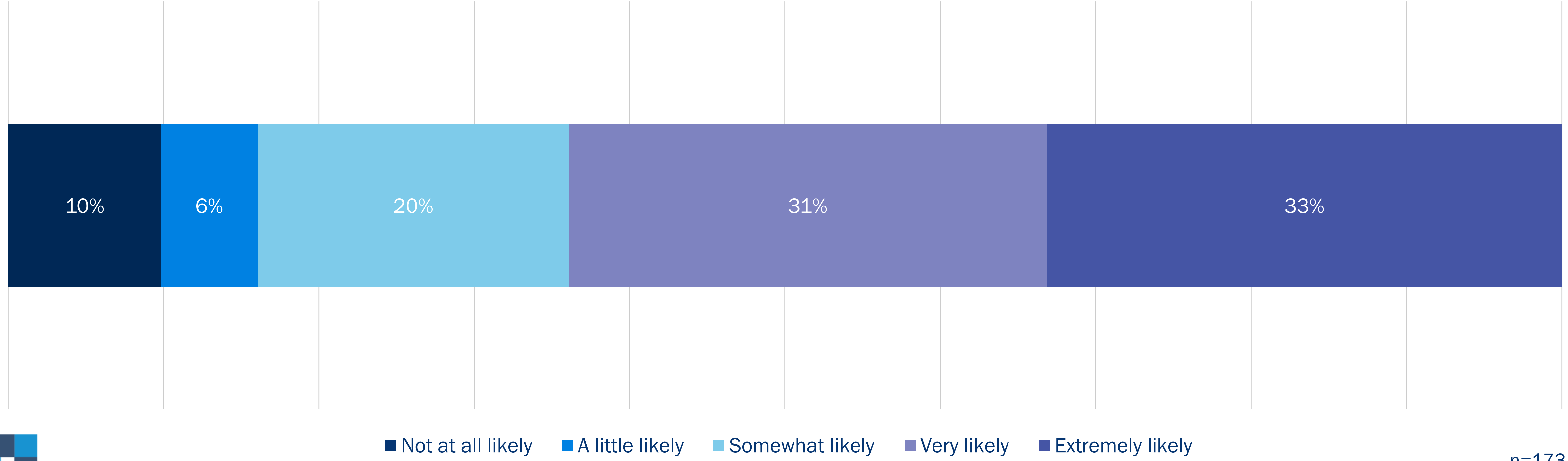
Opinion Dynamics

Interest in New Smart Thermostat-Based Demand Response (DR) Program

Likelihood to Participate in New DR Program – Customer Has Smart Thermostat

- Likely participation in a new DR program is high among the 15% of participants who already have a smart thermostat. Two-thirds are “very” or “extremely likely” to participate in a new DR program that uses their existing thermostat. The small number of participants who are “not at all likely” to participate say it is because they prefer a bill credit over gift cards, they like the current version of the program and don’t see a reason to change, and because their house gets too hot during events.

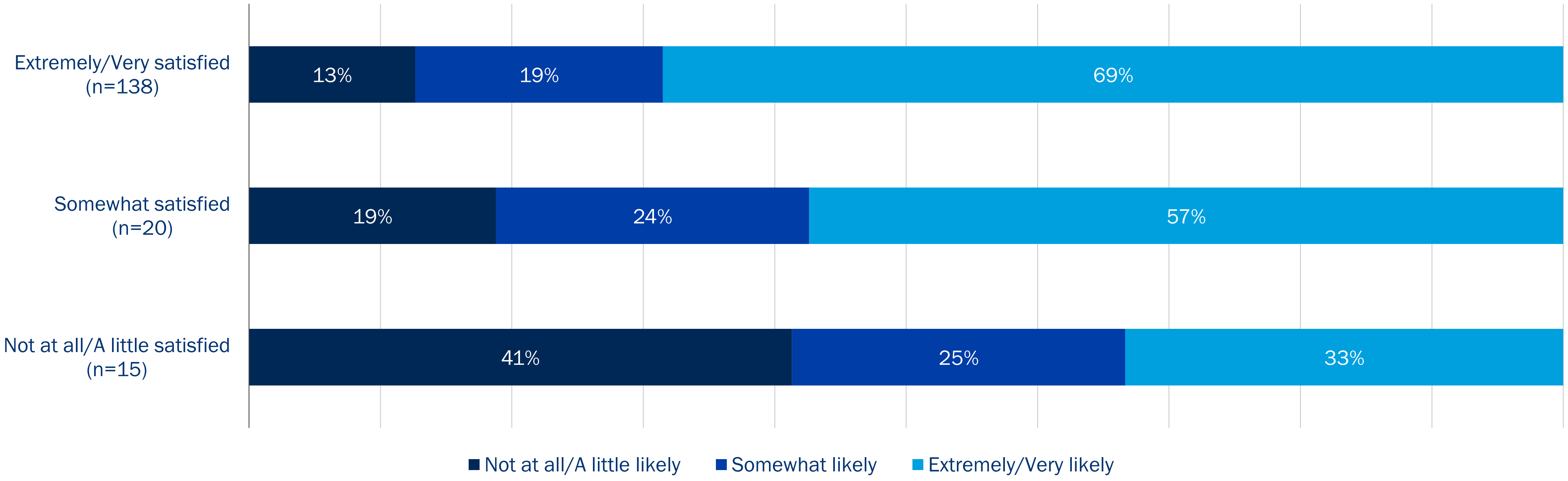
Q24: Alliant Energy is investigating how using a smart thermostat might work within an Appliance Cycling program. Under this new program, customers who currently have a switch on their central air conditioner would instead participate through their smart thermostat. (See survey instrument for full program description.) How likely would you be to participate in this new program?



n=173

Likelihood to Participate in New DR Program – Customer Has Smart Thermostat

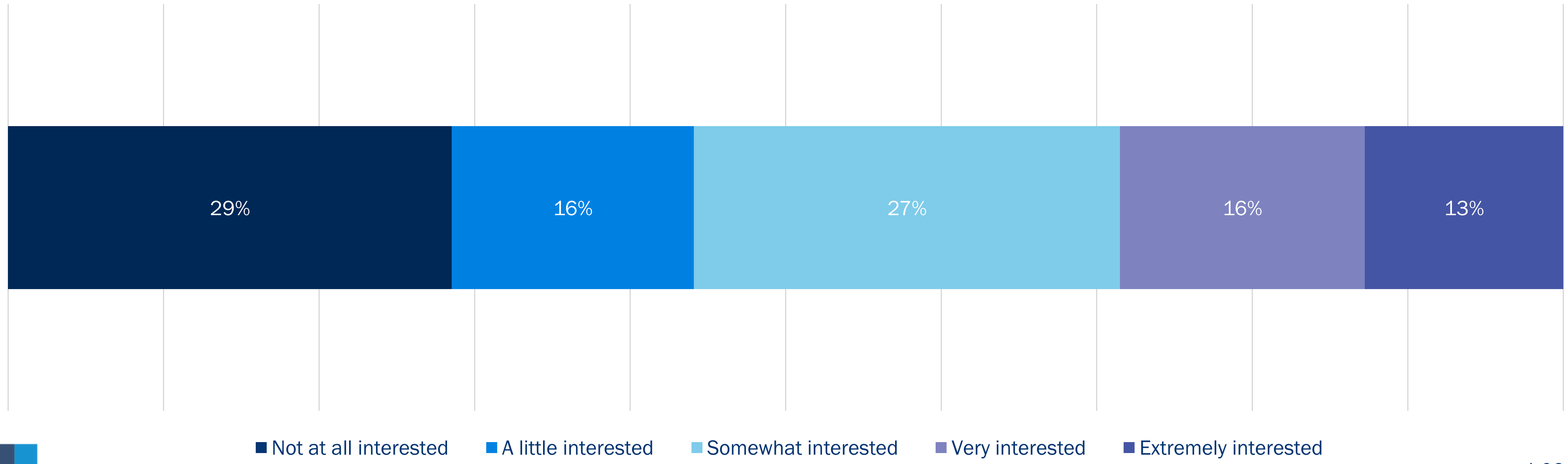
- Participants who are more satisfied with the AC Cycling Program are much more likely to participate in a new DR program that uses their existing smart thermostat compared to customers who were not very satisfied.



Interest in New DR Program - Customer Does Not Have Smart Thermostat

- Interest in a new DR program is low to moderate among participants who do not already have a smart thermostat. Less than one-third are "very" or "extremely" interested in new DR program that would require the purchase and installation of a new smart thermostat whereas 45% are "a little" or "not at all interested".

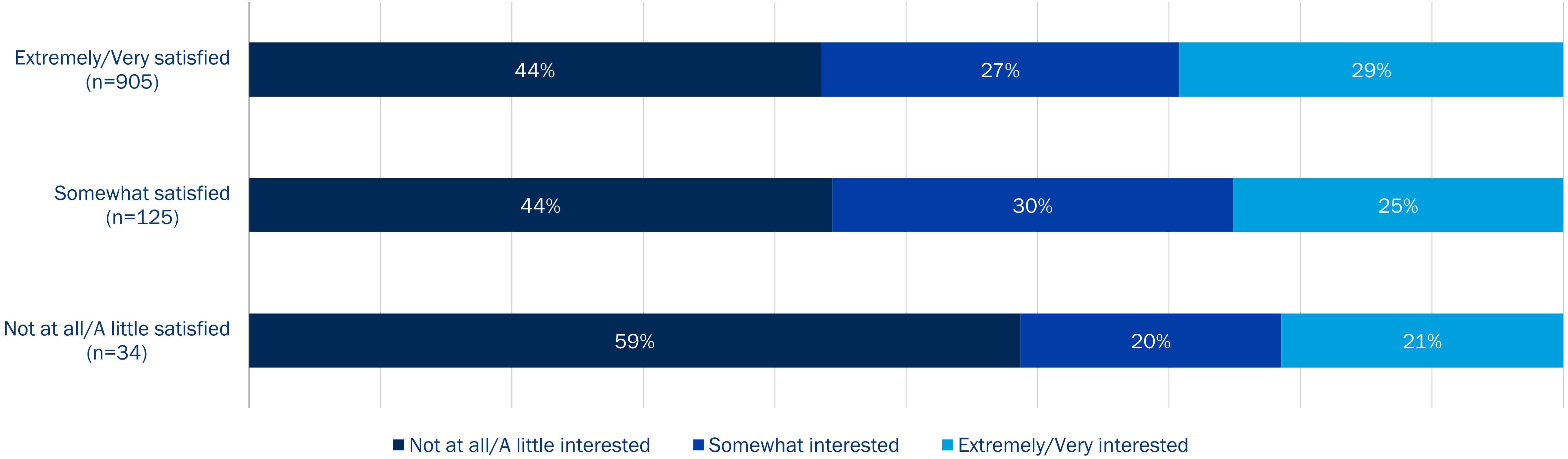
Q28: Alliant Energy is investigating how using a smart thermostat might work within an Appliance Cycling program. Under this new program, customers would need to purchase and install a smart thermostat to continue to participate. (See survey instrument for full program description.) Setting aside the cost to purchase and install a new smart thermostat, how interested would you be in participating in this new version of the Appliance Cycling Program?



n=1,064

Interest in New DR Program - Customer Does Not Have Smart Thermostat

- Participants who are more satisfied with the AC Cycling Program are slightly more likely to be interested in a new DR program that requires them to purchase and install a new smart thermostat than those who are less satisfied with the existing program suggesting that other barriers to participation matter more.



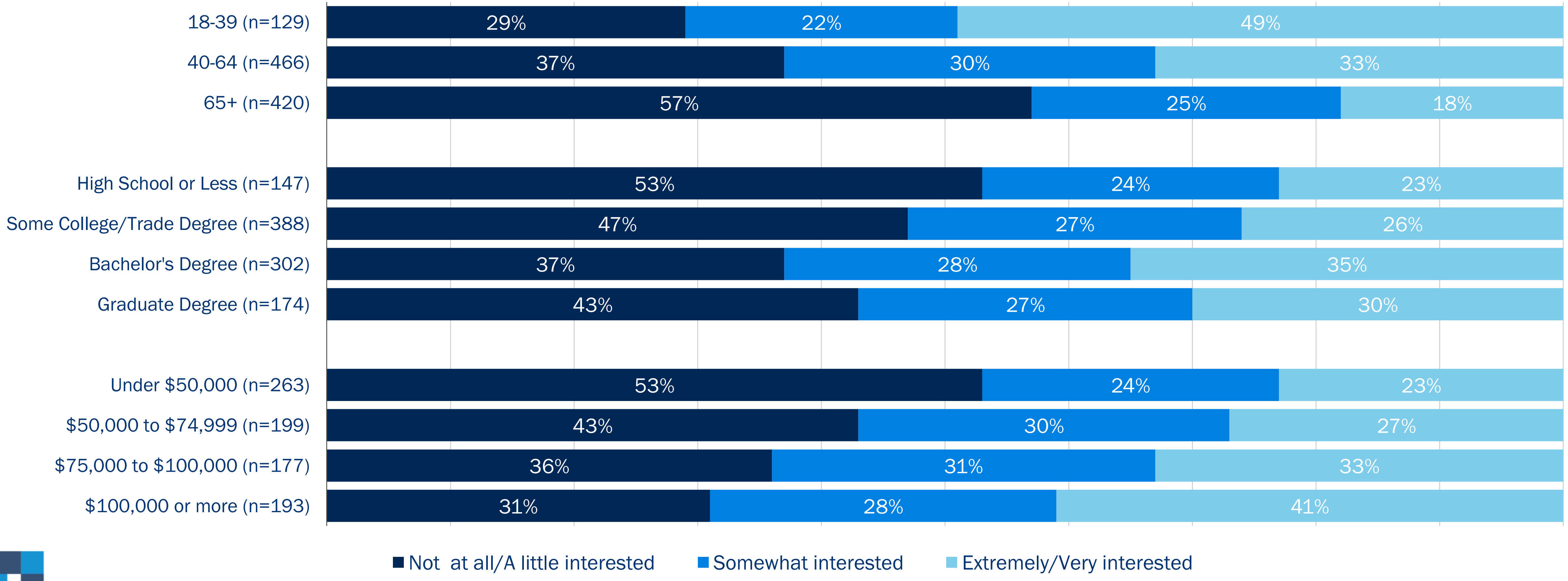
Reasons for Lack of Interest in New DR Program – Customer Does Not Have Smart Thermostat

- The top reason given for not being more interested in a new DR program is being satisfied with current thermostat.
- The cost of purchasing and installing a smart thermostat is also a barrier for many.
- Some customers are also concerned about smart thermostats being difficult to operate.
- A few are worried that smart thermostats could have security risks and that could cause their HVAC systems to be hacked.
- A small percentage say they do not have internet or WiFi access needed to participate

Top Reasons	Percent (n=300)
Satisfied with current thermostat	74%
Smart thermostat purchase cost	24%
Smart thermostat installation cost	22%
Worried smart thermostat would be difficult to operate	18%
Data/internet security concerns	7%
Do not have internet access/WiFi	4%

Interest in New DR Program - Customer Does Not Have Smart Thermostat

- Younger customers and those with higher educations and incomes are more interested in switching to a new DR program that requires a smart thermostat.

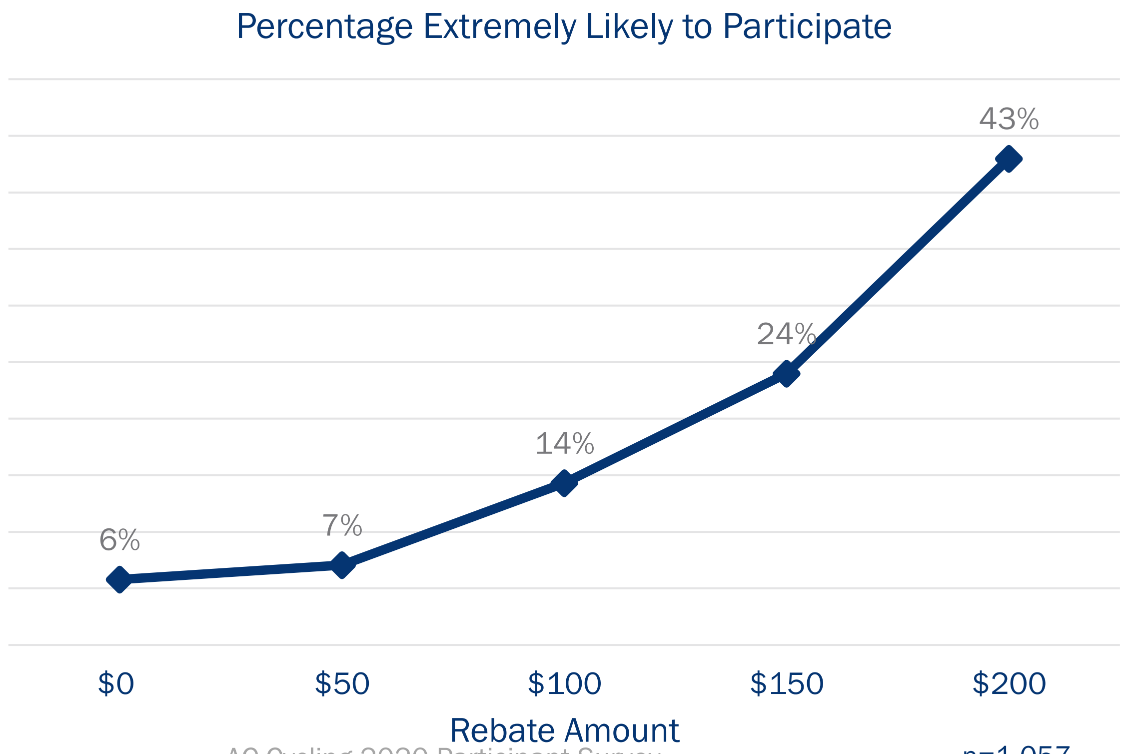


Customer Participation in New DR Program Under Varying Thermostat Rebate Amounts

- While 71% of AC Cycling participants who do not have a smart thermostat are at least "a little" interested in new DR program that requires a smart thermostat, only 6% are extremely likely to participate if they had to pay $200 to purchase and install a smart thermostat.
- The percentage who will participate increases as the rebate amount increases, but less than half are extremely likely to participate even if given a $200 rebate to cover thermostat purchase and installation costs.

Q30: You noted that you do not have any smart thermostats in your home. If a new smart thermostat and installation cost $200, the gift cards you would receive from participating in the Appliance Cycling Program would pay for the thermostat and installation after three years. How likely would you be to participate in the program if you had to pay $200 to purchase and install smart thermostat?

How about if you received a $50 rebate…? How about a $100 rebate, $150 rebate, $200 rebate… (See survey instrument for full question wording)



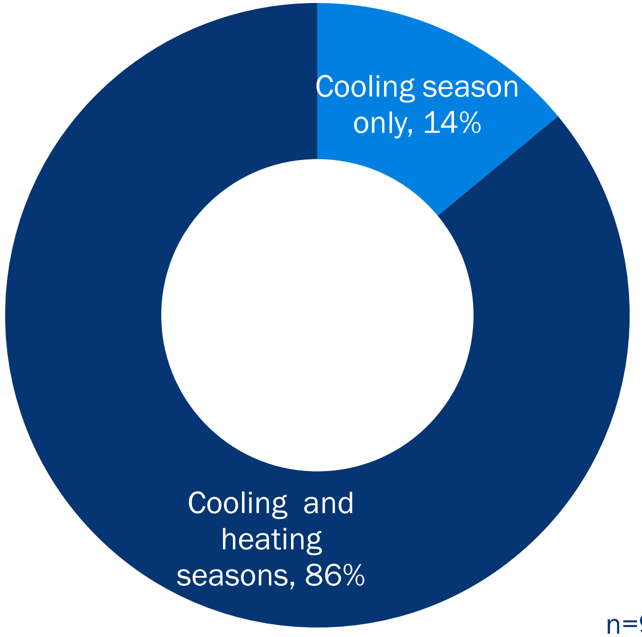
AC Cycling 2020 Participant Survey

n=1,057

Seasons in Which Likely to Participate in New DR Program

- Most customers who are “at least a little interested” in participating in a new DR program would participate in both the heating and cooling seasons.
- The top reasons given for not participating during the heating season include:
  - A greater desire to control heat because the customer does not like to be cold (39%)
  - IPL does not provide heating fuel (21%)
  - Wanting more information about the program (12%)

Q25 & Q31: For which seasons would you be likely to participate?



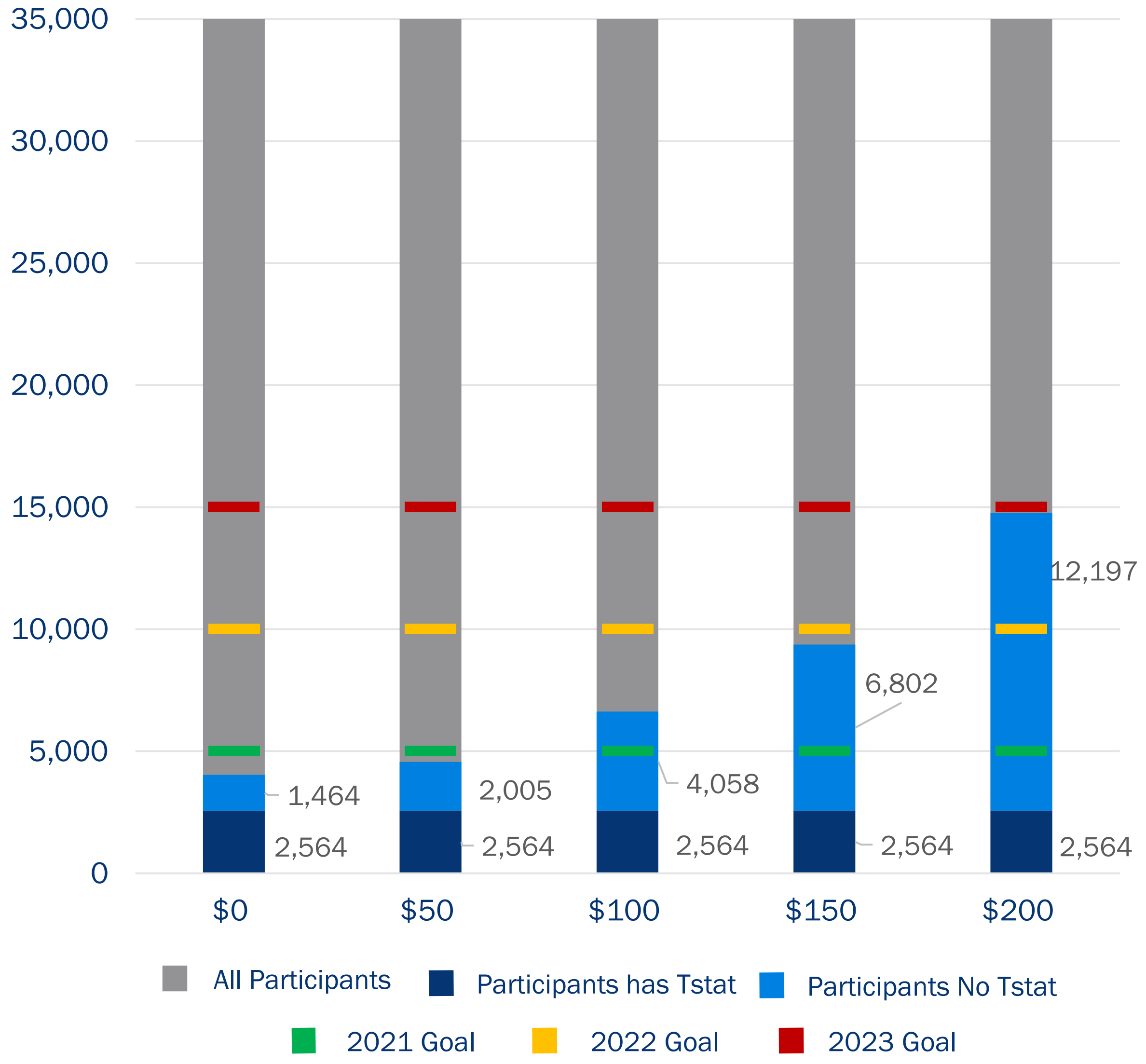
n=901

Estimated Participation in New DR Program

- We combined survey results on the likelihood to participate in a new DR program for respondents with and without an existing smart thermostat. We extrapolated the results to all current participants and estimated the number who would be likely to participate at different rebate levels for the purchase of a smart thermostat.
- We provide results for cooling season only and both cooling and heating seasons.
- For cooling season only, participation ranges from 15% to 46% of current participants (4,848 to 15,401 customers).
- For both cooling and heating seasons, participation ranges from 12% to 39% of current participants (3,994 to 13,175 customers).

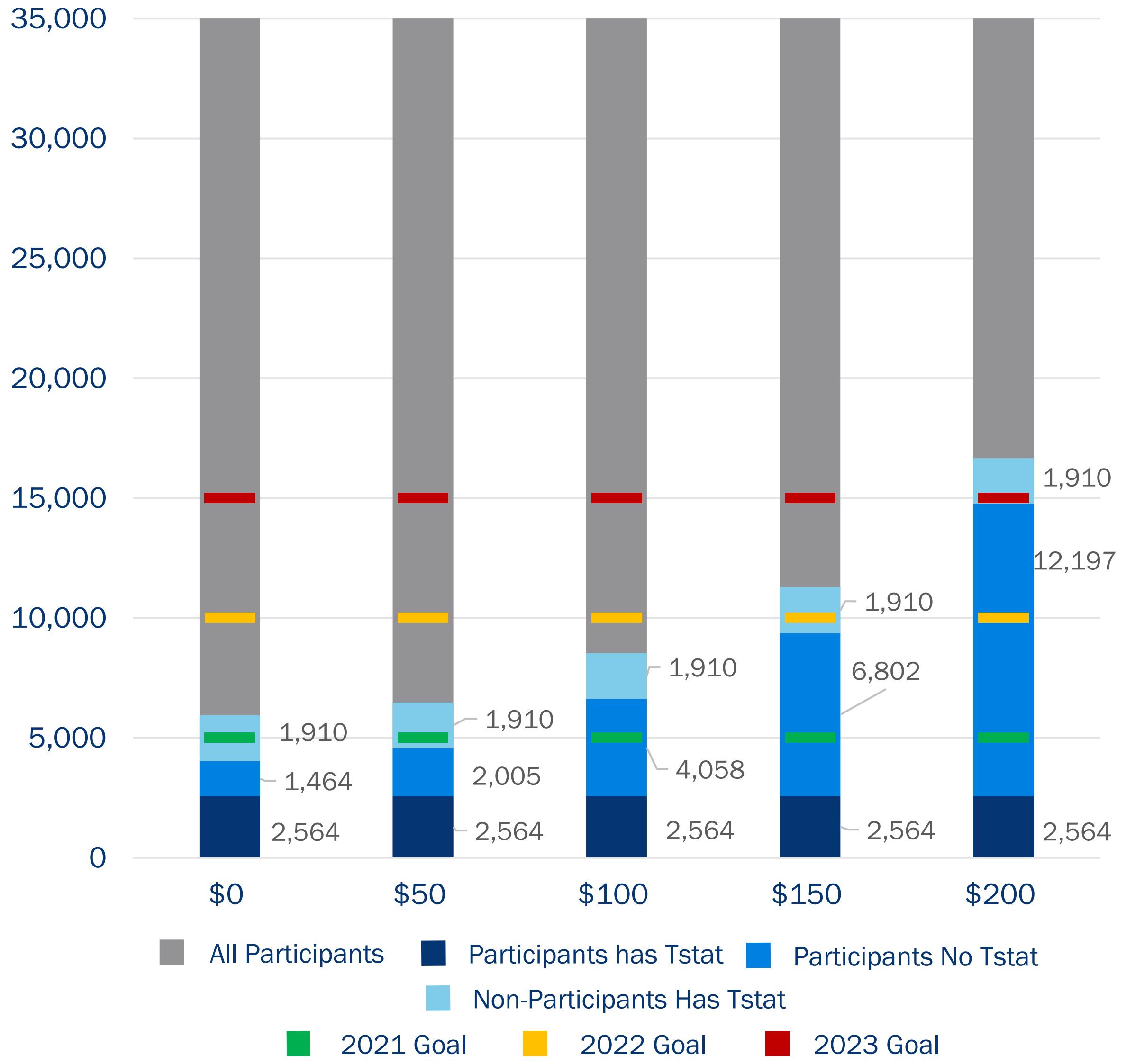
Estimated Participation in New DR Program Compared to Program Goals

- IPL has several marketing and customer targeting options it could use to reach its three-year program goals.
- The customers most likely to participate and the least costly to recruit are existing AC Cycling participants who have a smart thermostat.
  - We estimate that roughly 2,500 will participate in both the heating and cooling seasons, which would get IPL halfway to its participation 2021 goal.
- AC Cycling participants who do not have a smart thermostat are another potential target, but a rebate would be needed for many to purchase.
  - A $50 rebate would generate enough participants for IPL to reach its 2021 goal while $150 rebate would come close to reaching the 2022 goal. A $200 rebate would be needed for IPL to come near its 2023 goal.



Estimated Participation in New DR Program Compared to Program Goals

- Non-participants who have smart thermostats are another target for the new DR program.
  - Our research in other jurisdictions finds that when DR programs are marketed to customers with smart thermostats, participation is relatively low (~15%). If we assume that 10% of IPL customers currently have a smart thermostat, we estimate that approximately 2,000 combo fuel customers would participate in both the heating and cooling seasons.
    - There are more customers available for the cooling season due to the larger number of electric customers. We estimate that roughly 6,000 electric customers (electric only and combo) would participate.
  - The number of customers with smart thermostats will continue to increase over time, which will increase the number of potential participants at the same time program goals also increase.



Opinion Dynamics

Summary of Key Findings

Key Findings

- AC Cycling Program participants are highly satisfied with the program.
  - This high level of satisfaction makes current AC Cycling participants a good target for a new demand response (DR) program that utilizes smart thermostats.
- Most participants are unaware of the events when they occur. Those who are aware only notice slight changes in temperature, which has a small impact on comfort.
- Participants who spend more time at home are more likely to notice temperature changes and are a bit less comfortable, but they are still largely satisfied with the events and the program overall.
- Few participants (15%) have a smart thermostat so most would need to upgrade their thermostat to participate in a DR program that uses a smart thermostat instead of the AC switch.
- Most customers heat with natural gas, which would allow them to participate during the heating season as part of a new DR program.
- Participants who already have a smart thermostat say they would be likely to participate in a new DR program that uses the thermostat.
- Participants who do not have a smart thermostat are much less interested in a new DR program because they are satisfied with their current thermostat. The cost of a new smart thermostat is also a barrier. Few would install a new thermostat to participate in a new program without an incentive, and even with a $200 rebate, slightly under half would do so.
- IPL has several customer targeting options for the new DR program.
  - Current AC Cycling participants who have a smart thermostat would be an easy target. Two-thirds of current participants who have a smart thermostat are likely to participate in a new DR program using their thermostat, which would get IPL to halfway to their 2021 program participation goal of 5,000 customers.
  - Non-participants who already have a smart thermostat are likely to participate at lower rates than current AC Cycling participants. We estimate that approximately 2,000 customers who have a smart thermostat would participate in a new DR program.
  - AC Cycling participants who do not have a smart thermostat would need additional encouragement to switch to a new DR program that uses a smart thermostat. IPL will need to offer a rebate to offset the purchase and installation costs of a new thermostat to get most of these customers to participate.

Filed with the Iowa Utilities Board on April 30, 2021, EEP-2018-0003

Opinion Dynamics

IPL HOME ENERGY REPORTS

2020 CUSTOMER SURVEY RESULTS

February 22, 2021

Survey Methods

- **Target Population:** Electric-only customers enrolled in 2019 with emails on file, including treatment (customers who receive HERs) and control participants (customers who do not receive HERs)
- **Number of Completes:** 2,299 (1,180 treatment; 1,119 control)
- **Survey Dates:** December 15, 2020 – January 8, 2021
- **Outreach Mode:** Email
- **Survey Mode:** Online
- **Response Rate:** 12%
- **Margin of error:** 3%

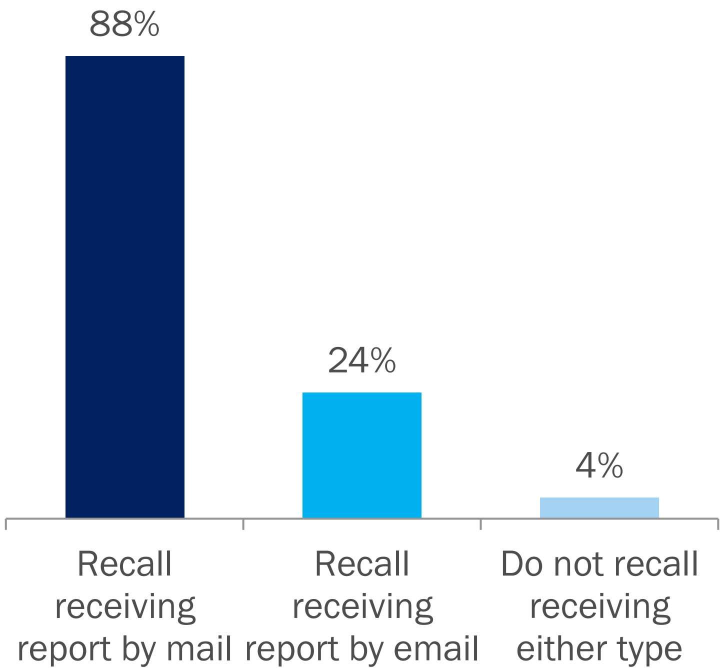
Opinion Dynamics

HER AWARENESS AND USE

HER Awareness and Use

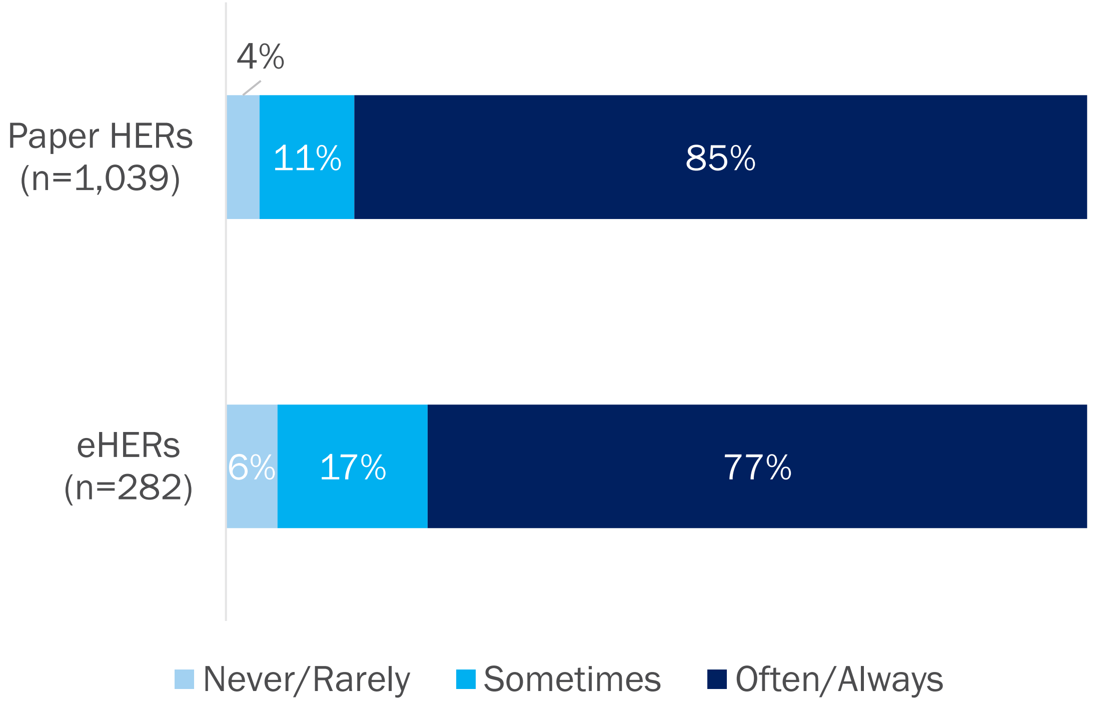
- Most customers (96%) recall receiving a report through the mail or through email, most of which typically read them

HERs Formats that Customers Recall Receiving (n=1,180)



Note: Multiple responses allowed

Frequency of Reading HERs

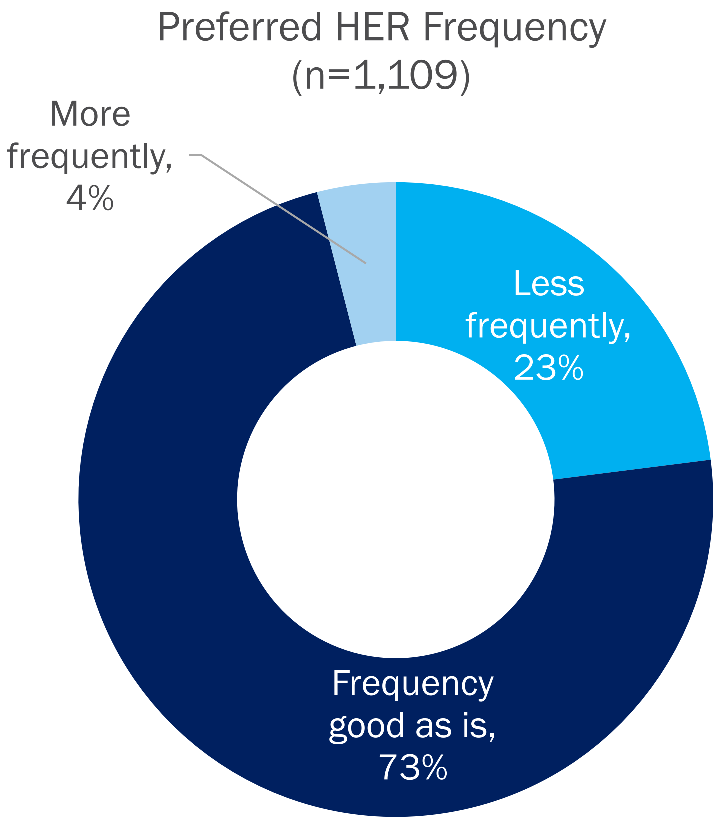


Note: Results are among respondents who recall receiving a given HER format
Excludes one “don’t know” response

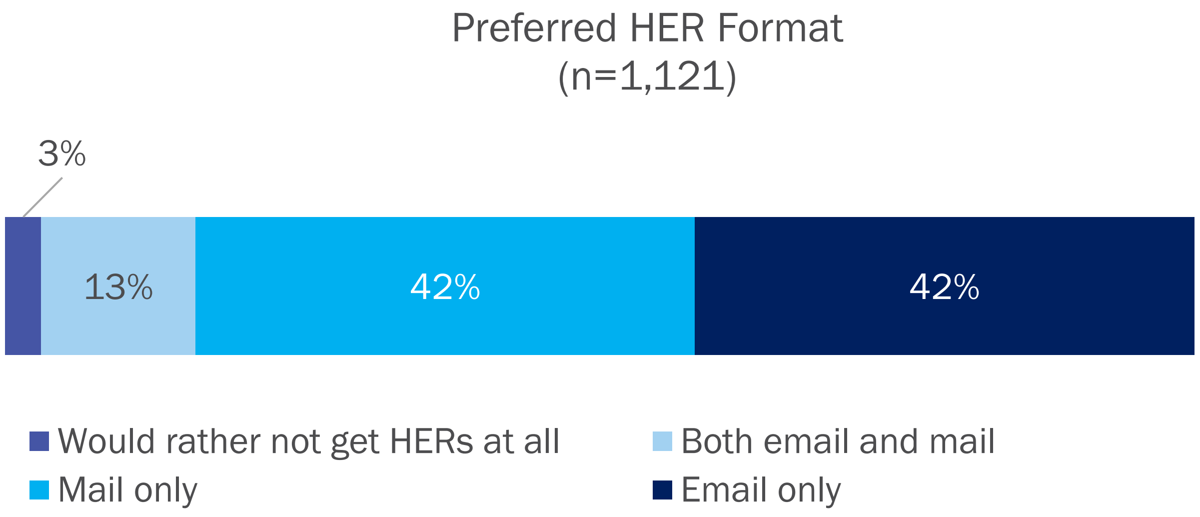
Opinion Dynamics

Preferred Frequency and Format

- Most customers (73%) are satisfied with the frequency with which they receive HERs
- Customers are split in terms of their preferred format (mail vs. email)



Note: Excludes “don’t know” responses



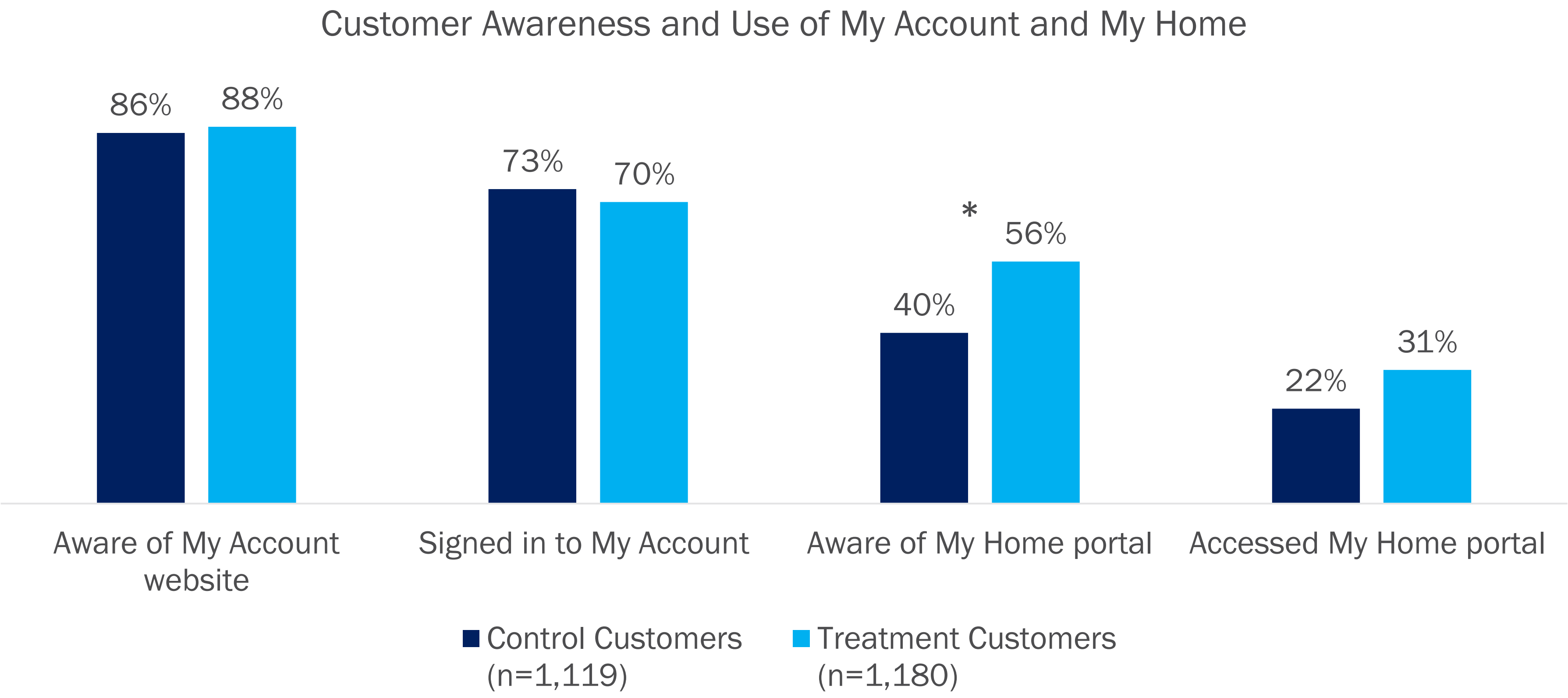
Note: Excludes “don’t know” responses

Opinion Dynamics

IMPACTS OF HER ON MY ACCOUNT AND MY HOME PORTAL USE

My Account and My Home Portal Awareness and Access

- Awareness and use of the My Home portal is limited



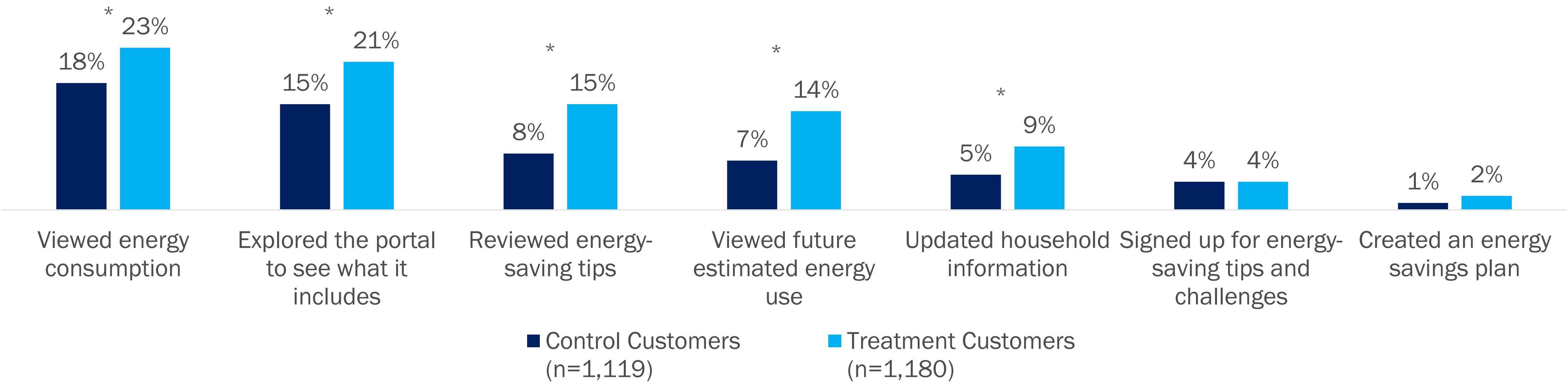
Note: * denotes significant difference between treatment and control

47% of control customers and **29%** of treatment customers would be interested in signing in to the My Home portal (of those who had not previously)

Use of the My Home Web Portal

- Customers primarily use the My Home Web Portal to view their consumption
- Treatment customers were more likely to review energy-saving tips, view their future estimated energy use, and to update their household information compared to control customers
- Few customers signed up for energy-saving tips or created an energy savings plan

Percentage of Customers Who Have Used Elements of the My Home Web Portal



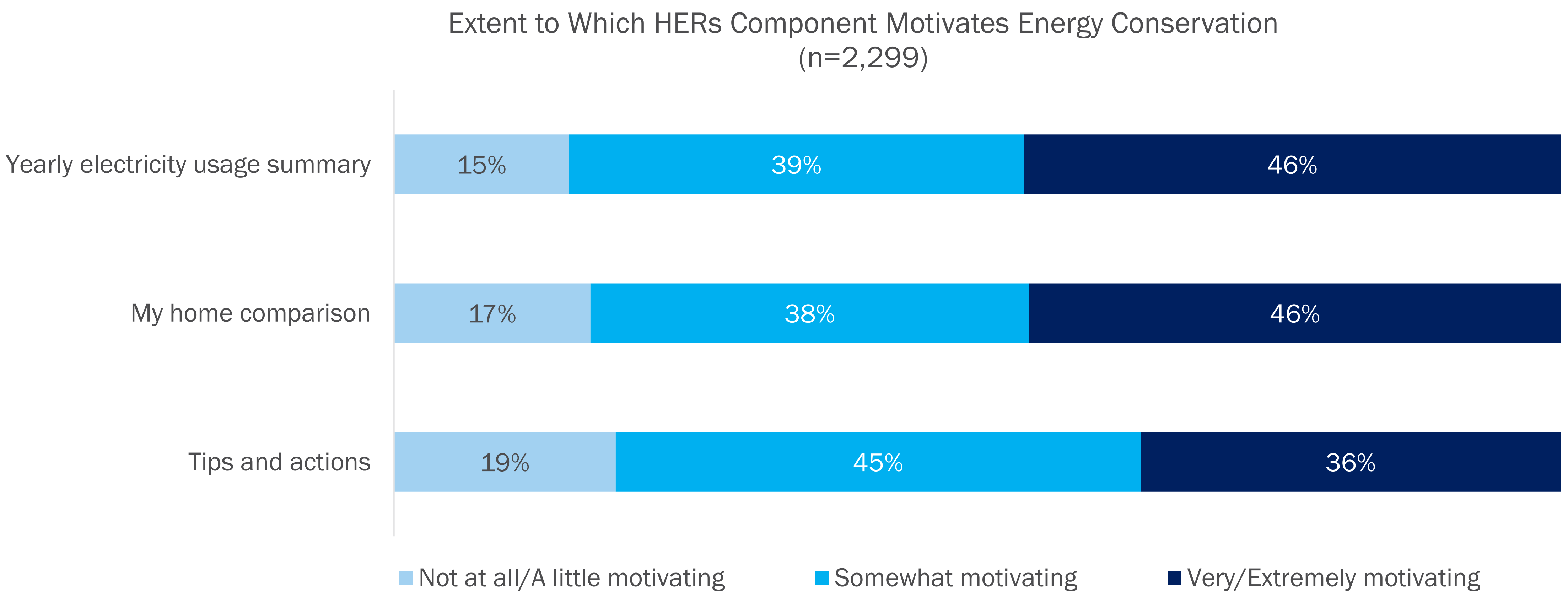
Note: * denotes significant difference between treatment and control

Opinion Dynamics

IMPACTS OF HERS ON CUSTOMER ENERGY USE: KNOWLEDGE, ENGAGEMENT, BEHAVIOR CHANGE, PROGRAM PARTICIPATION

Rated Motivational Impacts of HER Content

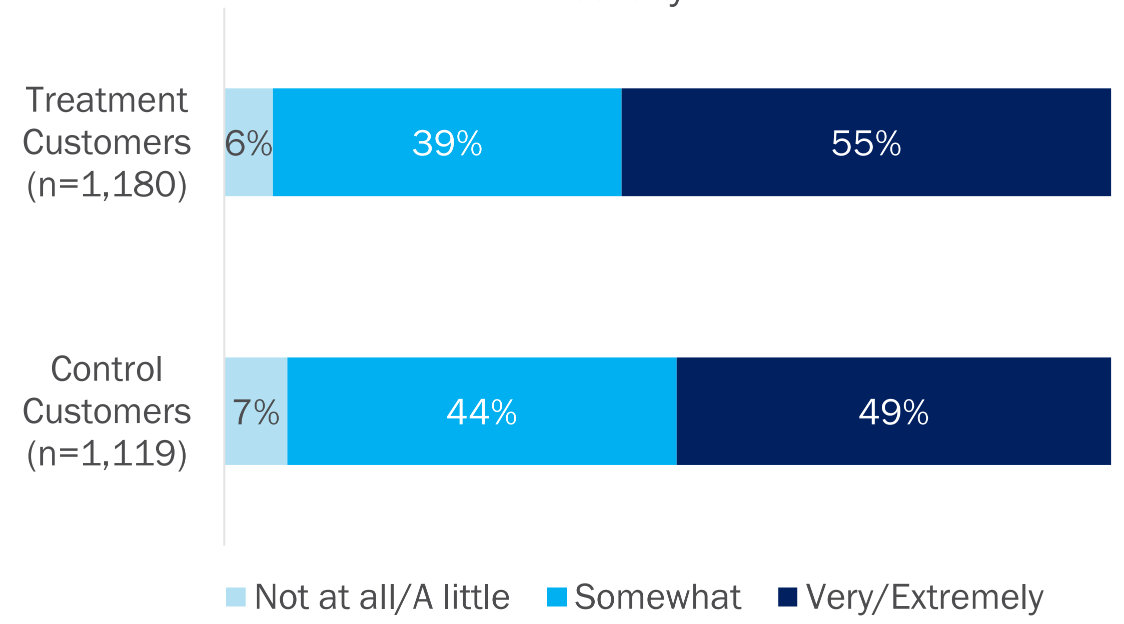
- Customers rated the yearly usage summary and home comparisons as greater motivators to save energy than the tips provided in HERs



HER Impact on Knowledge and Perceived Electricity Use

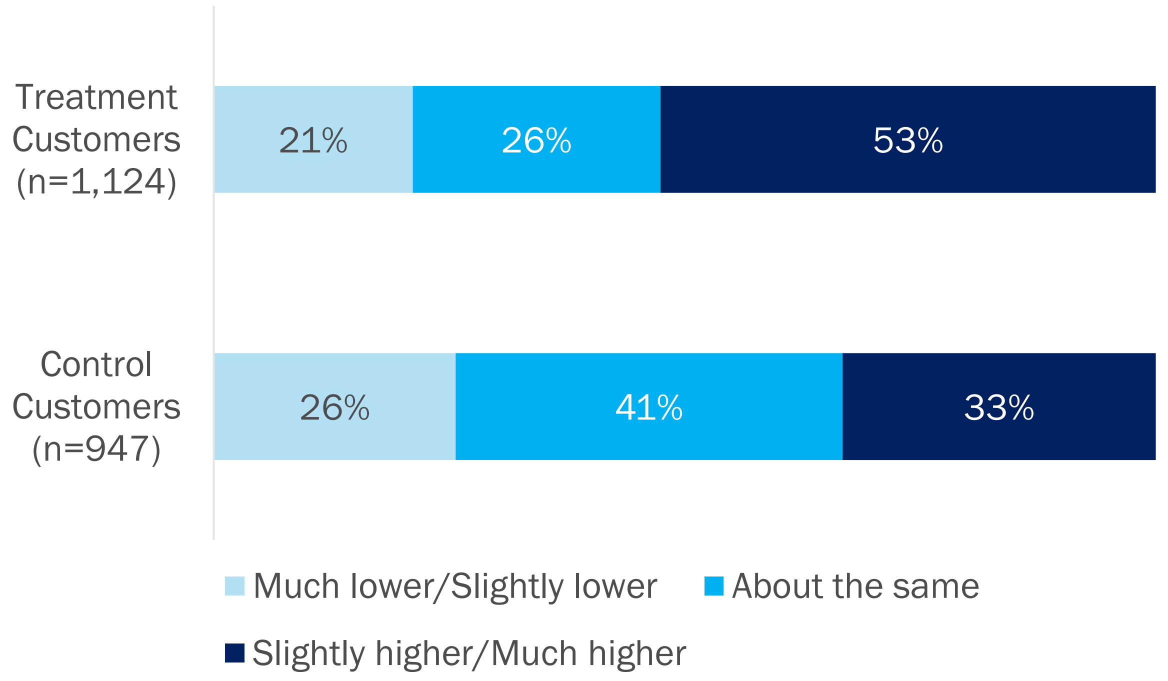
- HERs increases perceived electricity conservation knowledge and electricity use magnitude

Rated Level of Knowledge on Ways to Save Electricity*



Note: * denotes significant difference between treatment and control

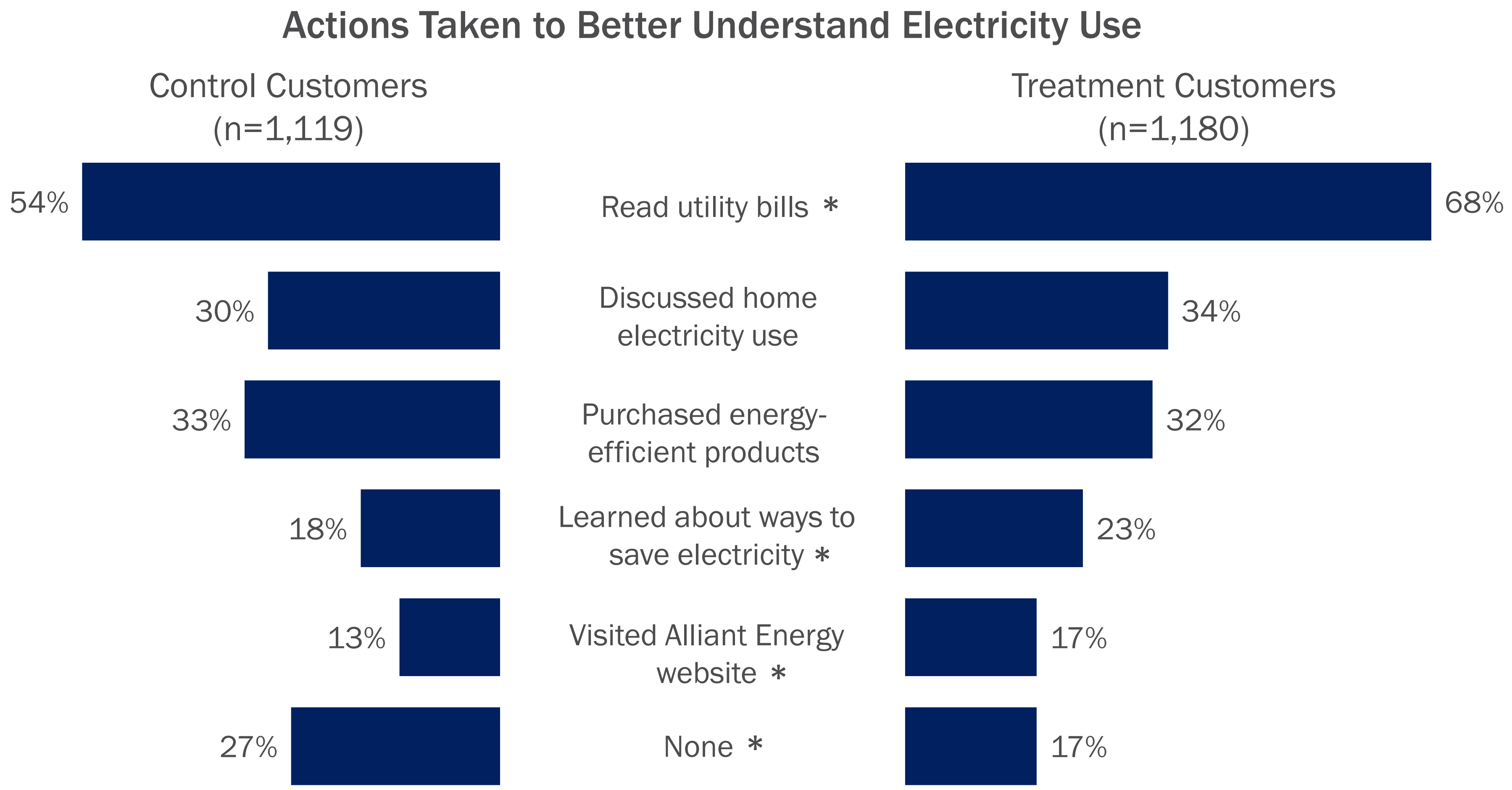
Perception of Home's Electricity Use Compared to Similar Homes*



Note: * denotes significant difference between treatment and control
Excludes "don't know" responses

HER Influence on Interest in Learning More about Electricity Use

- Customers who receive HERs are more interested in learning more about their electricity use



Note: * denotes significant difference between treatment and control

HER Impact on No- and Low-Cost Energy-Saving Actions

- However, customers who receive HERs are not significantly more likely to say they engage in electricity-conserving behaviors

Treatment Customers' Most *Common* Activities in the Past Six Months

77% Cleaned or replaced HVAC filters

73% Switched thermostat fan to "auto"

58% Unplugged electronic devices that are not regularly used

Treatment Customers' Most *Frequent* Activities in the Past Six Months

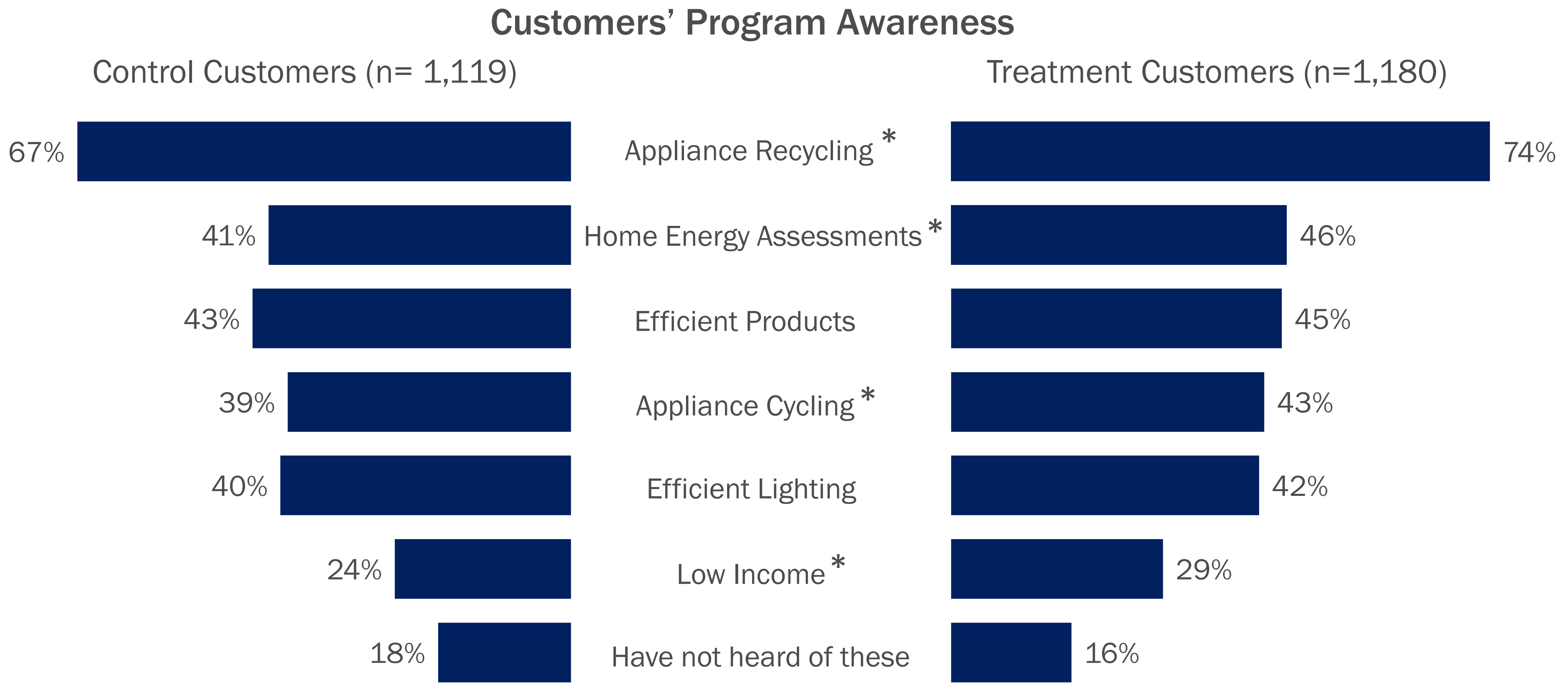
96% 'Always or Often' cleaned dryer lint filters before using clothes dryer

91% 'Always or Often' turned off lights when leaving a room

89% 'Always or Often' waited to do laundry until there was a full load to wash

HER Influence on Program Awareness and Program Participation

- Further, HERs increase customers' program awareness but does not significantly impact program participation



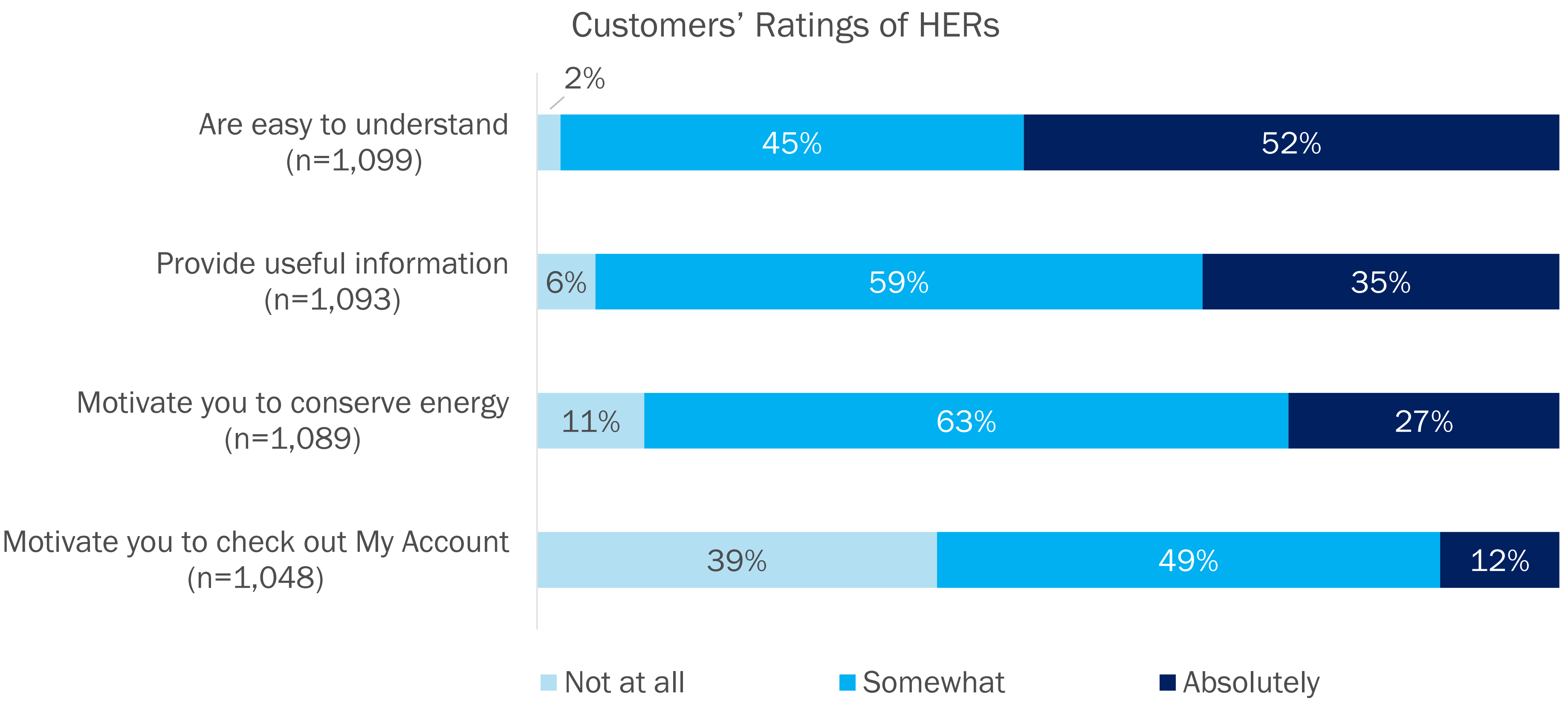
Note: * Denotes significant difference between treatment and control

Opinion Dynamics

SATISFACTION WITH HERS, MY HOME PORTAL, AND IPL

Perceptions of HERs

- Although easy to conserve energy or check their My Account portal on the Alliant Energy website enough to understand and generally full of useful information, HERs only moderately motivates customers

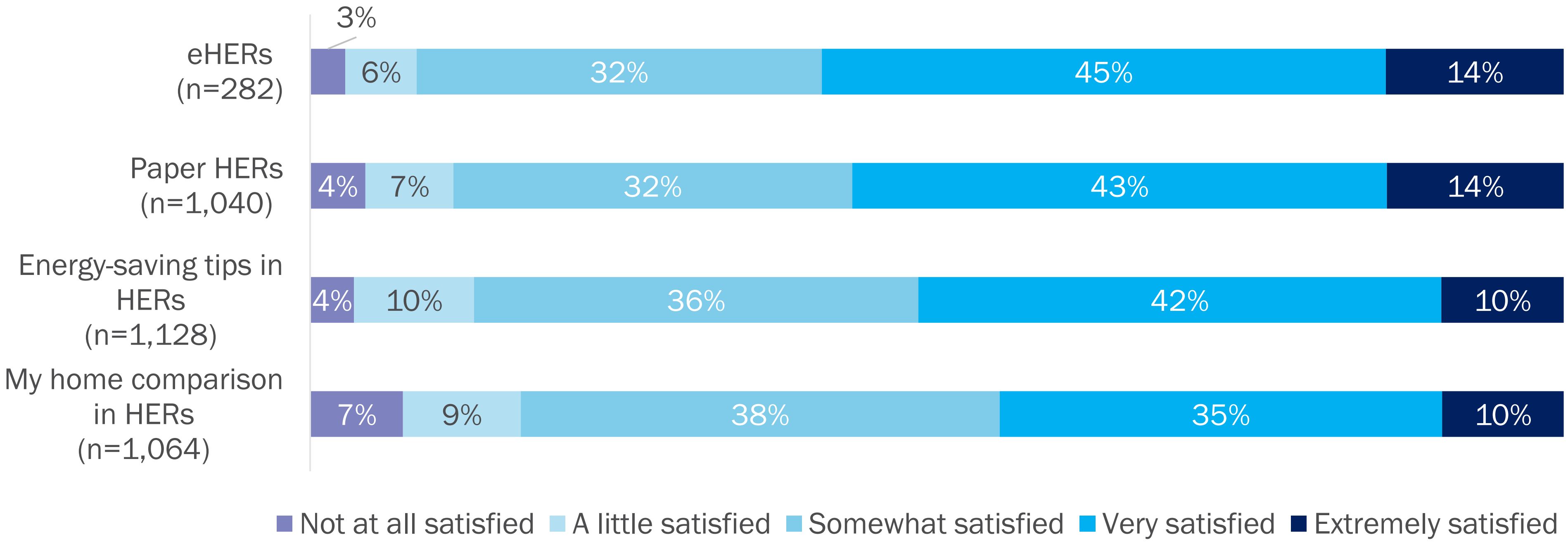


Note: Among treatment customers who have read at least rarely read HERs

Satisfaction with HERs

- Customers are generally satisfied with HERs, including the *My home comparisons* and the *energy saving tips* provided

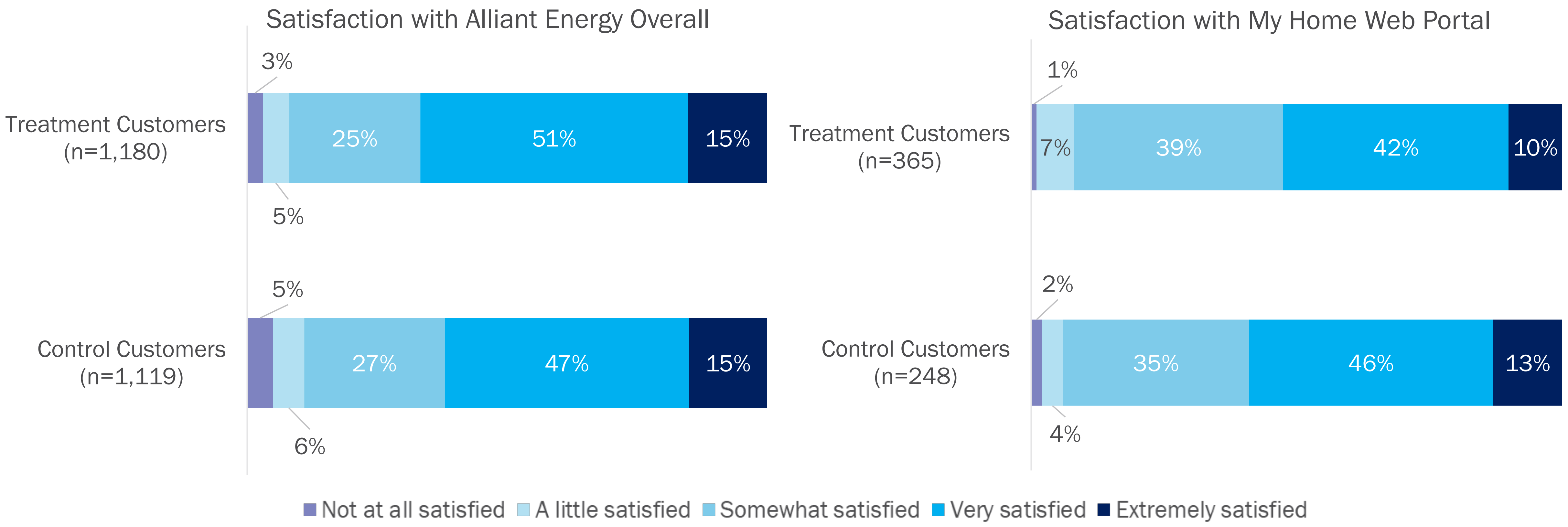
Treatment Customers' Satisfaction with Elements of their HERs



Note: Responses among those that interacted with a given element

Satisfaction with IPL and the My Home Portal

- About two-thirds of customers overall are extremely or very satisfied with Alliant Energy and a little over a half are extremely or very satisfied with the My Home web portal



Note: Responses among those that accessed My Home web portal

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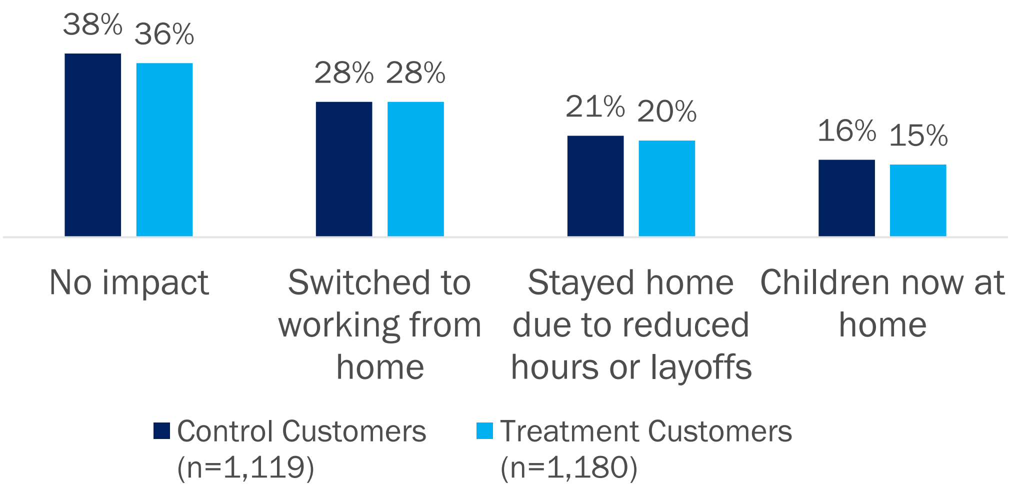
COVID IMPACTS

COVID Impacts

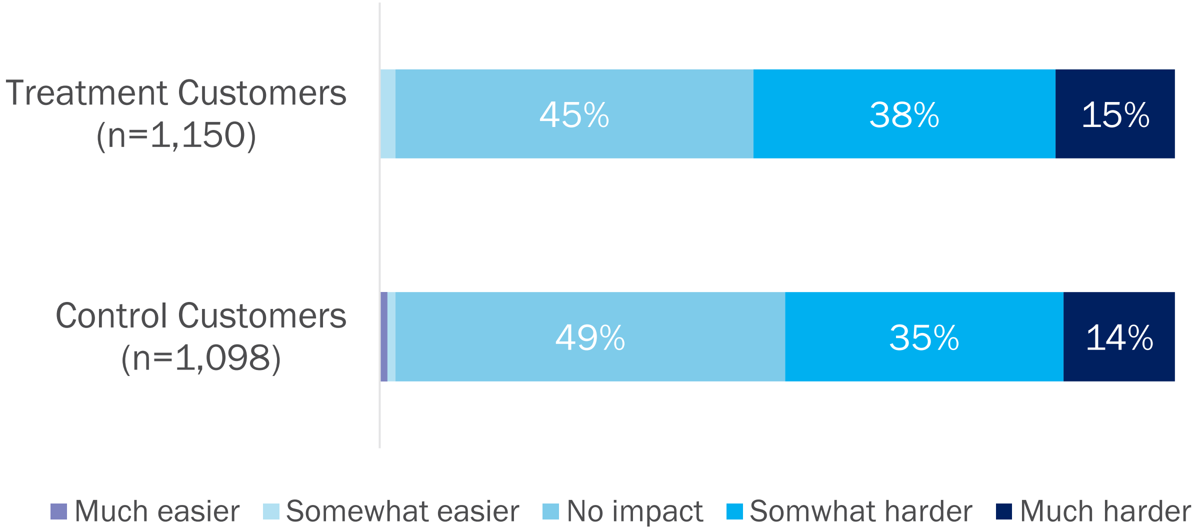
- Treatment and control customers did not substantially differ in how they have been impacted by the pandemic
- Almost two-thirds of customers overall have stayed home more as a result of the pandemic
- The pandemic has made electricity conservation harder for about half of surveyed customers overall

Pandemic Influence on Amount of Time at Home



Note: Multiple responses allowed

Pandemic Influence on Ability to Conserve Electricity



Note: Excludes "don't know" responses

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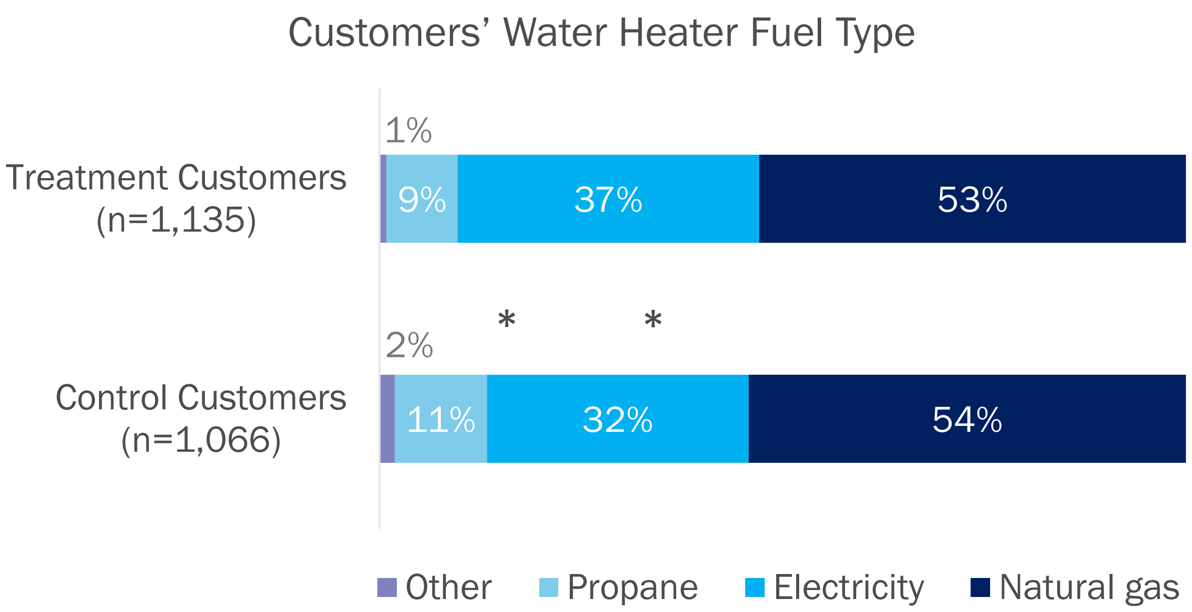
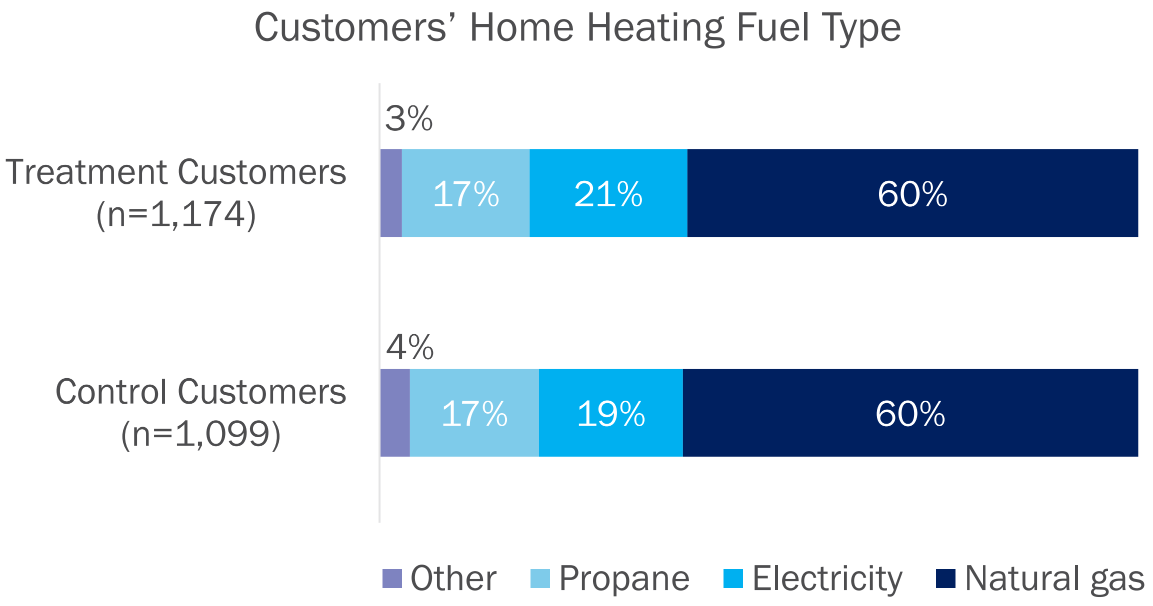
DEMOGRAPHICS AND HOME CHARACTERISTICS

Demographics, Non-Electric Fuel Use

- Treatment and control customers are demographically equivalent
- Most customers use natural gas or propane for their space and water heating needs
- Treatment customers are more likely to have electric water heaters and control customers are more likely to have propane water heaters



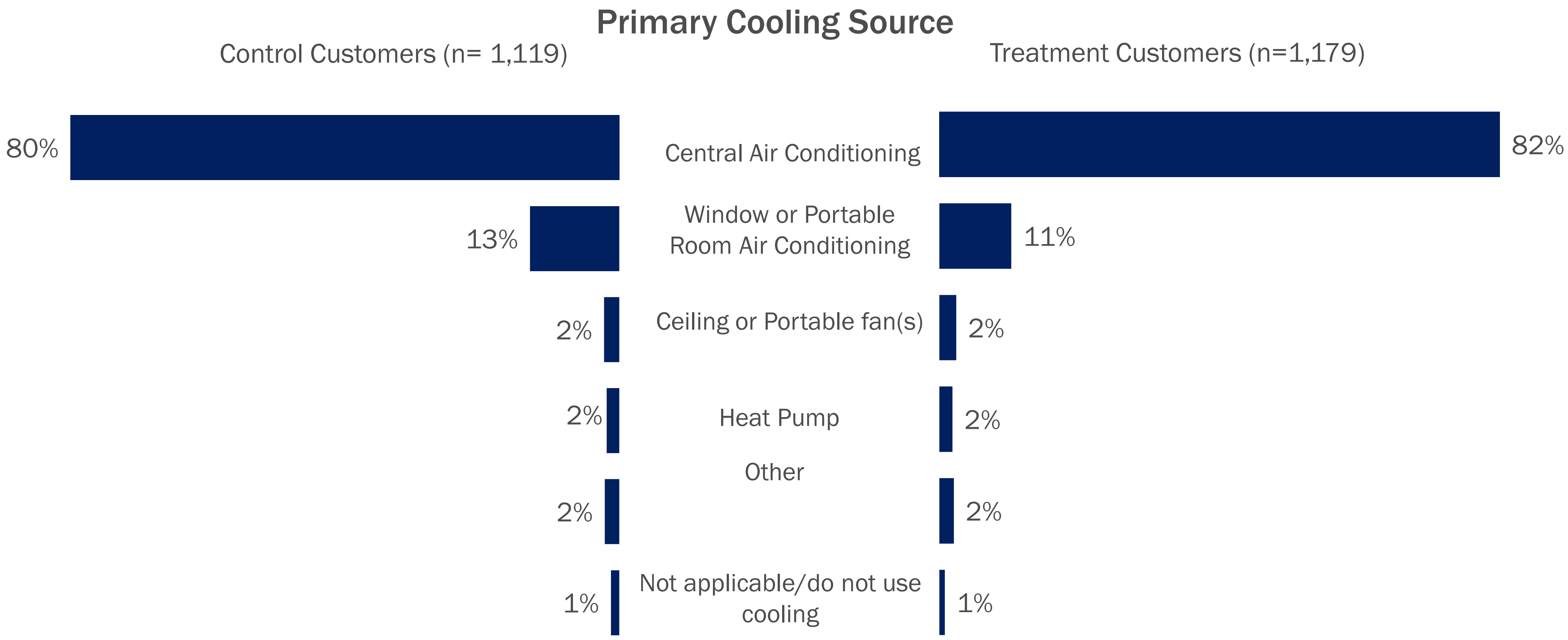
Note: * Denotes significant difference between treatment and control
Excludes "don't know" responses



Note: Excludes "don't know" responses

Home Cooling Sources

- Most customers use central AC for home cooling
- Treatment and control customers' use of home cooling sources did not significantly differ



Note: Excludes "don't know" responses

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SUMMARY OF KEY FINDINGS

Key Finding #1

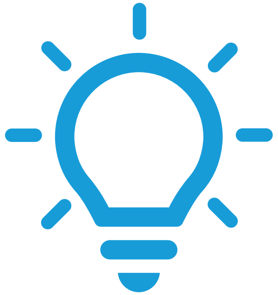
HERs reports are widely read and well received

- The vast majority (96%) recall receiving HERs, most of which claim they read them regularly
- Recipients are generally satisfied with HERs frequency, format, content, and IPL overall

Key Finding #2

eHERs may struggle to have the impact of paper HERs

- Only 24% of eHERs recipients recalled receiving eHERs, compared to 88% recalling receiving paper HERs
- However, there is a disconnect with format preference and deliverability:
  - Despite low awareness of eHERs, about half claim they would prefer eHERs over paper HERs



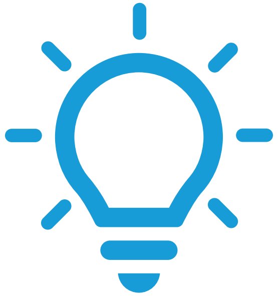
Recommendations:

- Continue sending paper HERs to all customers and eHERs to those with emails on file
- Investigate potential IT solutions to increase delivery and open rates

Key Finding #3

Widespread natural gas and propane use may limit savings opportunities

- Few customers have electric space or water heating technologies
- However, nearly every customer has mechanical air conditioning of some kind



Recommendations:

- Prioritize electricity saving strategies for air conditioner use
- Consider cross-promoting advanced rate offerings (e.g., demand rate) to encourage demand savings (kW) and additional energy savings (kWh)
  - Incorporate time-based shifting and staggering tips [once time-varying rate adoption is sufficient]

Key Finding #4

Although HERs makes customers more cognizant of their energy use, it may not incite substantial behavior change in its current form

- HERs recipients demonstrate significantly greater self awareness of their electricity use and IPL resources for saving energy
- However, HERs recipients report statistically similar levels of conservation behaviors as control customers
- Further, HERs recipients most commonly indicate HERs only “somewhat” motivate them to save electricity

Preliminary Recommendations:

- Explore new content strategies that better encourage electricity savings, such as segmenting/microtargeting customers and providing customized tips
- Conduct A/B testing to help identify new, successful approaches and content
- Conduct qualitative customer research to better understand salience of HERs content

Opinion Dynamics

Discussion

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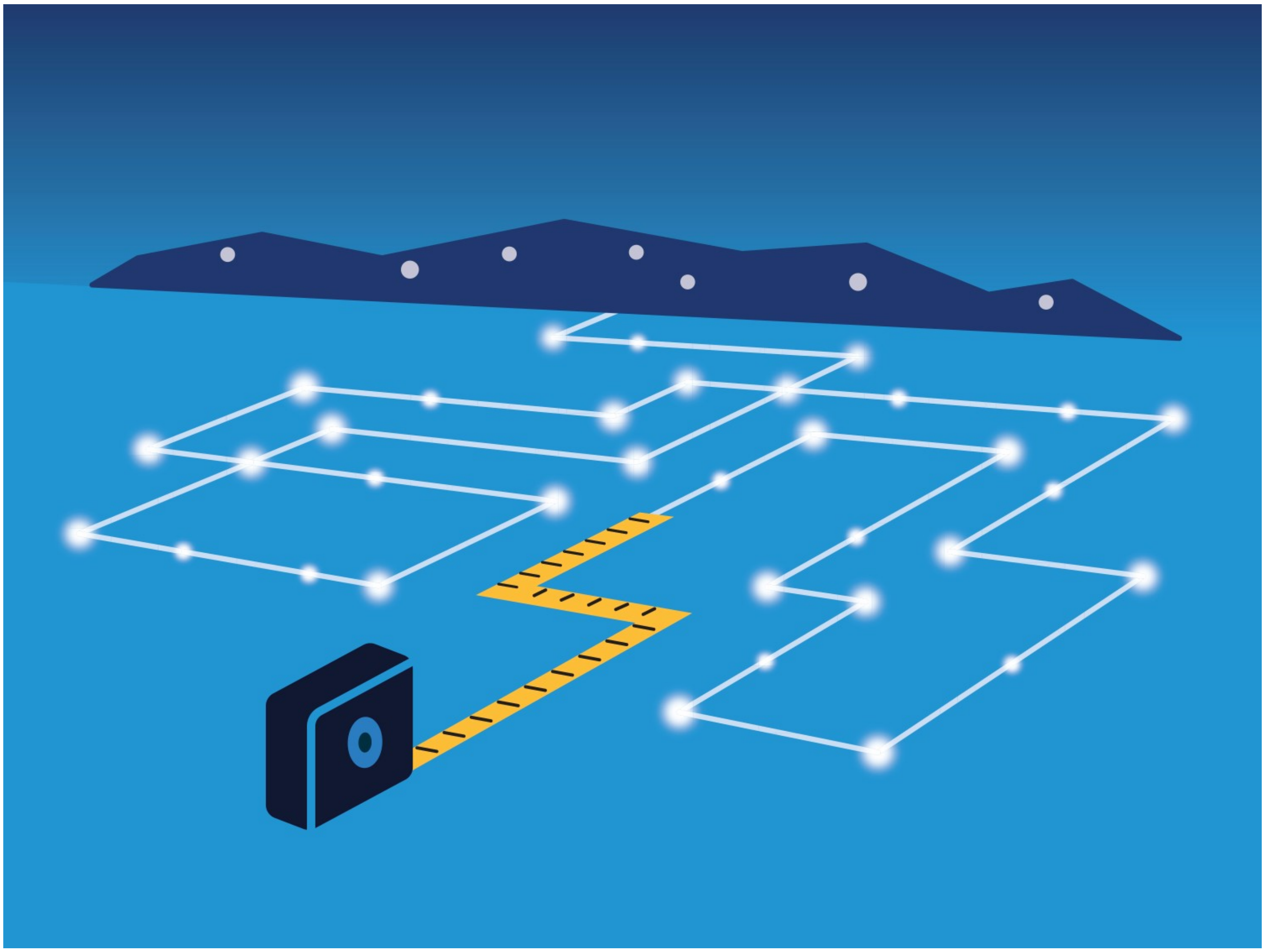

Interstate Power and Light Company

Agricultural Solutions Impact Evaluation Report

Final
March 19, 2021

Opinion Dynamics

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Opinion Dynamics

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1. Executive Summary

This report presents a summary of the findings and results from the 2019–2023 impact evaluation of the Interstate Power and Light Company (IPL) Agricultural Solutions program. The Agricultural Solutions program provides a comprehensive range of energy efficiency incentives to agricultural customers via a suite of products, including agriculture-specific prescriptive rebates and free on-site farm energy assessments.

The primary objectives of the impact evaluation were to quantify gross electric savings impacts from the program during the evaluation period (April 1, 2019–March 31, 2020)[1] and identify how IPL could improve program implementation and the estimation and tracking of program impacts moving forward.

To complete the impact evaluation, the Opinion Dynamics evaluation team conducted program manager and implementer interviews, a program database review, and an engineering impact analysis. Presented in this report are the evaluation methods, findings, and recommendations resulting from the impact evaluation activities.

Table 1 presents the Agricultural Solutions program savings achieved in the evaluation period. The Agricultural Solutions program achieved ex post gross savings of 4,192,476 kWh, 500.20 kW, and 0 therms.[2]

Table 1. Agricultural Solutions Annual Savings

	Electric Energy Savings (kWh)	Electric Demand Savings (kW)	Gas Savings (Therms)
Ex Ante Gross Savings	4,227,537	311.41	-67
Gross Realization Rate	99%	161%	0%
Ex Post Gross Savings	4,192,476	500.20	-

Based on the results of this impact evaluation, the evaluation team offers the following key findings and recommendations for the Agricultural Solutions program moving forward:

- **Key Finding #1**: For all grain dryer records, the ex ante analysis does not leverage actual bushels-per-year values reported in the Tool for Reporting Energy Efficiency Savings (TREES) database whereas the ex post analysis does, resulting in a program savings decrease of roughly 3% from ex ante savings to ex post savings.
  - **Recommendation**: Apply actual bushel-per-year values as an input in the Iowa Energy Efficiency Statewide Technical Reference Manual (IA-TRM) algorithms for grain dryers when estimating savings.
- **Key Finding #2**: For all process variable frequency drive (VFD) measures, the ex ante analysis does not claim electric demand savings, in contrast to the IA-TRM, which specifies demand savings for these measures.
  - **Recommendation**: Apply electric demand savings algorithms from the IA-TRM to estimate savings, starting with IA-TRM V5.0 in 2021.

[1] The choice of evaluation period is discussed further in Section 2

[2] One project reported negative natural gas savings due to lighting measure heating penalties. The IA-TRM specifies that agricultural buildings do not exhibit natural gas heating penalties, and therefore they are excluded from the ex post analysis for all measures.

2. Introduction

Within the following sections, the evaluation team presents the impact evaluation of the Agricultural Solutions program in IPL's 2019–2023 energy efficiency and demand response portfolio.

Across the Nonresidential portfolio, we defined an evaluation period beginning April 1, 2019, and ending March 31, 2020 ("evaluation period") for all programs. We selected this period for impact evaluation to represent one typical program year; IPL's 2019–2023 programs began implementation on April 1, 2019, and the ongoing COVID-19 pandemic is likely to cause nonrepresentative program effects during the 2020 program year, and so we selected an evaluation period that takes these factors into account yet covers a relatively representative program period lasting one year.

The following sections provide a high-level summary of program implementation, describe program participation in the evaluation period, detail our impact evaluation approach and methods, and report evaluation results, including ex post savings, findings, and recommendations.

2.1 Program Description

The Agricultural Solutions program provides a comprehensive range of energy efficiency incentives to agricultural customers via a suite of products, including agriculture-specific prescriptive rebates and free on-site farm energy assessments. The program is implemented by IPL and a third-party vendor, Franklin Energy.

IPL offers prescriptive rebates for electric energy efficiency measures intended for agriculture-specific applications. To participate, nonresidential agricultural customers must submit a program rebate application with documentation on the equipment purchase and installation to IPL's rebate processing center. IPL provides rebates for eligible equipment in the form of a check. Rebates are also available for constructing new facilities or expanding and upgrading existing facilities for various and diverse operations, such as for grain, swine, poultry, dairy, or beef.

Franklin Energy conducts the farm audits to inspect energy-using equipment and provide the customer with a written report recommending cost-effective energy efficiency upgrades and information about IPL's rebate programs. Franklin Energy maintains close relationships with agricultural customers and guides them through the rebate process of the Agricultural Solutions program. If a customer identifies energy efficiency upgrade opportunities which are not eligible for an Agricultural Solutions rebate (through a farm assessment or otherwise), Franklin Energy will also facilitate the customer's participation in IPL's Custom Solutions program by assisting the customer with participation forms, such as applications, and coordinating with IPL and the Custom Solutions program implementer on the customer's behalf.[3] The QA/QC process involves Franklin Energy performing on-site verification of a random sample of 3% of retrofit rebate projects selected by IPL and 100% of new construction projects.

Measures offered in the program include LED fixtures, grain bin fan controls, grain dryers, heat mats, livestock ventilation fans, and VFDs on dairy vacuum pumps, among other agricultural-specific measures (See Table 2 for the list of measure categories implemented in the evaluation period).

[3] Savings from custom measure installations are claimed in the Custom Solutions program.

Key Implementation Changes in Evaluation Period

Recent changes to program implementation have impacted participation, the achieved measure mix, and ex ante savings in the evaluation period:

- IPL removed incentives for dairy scroll compressors and high-volume low-speed fans from program offerings at the beginning of the 2019–2023 plan cycle.
- IPL discontinued incentives for participating dealers at the beginning of the 2019–2023 plan cycle.

2.2 Participation Summary

Table 2 summarizes Agricultural Solutions program participation during the evaluation period. The Agricultural Solutions program supported 216 projects with ex ante energy savings of 4,227,537 kWh and 311.41 kW of demand savings.

Table 2. Agricultural Solutions Participation Summary

Measure Category	Total Projects[a]	Ex Ante Gross Savings	
		kWh	kW
Grain Bin Fan Controls	14	1,413,625	0
LED Lighting	183	1,368,992	234.15
Process VFDs	19	340,140	0
Heat Mat	4	327,435	0
Ventilation Fans	16	315,562	64.75
Grain Dryer	15	304,000	0
Livestock Waterer	14	91,632	0
Heat Lamps	1	37,440	0
Circulation Fans	4	20,111	9.58
Geothermal Heat Pumps	2	5,896	0.83
Motors	3	2,673	2.06
Occupancy Sensors	1	31	0.05
Total	**216**	**4,227,537**	**311.41**

[a] Measure category project counts do not sum to the total projects because a project can contain more than one measure category

Grain Bin Fan Controls and LED Lighting account for 66% of the ex ante energy savings; process VFDs, ventilation fans, heat mats, and grain dryers account for an additional 30% of energy savings. LED lighting and ventilation fans make up 96% of the ex ante demand savings.

Table 3 presents a comparison of Agricultural Solutions program participation from the most recent evaluation in 2014 against the participation during the current evaluation period. Both ex ante electric energy and electric demand savings in the evaluation period are less than half of the program savings reported in 2014. According to program managers and implementers, this could be driven by a general economic downturn for the Iowa farming community as well as continuously rising prices for energy-efficient equipment leading to longer payback periods on energy efficiency investments. Franklin Energy conducted eleven audits in the evaluation period, compared to 40 in 2018.

Table 3. Comparison to 2014 Agricultural Solutions Participation Summary

Measure Category/Track	2014 Ex Ante Gross Savings		Evaluation Period Ex Ante Gross Savings	
	kWh	kW	kWh	kW
Heat Lamps	3,962,106	456.06	37,440	0.00
Lighting[a]	2,732,488	441.60	1,368,992	234.15
Occupancy Sensors	N/A	N/A	31	0.05
VFDs	836,319	179.19	340,140	0.00
Grain Dryers	164,400	0.00	304,000	0.00
Geothermal Heat Pumps	31,453	4.40	5,896	0.83
Livestock Vent Fans	963,289	118.33	315,562	64.75
Motors	N/A	N/A	2,673	2.06
Grain Bin Fan Controls[b]	N/A	N/A	1,413,625	0.00
Heat Mat	N/A	N/A	327,435	0.00
Livestock Waterer	N/A	N/A	91,632	0.00
Circulation Fans	N/A	N/A	20,111	9.58
Other Measures[c]	307,835	40.56	N/A	N/A
Total	**8,997,890**	**1,240.14**	**4,227,537**	**311.41**

[a] In 2014, Lighting measures included CFL, LED, linear fluorescents, and high bay lamps. In the evaluation period, Lighting measures include LED Fixtures and Linear LEDs.
[b] Prior to 2016 grain bin fan controls would have gone through the Custom program
[c] In 2014, Other Measures included automatic milker take-offs, variable speed drives for dairy vacuum pumps, heat reclaimers, milk pre-coolers, and scroll compressors. In the evaluation period, all measures are reported individually.

Measures installed through the Agricultural Solutions program in the evaluation period differ from those offered in 2014. The Agricultural Solutions program no longer offers fluorescent, high pressure sodium, and metal halide lighting measures (e.g., CFL, linear, high bay). Conversely, the Agricultural Solutions program continues to offer LED lighting measures, with the addition of exterior LEDs and linear LEDs. Combined, all lighting measures account for 32% and 75% of ex ante energy savings and demand savings, respectively, in the evaluation period (compared to 30% and 36% in 2014). Additionally, the Agricultural Solutions program saw a significant decrease in the share of ex ante savings from the heat lamp measure. In 2014, heat lamp measures were the greatest contributor to program savings, making up 44% and 37% of ex ante energy savings and demand savings, respectively, compared to 1% and 0% in the evaluation period. Nearly 44% of ex ante energy savings for the evaluation period are from measures that the program did not offer in 2014. Grain bin fan controls are the most impactful new measure, which are the single largest contributor of ex ante energy savings in the evaluation period.

3. Impact Evaluation Approach and Methods

The evaluation team developed ex post estimates of the gross electric energy and electric demand impacts from the Agricultural Solutions program. Impact evaluation activities included verification of program tracking data and verification of engineering calculations as part of estimating program savings.

Table 4. Impact Evaluation Activities

Evaluation Activity	Details
Program Manager & Implementer Interviews	▪ Interviewed program and implementation staff to gather staff perspectives on the performance of the program and to highlight any key areas where insight is needed from evaluation.
Program Database Review	▪ Reviewed program tracking system to ensure that data required for the evaluation are collected and data are complete.
Impact Analysis	▪ Reviewed project documentation and calculations to account for analytical errors, incorrect assumptions, etc. ▪ Verified that ex ante savings use correct IA-TRM values and algorithms. ▪ Developed ex post savings using IA-TRM values and algorithms and any updated evaluation-estimated parameters.

Program Manager & Implementer Interviews

To support our evaluation, we conducted interviews with program and implementation staff to cover program performance and other topics relevant to our impact and process evaluation research objectives. In total, we completed two interviews: one with IPL staff covering all Nonresidential Programs and one with Franklin Energy staff specific to the Agricultural Solutions program. While these interviews were predominantly process-focused, they also allowed us to fully explore ongoing efforts of program administrators and implementers, providing insight and context to the impact evaluation results.

We conducted the interview with IPL staff on October 15, 2020 and the interview with Franklin Energy staff on November 13, 2020. We recorded and transcribed both interviews.

Program Database Review

The evaluation team reviewed the program tracking database for the evaluation period to identify any database inconsistencies, such as duplicate records or misalignments between the IA-TRM and the data tracked in the TREES program database. The team first compared the total savings claimed between April 1, 2019 through December 31, 2019 within the TREES tracking database against the 2019 reported ex ante savings. The team found that savings totals aligned between the two sources and verified that the TREES database includes all completed projects through the program.[4] The evaluation team conducted a comprehensive comparison of fields populated in the TREES database against the required parameters necessary for calculating savings from the IA-TRM.

Based on the database review findings, the evaluation team identified two required parameters not included in the TREES program database: project replacement type (e.g., time of sale, retrofit, early replacement) and

[4] ANNUAL REPORT for 2019 Energy Efficiency Plan of Interstate Power and Light Co. (IPL) an Alliant Energy Company, May 1, 2020. Docket number EEP-2018-0003.

heat mat measure controller quantity. The evaluation team requested details on this data and incorporated responses from the implementation team into the impact calculations.

The database review resulted in the determination that a population-level engineering analysis was possible, eliminating the need to conduct desk reviews on a sample of projects and extrapolate the results of those reviews to the population of projects and measures. Population-level analysis is only possible when high-quality, comprehensive, and complete data are available at the measure level. From our review, the TREES database met those criteria (with the exceptions noted above).

Impact Analysis

The evaluation team conducted an engineering analysis on the entire program population to quantify ex post gross savings impacts for each measure-level record in the Agricultural Solutions program tracking database. The evaluation team applied the IA-TRM algorithms and assumptions in coordination with the program tracking data to derive ex post gross savings.

The IA-TRM is based on calendar years, with the IA-TRM V3.0 effective for the 2019 calendar year, and the IA-TRM V4.0 effective for the 2020 calendar year. The evaluation period, starting April 1, 2019 and running through March 31, 2020, spanned both versions (V3.0 and V4.0) of the IA-TRM. The evaluation team used the “acquired_date” field from the program tracking database to determine the applicable IA-TRM version.[5]

Grain Bin Fan Controls, which IPL recently converted from the custom program and which account for more than 33% of the program ex ante savings in the evaluation period, is not included in the IA-TRM. The evaluation team requested documentation detailing custom ex ante savings algorithms and assumptions applied by the implementation team. For each program year, 2019 and 2020, the implementation team provided separate, custom *Non-TRM Program Impact Algorithms* documentation.[6] The evaluation reviewed the algorithms and assumptions and found them to be high-quality and defensible. Therefore, we applied the same methods in ex post analysis. See Appendix A for additional detail on the ex ante savings and ex post savings estimation methods for the grain bin fan control measure.

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[5] A measure’s installation date in the TREES database determines the appropriate IA-TRM version to apply. Measures installed within the 2019 calendar year use the IA-TRM V3.0, while measures installed in the 2020 calendar year apply the IA-TRM V4.0

[6] For 2019 program reporting year, documentation provided as excel file entitled: *2019 Non-TRM Program Impact Algorithms_v5.* For 2020, excel file entitled: *2020 Non-TRM Program Impact Algorithms_v1.*

4. Results

4.1 Program Savings Summary

Table 5 presents ex post gross Agricultural Solutions savings achieved during the evaluation period. The Agricultural Solutions achieved ex post gross savings of 4,192,476 kWh, 500.20 kW, and 0 therms. One project reported negative natural gas savings due to lighting measure heating penalties. The IA-TRM specifies that agricultural buildings do not exhibit natural gas heating penalties, and therefore they are excluded from the ex post analysis for all measures. Throughout this report we present natural gas savings in the overall program performance tables for completeness but exclude them from other tables for brevity.

Table 5. Agricultural Solutions Annual Savings

	Electric Energy Savings (kWh)	Electric Demand Savings (kW)	Gas Savings (Therms)
Ex Ante Gross Savings	4,227,537	311.41	-67
Gross Realization Rate	99%	161%	0%
Ex Post Gross Savings	4,192,476	500.20	0

4.2 Program Savings Details

The Agricultural Solutions program incentivized a variety of measures, as shown in Table 6 through Table 7. The tables present electric energy and electric demand by measure category and are followed by a discussion of key drivers of discrepancies between the reported ex ante savings and ex post gross savings.

LED Lighting and Grain Bin Fan Controls are the two greatest drivers of Agricultural Solutions program savings, accounting for more than 35% and 33% of ex post gross electric energy savings, respectively, while process VFDs, heat mats, and ventilation fans account for 8% of ex post savings each. All other measures collectively account for 8% of ex post energy savings. Electric energy realization rates ranged from 3% (motors) to 115% (geothermal heat pumps). Overall, the Agricultural Solutions program achieved a 99% gross realization rate for electric energy. Table 6 presents electric energy realization rates, by measure, for the Agricultural Solutions program in the evaluation period.

Table 6. Agricultural Solutions Electric Energy Savings by Measure

Measure Category	Ex Ante Gross Savings (kWh)	Gross Realization Rate	Ex Post Gross Savings (kWh)
LED Lighting	1,368,992	108%	1,481,444
Grain Bin Fan Controls	1,413,625	99%	1,396,425
Process VFDs	340,140	98%	332,478
Heat Mat	327,435	100%	325,903
Ventilation Fans	315,562	100%	315,562
Grain Dryer	304,000	61%	184,600
Livestock Waterer	91,632	100%	91,632
Heat Lamps	37,440	100%	37,440
Circulation Fans	20,111	100%	20,111
Geothermal Heat Pumps	5,896	115%	6,768
Motors	2,673	3%	83
Occupancy Sensors	31	100%	31
Total	**4,227,537**	**99%**	**4,192,476**

LED lighting accounts for almost half of ex post demand savings (47%) while process VFDs and ventilation fans account for 38% and 13%, respectively. All other measures collectively account for 2% of ex post demand savings. Electric demand realization rates ranged from 4% (motors) to 154% (geothermal heat pumps). Overall, the Agricultural Solutions program achieved a 161% gross realization rate for electric demand. Table 7 presents electric demand realization rates, by measure, for the Agricultural Solutions program in the evaluation period.

Table 7. Agricultural Solutions Electric Demand Savings by Measure

Measure Category	Ex Ante Gross Savings (kW)	Gross Realization Rate	Ex Post Gross Savings (kW)
LED Lighting	234.15	101%	236.77
Process VFDs	0	N/A	187.70
Ventilation Fans	64.75	100%	64.75
Circulation Fans	9.58	100%	9.58
Geothermal Heat Pumps	0.83	154%	1.28
Motors	2.06	4%	0.08
Occupancy Sensors	0.05	100%	0.05
Grain Bin Fan Controls	0	N/A	0
Heat Mat	0	N/A	0
Grain Dryer	0	N/A	0
Livestock Waterer	0	N/A	0
Heat Lamps	0	N/A	0
Total	**311.41**	**161%**	**500.20**

The reasons for differences between ex ante and ex post gross savings for each measure are as follows:

- Grain Dryers: The gross electric energy realization rate for grain dryers is 61%.
  - The ex post analysis applied actual bushels-per-year values from program tracking data rather than default values from the IA-TRM, as applied in the ex ante analysis.[7] The actual bushels-per-year values are lower, on average, than the IA-TRM default values, resulting in lower ex post savings. There are no demand savings for this measure, so this finding affects energy savings only.
- LED Lighting: The gross realization rates for LED lighting are 108% for electric energy, 101% for electric demand, and 0% for natural gas.
  - A single project consisting of 192 exterior LED lamps underestimated savings by 156 kWh. Based on measure-specific information in the program tracking data, the ex post analysis calculated an increase in savings of 80,933 kWh over ex ante savings. Using known values from the program tracking data, including quantity, wattage, and building type, the evaluation attempted to back-calculate parameter assumptions from the IA-TRM, but could not determine the discrepancy source. The overall impact on the LED Lighting measure group is an increase of roughly 6% for ex post electric energy savings as compared to ex ante savings.
  - For 13% of LED lighting records (n=28), the evaluation team was unable to resolve discrepancies between ex ante savings estimates and ex post savings estimates. Across these 28 records, we observed high variability in the discrepancy percentages between ex post savings and ex ante savings. Using known values from the program tracking data, including quantity, wattage, and

[7] Actual bushels-per-year values were reported under the field name *avg_bushels_dried_year* in the TREES database.

building type, the evaluation team attempted to back-calculate parameter assumptions from the IA-TRM, but could not determine the source of discrepancies. The overall impact on the LED Lighting measure group is an increase of roughly 4% for ex post electric energy savings as compared to ex ante energy savings.

- Program tracking data for 26% of LED lighting records (n=55) assigned either an existing wattage for replaced lamps of 0 watts or an entry of “N/A,” indicating no previous lamp existed at the project site. In these scenarios, the evaluation team assumed a time-of-sale replacement and applied the IA-TRM specified in-service rate (ISR) of 95%. Ex ante calculations applied the retrofit ISR of 100%. This ISR difference decreased total electric energy savings by roughly 2% in the ex post analysis as compared to ex ante energy savings in the LED Lighting measure group.
- For one project, accounting for 1% of LED lighting records (n=3), the ex ante analysis claims negative natural gas savings. These three measures represent the only natural gas savings reported in the Agricultural Solutions program. The ex post analysis estimated zero natural gas savings for all records, in accordance with the IA-TRM, which stipulates that agricultural building types do not have specified natural gas or electric heating penalties.

- Process VFDs: The electric energy gross realization rates for process VFDs is 98%. Electric demand savings are not claimed in the ex ante analysis, however the ex post analysis estimates electric demand savings of 0.188 MW.
  - For all process VFD records (n=36), the ex ante analysis did not claim electric demand savings, but the IA-TRM does indicate same savings for these measures. The IA-TRM V3.0 specifies custom demand calculations for process VFD measures, leading the evaluation team to leverage the IA-TRM V4.0 prescriptive approach for demand savings.
- Motors: The gross realization rates for motors are 3% for electric energy and 4% for electric demand.
  - For all motor records (n=4), the ex ante analysis applied the reported installed motor efficiency value as an integer (e.g., 88) and not a percentage when estimating electric energy and demand savings. Since the IA-TRM specifies percentage efficiency values be applied in the motor algorithms, the ex post analysis converts the reported installed motor efficiency values into a percentage (e.g., 88%) when estimating savings. This calculated error resulted in overstated ex ante savings; correcting the error resulted in significantly lower ex post electric energy and demand savings.
- Geothermal Heat Pumps: The gross realization rates for geothermal heat pumps are 115% for electric energy and 154% for electric demand.
  - For one of two reported geothermal heat pump records, the evaluation team found a discrepancy between ex ante savings and ex post savings. For this one record, we used known values from the program tracking data, including cooling and heating capacity, system efficiencies, and building type, to back-calculate parameter assumptions from the IA-TRM, but could not determine the discrepancy source. The overall impact on the geothermal heat pump measure group is an increase of roughly 15% for ex post electric energy savings as compared to ex ante savings.

5. Findings and Recommendations

Based on the results of this evaluation, the evaluation team offers the following key findings and recommendations for the Agricultural Solutions program moving forward:

- **Key Finding #1**: For all grain dryer records, the ex ante analysis does not leverage actual bushels-per-year values reported in the TREES database, whereas the ex post analysis does, resulting in a program savings decrease of roughly 3% from ex ante savings to ex post savings.
  - **Recommendation**: Apply actual bushel-per-year values as an input in the IA-TRM algorithms for grain dryers when estimating savings.
- **Key Finding #2**: For all process VFD measures, the ex ante analysis does not claim electric demand savings, in contrast to the IA-TRM, which specifies demand savings for these measures.
  - **Recommendation**: Apply electric demand savings algorithms from the IA-TRM to estimate savings, starting with IA-TRM V5.0 in 2021.

Appendix A. Detailed Methodology

The evaluation team calculated ex post savings by applying program tracking data and savings methods from the IA-TRM for all but one measure category in the Agricultural Solutions program: Grain Bin Fan Controls. The evaluation team applied the IA-TRM V3.0 to measures completed in 2019 and applied the IA-TRM V4.0 to measures completed in 2020.[8] We found IA-TRM V3.0 and IA-TRM V4.0 methods for the Agricultural Solutions program to be consistent with each other except for geothermal heat pump and motor measures. We observed the following differences between IA-TRM V3.0 and V4.0:

- Geothermal Heat Pumps
  - The IA-TRM V4.0 specifies values of 11.8 and 8.2 for baseline EER and HSPF, respectively whereas the IA-TRM V3.0 refers the reader to IECC efficiency lookup tables.
  - The IA-TRM V4.0 received updated values over V3.0 for coincidence factors by building type table.
- Motors
  - The IA-TRM V4.0 received updated values over V3.0 for operational hours by motor horsepower.

Table 8 lists the section in the IA-TRM used to evaluate each measure in the Agricultural Solutions program.

Table 8. Agricultural Solution Program Measures Evaluated

Measure Category	IA-TRM Section	IA-TRM Section Name
LED Lighting	3.4.5	LED Fixtures
Grain Bin Fan Controls	N/A – Non-TRM measure	N/A – Non-TRM measure
Ventilation Fans	3.1.2	Ventilation Fans
Process VFDs	3.5.1	Variable Frequency Drives for Process
Heat Mat	3.1.9	Heat Mat
Grain Dryer	3.1.10	Grain Dryer
Livestock Waterer	3.1.11	Livestock Waterer
Heat Lamps	3.1.7	Heat Lamp
Circulation Fans	3.1.1	Circulation Fans
Geothermal Heat Pumps	3.3.5	Geothermal Source Heat Pump
Motors	3.5.3	Motors
Occupancy Sensors	3.4.12	Occupancy Sensor

Custom Engineering Savings Method for Grain Bin Fan Control Measures

The IA-TRM does not include a section detailing measure savings algorithms and assumptions for Grain Bin Fan Controls. Therefore, the implementation team developed and applied custom methods to estimate ex ante savings.

[8] The evaluation team used the installed date in the TREES database to determine the appropriate IA-TRM version to apply. Measures installed within the 2019 calendar year use the IA-TRM V3.0, while measures installed in the 2020 calendar year apply the IA-TRM V4.0.

Table 9 and Table 10 document the algorithms and assumptions leveraged by both the implementation team to develop ex ante estimates and by the evaluation team in the ex post analysis.

Table 9. Algorithms for Grain Bin Fan Control Measures[9]

Algorithms	
kWh Savings	= Fan_{BHP} × kWh Savings per HP
kW Savings	= 0
Fan_{BHP}	= (Design CFM × Static Pressure/ 6356 × Fan eff) × (1+ Exhaust Fan Factor)
kWh Savings per HP	= 1hp × kWConversion × 1/ $Efficiency_{motor}$ × ($Hours_{manual}$ – $Hours_{controls}$)
Design CFM	= Bushel Capacity × Design CFM per Bushel
Bushel Capacity	= π × (Diameter/ 2)^2 × Eave Height × Bushels/ft^3
Static Pressure	= (0.002142 × Eave Height^2) + (-0.067922 × Eave Height) + 1.212104

Table 10. Input Assumptions for Grain Bin Fan Control Measures[10]

Parameter	Default Value	Description	Source
Fan_{BHP}	Calculated	Fan brake horsepower (including motor loading) required to provide the necessary aeration to grain bin	Algorithm
kWh Savings per HP	Calculated	The standard kWh savings per brake horsepower (BHP) for grain bin aeration fans	Algorithm
Design CFM	Calculated	The total CFM required to provide proper aeration to the stored grain	Algorithm
Bushel Capacity	Calculated	The total storage capacity of the grain storage bin, in bushels	Algorithm
Design CFM per Bushel	0.170 CFM/bushel	Design CFM required per Bushel for proper aeration	Vendor design information, comparison to Alliant Energy Custom Rebate data from 2013–2015
Static Pressure	Calculated	The design static pressure of the stored grain required to be overcome by the aeration fan	Kansas State University research paper http://entomology.k-state.edu/doc/finished-chapters/s156-ch11.pdf.
Fan Eff	60%	Fan efficiency	Rule of thumb for fans with high static pressure
Exhaust Fan Factor	5%	The percentage of the aeration fan horsepower that can be attributed to the bin exhaust fans, which are also controlled in the system	Alliant Energy Custom Rebate project data from 2013–2015
kWConversion	0.7457 kW/HP	Conversion from brake horsepower to kW	Standard conversion
$Efficiency_{motor}$	93.60%	Default motor efficiency	For a NEMA Premium Efficient, 60HP, ODP, 3600RPM motor; Typical for larger bin sizes,

[9]The implementation team developed the algorithms and assumptions shown in Table 9 and Table 10. All algorithms and assumptions are sourced from excel documentation files entitled: *2019 Non-TRM Program Impact Algorithms_v5* and *2020 Non-TRM Program Impact Algorithms_v1.*
[10] Ibid

Parameter	Default Value	Description	Source
			per Alliant Energy Custom Rebate project data from 2013–2015
$Hours_{manual}$	720 hours	Annual hours of operation for grain storage bin aeration fans with manual controls	Alliant Energy Custom Rebate project data from 2013–2015
$Hours_{controls}$	180 hours	Annual hours of operation for grain storage bin aeration fans with controls	Integris fan control runtime models, Alliant Energy Custom Rebate project data from 2013–2015
Diameter	Actual	Diameter of the storage bin, in feet	Provided on application form and on invoice
Eave Height	Actual	Height of the storage bin walls before the roof begins; Not to be confused with peak height, which is the top of the roof	Provided on application form and on invoice
$Bushels/ft^3$	0.804 $Bushels/ft^3$	Bushels per cubic foot (for storage)	Approximations for volume per bushel of dry grain or shelled corn. https://www.extension.iastate.edu/agdm/wholefarm/html/c6-84.html

The evaluation team reviewed documentation detailing these custom, non-TRM savings algorithms and assumptions for each program reporting year, 2019 and 2020. We found that the algorithms and assumptions for each program year were identical. From our review, we determined that the methods are high-quality and defensible. Therefore, we applied the algorithms and assumptions in the ex post savings analysis, substituting deemed eave heights and eave diameters with actual values reported in the TREES database for each record.

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Memorandum

To: Kari Gehrke and Nick Ludwig, Interstate Power & Light

From: The Opinion Dynamics Evaluation Team

Date: March 29, 2021

Re: Interstate Power & Light (IPL) Nonresidential Interruptible Rates (NIR) Program Participant Interview Results

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This memo summarizes the results from the NIR participant interviews. The results presented in this memo focus on key findings related to participant experience, sentiment toward recent tariff changes, satisfaction with program processes, and the impact of COVID-19 on participant businesses and future engagement with the program.

Program Description

IPL's NIR program is a tariff-based curtailment program that achieves peak demand reductions by offering incentives to participants who reduce their loads during periods of high market prices or reliability-based events. In return for reducing power when called to do so, program participants earn incentives in the form of bill credits. The program refers to calls for reduction as “interruptions”. IPL calls interruptions based on several conditions, as per the tariff:

- System reliability
- Energy efficiency (peak demand and energy)
- Program quality control.

A minimum interruptible load of 200kW is required to qualify for the program. During interruptions, participants must reach a predetermined, contractual, firm demand. In return, participants receive monthly interruptible bill credits (Table 1).

Table 1. 2020 NIR Program Bill Credits

Season	Bill Credit ($/kW FSL)
Summer	$5.37
Winter	$3.46

Program participants can implement their own demand reduction strategies via shed, shift, or on-site generation. IPL notifies participants of the scheduled interruptions via their Power Manager Communication system. The system can send notifications simultaneously to multiple contacts within the participant company and offers a range of modes, including phone, email, and text. Notifications contain interruption start and end time and are dispatched at least two hours prior to the scheduled interruption. Recently, IPL[1] changed its electric tariff to reduce the NIR participant bill credits to the levels shown in Table 1 above. The updated tariff also extended the mandatory contract period from one-year to three-years.

Methodology Overview

The evaluation team interviewed 29 active participants in the NIR program, representing 31 enrolled accounts across 28 unique organizations.[2] We drew a purposive sample of 48 primary contacts from the population of 157 primary contacts active in the program in 2020. We selected contacts in the sample to ensure a variety of participant characteristics, with the focus on the size of the service level commitment, customer business segment, and presence of back-up generation. We reached out to participants via email to schedule interviews, and we completed interviews over the phone. We completed interviews between December 15th, 2020 and January 22nd, 2021.

Participant Characteristics

- Most of the participants (55%) we interviewed represented manufacturing facilities, including equipment manufacturers, lumber and paper product manufacturers, and chemical manufacturers. We also interviewed participants representing water utilities (14%), educational facilities (10%), agricultural facilities (10%), medical facilities (3%), wastewater treatment plants (3%), and insurance agencies (3%).
- More than half of participants (54%) reported they had been participating in the NIR program for over 15 years. Conversely, 7% of participants said their organization enrolled in the program within the last 5 years.
- Nearly two-thirds (63%) of participants reported operating on a 24/7 schedule, at least during part of the year. These participants represented many of the manufacturing facilities, water utilities, medical facilities, agricultural facilities, educational organizations, and the wastewater treatment plant. Notably, participants from the agricultural and educational organizations reported their operations vary by season. Other organizations reported traditional 5-day work weeks with 8–10 hour shifts.

While we interviewed a diverse group of participants, many of them reported the same types of equipment account for the bulk of their electricity usage, including motors (64%), process-related equipment (36%), and space heating and cooling equipment (21%).

Motivations for Program Enrollment

The primary reason for program enrollment is to take advantage of bill credit opportunities. Over eight in ten (82%) of participants cited the bill credits as the primary factor in their organization's decision to participate in the program. Two participants reported seeking the resilience of adding back-up generation and one reported a desire to serve as a good partner to Alliant Energy.[3]

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[1] Customers know the utility as Alliant Energy. Therefore, we refer to the utility as Alliant Energy in the following discussions on participant experience.
[2] Two participants managed operations at different locations for the same organization.
[3] Two participants did not know their organization's motivations for participating.

Participation Experience

Due to the long-running nature of the NIR program, many participants have well-established systems in place to respond to interruptions and typically deploy the same response strategy for every interruption.

- Response strategies to interruptions varied among interviewed participants and included the following combinations:
  - Over half (52%) of participants used back-up generation, either exclusively or in combination with other load curtailment strategies, to reach their firm service level (FSL) commitment during interruptions. Over one-third of participants (38%) relied exclusively on back-up generation to curtail load during interruptions, while 14% used a combination of back-up generation and other strategies. Most participants (80%) who reported using back-up generation in their response used diesel generators; one participant reported using natural gas and coal cogeneration and another used a natural gas generator.[4] More than half the participants (55%) who exclusively relied on back-up generation had enough generation capacity to offer 0 kW service level commitments.
  - One-fifth (21%) of participants reported using a combination of load shifting and shedding to respond to interruptions. Most commonly used approaches included reducing or shutting down operations during the interruptions. Depending on production schedules, their organizations may try to make up for this lost production by extending shifts or adding days to the production schedule.
  - Just about a quarter of participants (24%) exclusively shed load during interruptions by completely shutting down operations, leaving just a small buffer of load to support critical functions, such as office lighting and computers. Notably, these participants did not adjust production schedules to make up for lost production during interruptions. These participants also tend to have lower service level commitments.
  - One participant relied solely on load shifting during interruptions. This participant shut down operations during interruptions and extended subsequent production shifts to make up for lost production.
  - While response strategies differed between participants, all participants reported that their organization used the same general response strategy to respond to each interruption. Some of the details changed, such as which production lines they shut down or whether they tried to make up for lost production, but the mechanics of the response were the same every time.
  - Notably, 10% of participants reported they would like more support from Alliant Energy in developing their FSL commitment. Additionally, 7% of participants said they would like Alliant Energy to help them install real-time demand meters to assist with their response to interruptions.
- Not everyone achieves their service level commitments. More specifically, 59% of participants reported their organization failed to meet their service level commitment for at least one interruption.
  - Nearly a third of participants (31%) mentioned that their organization experienced challenges responding to the interruption called during the 2019 Polar Vortex. Some of the participants could not get their back-up generation to start. Others exceeded their FSL because they needed to heat

[4] We did not collect back-up generation fuel type for one participant.

the building to avoid freezing in process lines. One participant did not exceed their FSL but experienced freezing in their boiler system because they had to shut the system down to deliver on their FSL.

- The Polar Vortex interruption served as a learning experience and resulted in participants taking proactive steps to ensure preparedness for future interruptions. As a result, two-thirds of participants (67%) reported they would not experience challenges responding to a winter interruption moving forward. The remaining one-third said responding to a winter interruption is more challenging due to the potential for freezing. These participants were not confident that their current FSL would accommodate the necessary heating loads to prevent freezing.
- While the Polar Vortex interruption caused unique challenges, nearly half (45%) of participants reported failing to meet their service level commitment during a more routine interruption over the course of the summer season. However, no participant reported failing to meet their service level commitment more than twice. Reasons for failure included not shutting down operations in time, failure of back-up generation, and staff failing to shut down all the necessary equipment.

- Notably, 26% of participants recalled buying through at least one interruption.
  - These participants said their organizations consider production schedules and financial ramifications when deciding whether to buy-through or not. If the cost of buying through the interruption is less than the profits from continued activity, the organization may decide to buy-through.
- While most participants reported little to no change to their electric loads during COVID-19 (78%), over half (52%) reported other facets of their operations being impacted by the pandemic, namely reduced production (22%), employees/students moving to a remote environment (17%) and staffing challenges due to exposure or illness from the virus (13%). In some cases, these impacts were large enough to result in decreased electric loads, while other participants reported their electric loads remained consistent with pre-COVID levels. Notably, none of the participants reported the COVID-driven load changes would impact their ability to deliver on their service level commitment.

Changes to Participation Requirements

Most participants reported that the recent tariff changes will not impact their willingness to participate in the program in future years.

- 79% of participants reported the reduced incentive levels will not impact their decision to participate in the program moving forward.
- 86% of participants reported the lengthened participation agreement will not impact their decision to participate in the program.
- Additionally, the recent updates to Midcontinent Independent System Operator (MISO) load accreditation requirements that reduced minimum notification periods for emergency interruptions from 12 hours to 6 hours will not impact NIR participants' ability to participate in the program. Notably, the current NIR participant agreement requires that participants be able to deliver on their service level commitment within 2 hours of receiving notice.

Participant Satisfaction

Participant satisfaction is high with the program overall, as well as its individual components. Table 3 details average participant satisfaction ratings. Participants provided an average satisfaction rating of 7.8 for the program. Satisfaction with individual program components ranged from a low of 6.1 to a high of 8.7. Participants were least satisfied with the bill credit levels. Some participants (24%) expressed frustration over declining bill credit amounts and reported they would have to reconsider participation if the credits continued to decrease. Four of these participants have been enrolled in the program for 20 or more years. On average, participants enrolled in the program for 20 or more years reported lower satisfaction scores compared to the rest of the participants. Specifically, participants of 20 or more years provided average satisfaction ratings of 6.4 for the overall program and 3.6 for the bill credits.

Table 2. Satisfaction with NIR Program Components

Program Component	Average Satisfaction Rating (Scale from 0 to 10, where 0 meant "not at all satisfied" and 10 meant "extremely satisfied.")
Program overall	7.8
Bill credits	6.1
Notification process	8.5
Notification lead-times	8.4
Number of interruptions	8.7
Support from Alliant Energy staff	8.0

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Memorandum

IPL 2019–2020 Be Bright Program Evaluation

To: Kari Gehrke, Nick Ludwig, and Kurt Sempf, IPL

From: The Opinion Dynamics Evaluation Team

Date: April 15, 2021

Re: Impact Analysis Findings for IPL 2019–2020 Be Bright Program

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Introduction

This memorandum provides preliminary results of Opinion Dynamics' impact evaluation of the Interstate Power & Light Company (IPL) Be Bright program. We will provide a final evaluation report in June 2021 that includes impact and process evaluation findings. As such, the purpose of this memorandum is to provide an early indication of evaluation results, highlight potential savings estimation issues, and begin the process of clarifying any outstanding questions prior to the final report.

The Be Bright Program is an upstream lighting rebate offering intended to promote the adoption of ENERGY STAR-qualified LED bulbs and fixtures.[1] Implemented by Slipstream, the program partners with manufacturers and retailers throughout IPL's service territory to provide point-of-sale discounts on qualified LED lighting. The program discounts a variety of LED lighting products and employs field outreach staff to distribute point-of-purchase marketing materials that promote the benefits of LED lighting.

This impact evaluation assesses the Be Bright program from April 1, 2019 through March 30, 2020, referred to herein as "the evaluation period." The purpose of this impact evaluation is to review Be Bright program tracking data, calculate ex post savings per appropriate Iowa Technical Reference Manual (TRM) recommendations, and provide feedback on the methodology used to estimate ex ante savings. We used the Iowa TRM Versions 3.0 and 4.0 to verify ex ante savings assumptions.[2]

Key Findings and Recommendations

Based on the results of this evaluation, Opinion Dynamics offers the following key findings and recommendations for the Be Bright Program:

- **Key Finding #1:** Program tracking data is clear, comprehensive, and free of any noteworthy data entry errors, gaps, or inconsistencies.

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[1] All product or company names that may be mentioned in this publication are tradenames, trademarks or registered trademarks of their respective owners.

[2] All evaluated savings presented in this document reflect methods and assumptions outlined in the Iowa TRM V3.0 and Iowa TRM V4.0, which are applicable to sales occurring in 2019 and 2020, respectively.

- **Key Finding #2:** In calculating ex ante savings, program administrators accurately and consistently applied nearly all recommended savings assumptions from the appropriate versions of the Iowa TRM, resulting in relatively minor differences between ex ante and ex post savings (i.e., realization rates close to 100%).
- **Key Finding #3**: In calculating ex ante savings, program administrators assumed lighting sales to four sectors (residential, multifamily, agriculture, and commercial), relying on data collected from in-store coupons as part of the Change-A-Light program, which is from at least ten years ago and is slightly misaligned with current Iowa TRM recommendations.
  - Recommendation: We recommend a simple residential and commercial split, which aligns with Iowa TRM V3.0 and V4.0 recommendations, as well as industry standard practice. In the absence of more recent jurisdiction-specific research, we recommend consolidating the existing values, summing residential with multifamily shares and commercial with agricultural ones.
- **Key Finding #4**: In calculating ex ante savings for LED fixtures, program administrators distinguished between two fixture categories, whereas the evaluation team followed current Iowa TRM guidance distinguishing between three fixture categories. Unfortunately, program tracking data does not include fixture categories that align with either, making it difficult to establish exact sources of differences between ex ante and ex post savings calculations.
  - Recommendation: We recommend incorporating fixture categories into program tracking data that align with categories outlined in the current version of the Iowa TRM. This change will serve both to support application of TRM-recommended savings assumptions and to ensure that assignment of savings is transparent and replicable by future evaluators.
- **Key Finding #5:** The LED lighting market is nearing transformation, especially for standard bulbs. We expect savings potential for these products to decrease or disappear entirely in coming years; in part due to enactment of previously delayed components of the Energy Independence and Security Act (EISA) federal lighting standards, and in part due to naturally occurring market forces (e.g., the growing price-parity of LEDs with less efficient technologies). Market actor interviews we will conduct later in 2021 will help better gauge industry expectations for how upcoming market and regulatory changes are likely to affect different bulb types.
  - Recommendation: While IPL may choose to continue offering standard LED rebates as long as savings are cost-effective, we recommend that program administrators consider focusing the offering on specialty and reflector LED products in the final years that LEDs have meaningful savings potential and as less energy-efficient standard LED lighting options (i.e., baseline products) become obsolete.

Participation Summary

During the evaluation period, standard LED bulbs made up the vast majority of sales, accounting for 82% of all products sold by the program. Reflector and other specialty products each accounted for approximately half of the remaining sales. Altogether, the program provided discounts on over 1.2 million LED bulbs and fixtures in the one-year evaluation period. Table 1 summarizes this participation by product type.

Table 1. Be Bright Program Participation Summary

Product Type	Bulb Shape	Sales Quantity	Share of Sales
Standard LEDs	A-line	1,007,704	82%
Reflector LEDs	BR/R	79,934	6%
Reflector LEDs	PAR/MR	21,296	2%
Specialty LEDs	Decorative	66,665	5%
Specialty LEDs	Globe	37,880	3%
Specialty LEDs	3-way	4,554	<1%
LED Fixtures	N/A	12,318	1%
Total	**N/A**	**1,230,351**	**100%**

LED pricing varies considerably across products and by product type, and the Be Bright implementation team adjusted rebate amounts throughout the year to customize the offering and react to market or price changes. Incentive amounts generally ranged from $1 to $2 per bulb, though incentives for certain products were as high as $4 per bulb or $10 per fixture. Standard LEDs received the largest percentage discount. After the average program discount of about $1.50 per-bulb, or 64% of list price, the average standard bulb cost less than $1.00. Program incentives for reflector and specialty products were slightly higher but, on average, amounted to smaller percentages of those products' list prices. Fixtures received the smallest percentage discount; about 13% of their list price, on average. This discount structure, and the fact that standard lighting accounts for 82% of program sales, reflect the program's heavy emphasis on standard LED lighting sales during the evaluation period. Table 2 provides an overview of Be Bright product pricing and incentives by product type.

Table 2. Be Bright Program Pricing and Incentives Summary

Product Type	Average List Price Per Bulb	Average Incentive Amount Per Bulb	Average Sale Price Per Bulb	Average Percent Discount
Standard LEDs	$2.37	$1.51	$0.86	64%
Reflector LEDs	$4.64	$1.71	$2.93	37%
Specialty LEDs	$3.62	$1.53	$2.09	42%
LED Fixtures	$15.32	$2.02	$13.30	13%
Overall	**$2.80**	**$1.53**	**$1.27**	**55%**

The Be Bright program incentivized LED lighting at nearly 300 retail locations throughout Iowa during the evaluation period. More than two-thirds of all sales (69%) occurred at big box and DIY retailers, while dollar and thrift stores accounted for another 10%. Table 3 provides a summary of Be Bright participation by retail channel.

Table 3. Be Bright Program Sales by Retail Channel

Retail Channel	Store Locations	Sales Quantity	Share of Sales
Big Box	49	592,215	48%
DIY	39	254,666	21%
Dollar	68	111,123	9%
Pharmacy	54	100,078	8%
Club	2	69,746	6%

Retail Channel	Store Locations	Sales Quantity	Share of Sales
Thrift	31	17,146	1%
Hardware	42	15,976	1%
Other	12	69,401	6%
Total	**297**	**1,230,351**	**100%**

Impact Results Summary

The Be Bright Program achieved 38.6 MWh in gross energy savings during the evaluation period. As shown in Table 4, standard LED bulbs accounted three-quarters of energy savings. Ex post savings are slightly higher than ex ante estimates for all four product types, resulting in an overall gross realization rate of 106% for energy savings. These differences are primarily the product of a relatively minor, but recurring, misalignment between ex ante assumptions regarding sector allocations and the respective recommendations in the Iowa TRM V3.0 and Iowa TRM V4.0.

Table 4. Be Bright Program Energy Savings by Product Type

Product Type	Ex Ante Gross kWh Savings	Gross Realization Rate	Ex Post Gross kWh Savings
Standard LEDs	27,192,137	107%	29,097,303
Reflector LEDs	4,767,933	102%	4,841,925
Specialty LEDs	3,703,549	101%	3,745,315
LED Fixtures	793,552	112%	887,736
Total	**36,457,172**	**106%**	**38,572,280**

The Be Bright program achieved 6.1 MW in gross peak demand savings during the evaluation period, as shown in Table 5. As with energy savings, standard LED products accounted for nearly three-quarters (72%) of demand savings, and gross realization rates were slightly over 100% for each product type, resulting in a gross realization rate of 106% for demand savings. The discrepancy in sector allocations assumptions mentioned above is also the primary driver for demand savings realization rates.

Table 5. Be Bright Program Peak Demand Savings by Product Type

Product Type	Ex Ante Gross kW Savings	Gross Realization Rate	Ex Post Gross kW Savings
Standard LEDs	4,246	104%	4,426
Reflector LEDs	760	115%	876
Specialty LEDs	596	109%	649
LED Fixtures	157	103%	162
Total	**5,760**	**106%**	**6,113**

Detailed Savings Comparisons

We compared ex ante and ex post savings for each product type and found the following explanations for differences (i.e., reasons for gross realization rates not equal to 100%):

- **Overarching findings.** The following findings applied to all bulb types sold in the evaluation period.
  - Although realization rates are relatively close to 100%, ex post savings do not perfectly match ex ante savings for any individual records in program tracking data.
  - After minor rounding adjustments, the evaluation team was able to replicate ex ante savings in most cases (virtually 100% of standard and specialty cases; 56% of reflector cases; and 91% of fixture cases) using stated ex ante assumptions, which include a four-way split of sales into residential, multifamily, agricultural, and commercial sectors. To calculate ex post savings, the evaluation team followed TRM guidance, grouping residential and multifamily into a single residential sector and agricultural and commercial into a single commercial sector; and using respective TRM-recommended parameters for each.
- Reflector LEDs
  - The remaining 44% of reflector LED discrepancies left unexplained by stated ex ante assumptions consist almost entirely of PAR reflector bulbs. In these cases, differences in baseline wattage assumptions are the most likely source of the disparity between ex ante and ex post savings. Ex ante savings calculations appear to rely on manufacturer-specified incandescent equivalent wattages, whereas the evaluation team determined baseline wattages for PAR reflector products based on TRM-specified lumen outputs and bulb diameters.
- LED Fixtures
  - In addition to using a four-way split of sales into residential, multifamily, agricultural, and commercial sectors, stated ex ante assumptions for LED fixtures include two fixture categories: downlights and shoplights. To calculate ex post savings, the evaluation team followed TRM guidance, which entailed assigning fixtures to one of three categories: downlight, indoor, and outdoor.
  - Program tracking data does not indicate fixture categories that align with either stated ex ante assumptions or TRM recommendations. The exclusion of fixture categories from program tracking data makes it difficult to establish exact sources of differences between ex ante and ex post savings calculations. In the absence of this information, differences in category assignment or baseline wattage assumptions are the most likely explanations for remaining 9% of differences left unexplained by stated ex ante assumptions.

Appendix A. Applied Impacts Assumptions

Lighting Savings Assumptions

The evaluation team calculated ex post gross electric and demand savings for Be Bright program-rebated lighting products using the program tracking database and applying algorithms and savings assumptions based on the Iowa TRM V3.0 and Iowa TRM V4.0 for sales occurring in 2019 and 2020, respectively. The evaluation team used the following equations to estimate electric energy and electric demand savings for LED lighting:

Equation 1. Lighting Energy Savings Equation

$$kWh = \left[Qty \times \%Res \times \left[\frac{(Watt_{base} - Watt_{ee})}{1000} \times ISR_{res} \times HOU_{res} \times \left(WHFeH_{res} + (WHFeC_{res} - 1)\right)\right]\right] + \left[Qty \times \%Com \times \left[\frac{(Watt_{base} - Watt_{ee})}{1000} \times ISR_{com} \times HOU_{com} \times WHFe_{com}\right]\right]$$

Equation 2. Lighting Demand Savings Equation

$$kW = \left[Qty \times \%Res \times \left[\frac{(Watt_{base} - Watt_{ee})}{1000} \times ISR_{res} \times CF_{res} \times WHFd_{res}\right]\right] + \left[Qty \times \%Com \times \left[\frac{(Watt_{base} - Watt_{ee})}{1000} \times ISR_{com} \times CF_{com} \times WHFd_{com}\right]\right]$$

Where:

Qty	=Quantity of bulbs from program tracking data
%Res	=Portion of bulbs purchased for residential application
%Com	=Portion of bulbs purchased for commercial application
Watt_base	=EISA-compliant baseline wattage
Watt_ee	=Actual wattage of installed energy-efficient bulb
ISR	=In-service rate
HOU	=Hours of use
WHFeH	=Waste heat factor for energy savings from electric heating
WHFeC	=Waste heat factor for energy savings from electric cooling
WHFd	=Waste heat factor for demand savings
CF	=Coincidence factor
res	=Residential values
com	=Commercial values

Residential Versus Commercial Installation

Both the Iowa TRM V3.0 and Iowa TRM V4.0 recommend that utilities determine an assumption of the portion of bulbs sold to residential and commercial customers via upstream programs. To allocate sales by segment, program administrators relied on a four-way split determined by in-store coupons as part of the Change-A-Light program from at least ten years ago, which found in-store lighting purchases to be 90% residential, 3% multifamily, 4% agricultural, and 3% commercial. In the absence of more recent jurisdiction-specific research, the evaluation team consolidated these values to align with TRM guidance and applied a 93% residential vs. 7% commercial split.

Lighting Baseline Wattages

The baseline wattages in the Iowa TRM V3.0 and V4.0 are the same, with both varying depending on the bulb type. Baseline wattages for standard LEDs are based on the lumen output and account for EISA efficiency standards, where appropriate. Table 6 lists the baseline wattages as they were applied to calculate ex post savings for standard LEDs.

Table 6. Baseline Wattages for Standard LEDs

Lumen Range	Base Wattage
250–309	25
310–749	29
750–1,049	43
1,050–1,489	53
1,490–2,600	72
2,601–3,000	150
3,001–3,999	200
4,000–6,000	300

The baseline wattages for directional LEDs vary depending on the directional bulb type and lumen range, and account for the Department of Energy (DOE) energy efficiency standards for incandescent reflector lamps and any appropriate exemptions to the standards. The Iowa TRM does not specify baseline wattages for PAR reflector bulbs, so the evaluation team treated them the same as other reflectors. Table 7 lists the baseline wattages as they were applied to calculate ex post savings for specialty reflector LEDs.

Table 7. Baseline Wattages for Reflector LEDs

Bulb Type	Lumen Range	Base Wattage
R, ER, BR with medium screw bases w/ diameter >2.25" (*see exceptions below)	420-472	40
	473–524	45
	525–714	50
	715–937	65
	938–1,259	75
	1,260–1,399	90
	1,400–1,739	100
	1,740–2,174	120
	2,175–2,624	150
	2,625–2,999	175
	3,000–4,500	200
*R, BR, and ER with medium screw bases w/ diameter <=2.25"	400–449	40
	450–499	45
	500–649	50

Bulb Type	Lumen Range	Base Wattage
	650–1,199	65
*ER30, BR30, BR40, or ER40	400–449	40
	450–499	45
	500–649	50
BR30, BR40, or ER40	650-1,419	65
*R20	400-449	40
	450-719	45
*All reflector lamps below lumen ranges specified above	200-299	20
	300-399	30

Table 8 lists the baseline wattages as they were applied to calculate ex post savings for specialty non-reflector LEDs such as three-way, globe, and candelabra bulbs.

Table 8. Baseline Wattages for Specialty LEDs

Bulb Type	Lumen Range	Base Wattage
Three-way	250–449	25
	450–799	40
	800–1,099	60
	1,100–1,599	75
	1,600–1,999	100
	2,000–2,549	125
	2,550–2,999	150
Globe (medium and intermediate bases less than 750 lumens)	90–179	10
	180–249	15
	250–349	25
	350–749	40
Decorative (Shapes B, BA, C, CA, DC, F, G, medium and intermediate bases less than 750 lumens)	70–89	10
	90–149	15
	150–299	25
	300–749	40
Globe (candelabra bases less than 1050 lumens)	90–179	10
	180–249	15
	250–349	25
	350–499	40
	500–1,049	60
Decorative (Shapes B, BA, C, CA, DC, F, G, candelabra bases less than 1050 lumens)	70–89	10
	90–149	15
	150–299	25
	300–499	40
	500–1,049	60

Lighting In-Service Rates

Per the Iowa TRMs V3.0 and V4.0, the in-service rate (ISR) varies by bulb type and installation location and is discounted using the statewide real discount rate of 7.71%, so that savings from bulbs that would be installed in future years can be claimed in the evaluation period they were sold. All commercial LED fixtures are assumed installed in the year purchased. TRM V3.0 is used for 2019 and V4.0 is used for 2020. Table 9 below provides NPV-adjusted ISRs by bulb type and installation location.

Table 9. Iowa Statewide TRM Versions 3.0 and 4.0: Discounted ISR

Year	Install Location	Bulb Type	Discounted ISR
2019	Residential	LED bulbs	94%
		LED fixtures	100%
	Commercial	LED bulbs	92%
		LED fixtures	95%
2020	Residential	LED bulbs	90%
		LED fixtures	100%
	Commercial	LED bulbs	89%
		LED fixtures	95%

Lighting Hours of Use

The Iowa TRM V3.0 and V4.0 provide different residential HOU assumptions for different bulb types depending on where they get installed. TRM V3.0 is used for 2019 and V4.0 is used for 2020. Table 10 provides the applied HOU assumptions.

Table 10. Iowa Statewide TRM Versions 3.0 and 4.0: Lighting HOU

Year	Install Location	Bulb Type	Hours of Use
2019	Residential	Standard LEDs	1,157
		Specialty LEDs	849
		Indoor fixtures	926
		Downlight fixtures	926
		Outdoor fixtures	2,475
	Commercial	All	3,065
2020	Residential	Standard LEDs	1,157
		Specialty LEDs	1,020
		Indoor fixtures	926
		Downlight fixtures	926
		Outdoor fixtures	2,475
	Commercial	All	3,065

Lighting Waste Heat Factors

The Iowa TRM V3.0 and V4.0 provide different waste heat factor values for energy and demand savings and depending on installation location. TRM V3.0 is used for 2019 and V4.0 is used for 2020. Table 11 outlines waste heat factor assumptions by savings type and installation location.

Table 11. Iowa Statewide TRM Version 3.0 and 4.0: Waste Heat Factors

Year	Install Location	Waste Heat Factor (Energy)	Waste Heat Factor (Demand)
2019	Residential	0.93 (heating); 1.11 (cooling)	1.19
	Commercial	1.06	1.28
2020	Residential	0.93 (heating); 1.11 (cooling)	1.19
	Commercial	1.13	1.42

Lighting Coincidence Factors

The Iowa TRM V3.0 and V4.0 provide peak coincidence factors based on installation location and bulb type. TRMs V3.0 and V4.0 have the same assumptions for coincidence factors. Table 12 provides the applied coincidence factor assumptions.

Table 12. Iowa Statewide TRM Version 3.0 and 4.0 – Coincidence Factors

Year	Install Location	Bulb Type	Coincidence Factor
2019	Residential	Standard LED	0.125
		Specialty LED	0.125
		Indoor Fixture	0.131
		Outdoor Fixture	0.018
		Downlight Fixture	0.131
	Commercial	All	0.7170
2020	Residential	Standard LED	0.125
		Specialty LED	0.114
		Indoor Fixture	0.131
		Outdoor Fixture	0.018
		Downlight Fixture	0.131
	Commercial	All	0.6907

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Memorandum

IPL Portfolio Evaluation

To: Kari Gehrke, Nick Ludwig, and Kurt Sempf, IPL

From: Opinion Dynamics Evaluation Team

Date: February 8, 2021

Re: Home Energy Reports Program EM&V: Equivalency Analysis Results

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This memorandum provides the results of an early equivalency analysis that Opinion Dynamics performed in preparation for an impact analysis of the Interstate Power & Light (IPL) Home Energy Reports (HER) program. Our findings, summarized in this memo, reveal that the treatment and control groups are equivalent and that the program adheres to the requirements of an appropriate randomized control trial (RCT) design and will support an unbiased evaluation of program energy savings.

Introduction

Following a pilot with approximately 60,000 dual-fuel customers in 2016, IPL launched the full HER program in May 2019. As part of the full launch, IPL expanded the program to include more customers. This first expansion of the program includes approximately 157,000 electric-only customers; about two-thirds of which receive HERs (the "treatment" group), with the remaining one-third serving as "control" group customers for evaluation purposes. The program, which is administered by Uplight, achieves energy savings by delivering HERs to customers with information about their energy consumption and tips for reducing usage.

To ensure evaluability, the program is designed as an RCT. In this RCT, customers are randomly assigned into treatment and control groups, where treatment group customers receive HERs and control group customers do not. The random assignment of customers to either group theoretically ensures that the two groups are equivalent, particularly in terms of energy usage patterns. However, this assumption must be confirmed in an equivalency analysis prior to measuring ex post impacts. The similarity between the treatment and control groups before the program begins strengthens the assertion that any differences in energy use post-intervention compared to the control group in the same period are due to the program and not a result of other exogenous (i.e., non-program-related) factors.

Opinion Dynamics' evaluation focuses specifically on the electric savings from the approximately 157,000 electric-only customers, which is the largest cohort of the program and has not previously been evaluated. As such, the analysis below excludes pilot participants.

Equivalency Analysis Methods

Opinion Dynamics performed the following steps to support equivalency analysis:

- Cleaned and prepared consumption data for treatment and control group customers; and
- Conducted visual analysis of consumption patterns of equivalency across groups.

Data sources for this analysis included customer consumption data and treatment/control group assignments from Uplight. The data provided by Uplight contained a total of 157,353 customers (114,497 treatment group and 42,856 control). The consumption data contained bill records starting in April 2018 and ending in September 2020, with pre-treatment data spanning from April 2018 to April 2019 and program period (also known as the "treatment" or "post" period) data starting in May 2019. The total number of bill records in the treatment and control groups were 3,087,524 and 1,154,293, respectively. Table 1 summarizes the data used in this analysis.

Table 1. Summary of Pre-Cleaned IPL HER Data

Group	Number of Accounts	Number of Billing Records
Control	42,856	1,154,293
Treatment	114,497	3,087,524

Before performing the equivalency analysis, we cleaned the billing data for anomalous records. Anomalous records include duplicate bills, bills with zero bill duration, bills with negative usage, customers with an average usage of zero, accounts with less than nine months in the pre-period bills, accounts with less than nine months in program period bills, accounts with insufficient heating or cooling season days, bills with gaps or overlapping periods, dual-fuel and potential dual-fuel customers,[1] and billing periods not falling within the pre-treatment period. Opinion Dynamics used the cleaned billing data for the energy usage equivalency analysis.

We excluded a total of 892,484 (29%) bill records from the treatment group and 337,329 (29%) from the control group via the cleaning steps outlined above. In total, we excluded 16,881 (15%) treatment group and 6,525 (15%) control group accounts from the equivalency analysis due to insufficient cleaned data.

Approximately 98,000 treatment customers and 36,000 control customers remained in the analysis after data cleaning; a sufficient sample to move forward with the analysis. Using the cleaned data, we calculated average daily consumption (ADC) per billing period individually for all households by dividing the billing period usage by the number of days present in the billing period.

Equivalency Analysis Results

Table 2 summarizes the number of customers and the overall average ADC for control and treatment groups. The two groups have equivalent average pre-period ADC.

Table 2. Summary of IPL HER Equivalency Analysis

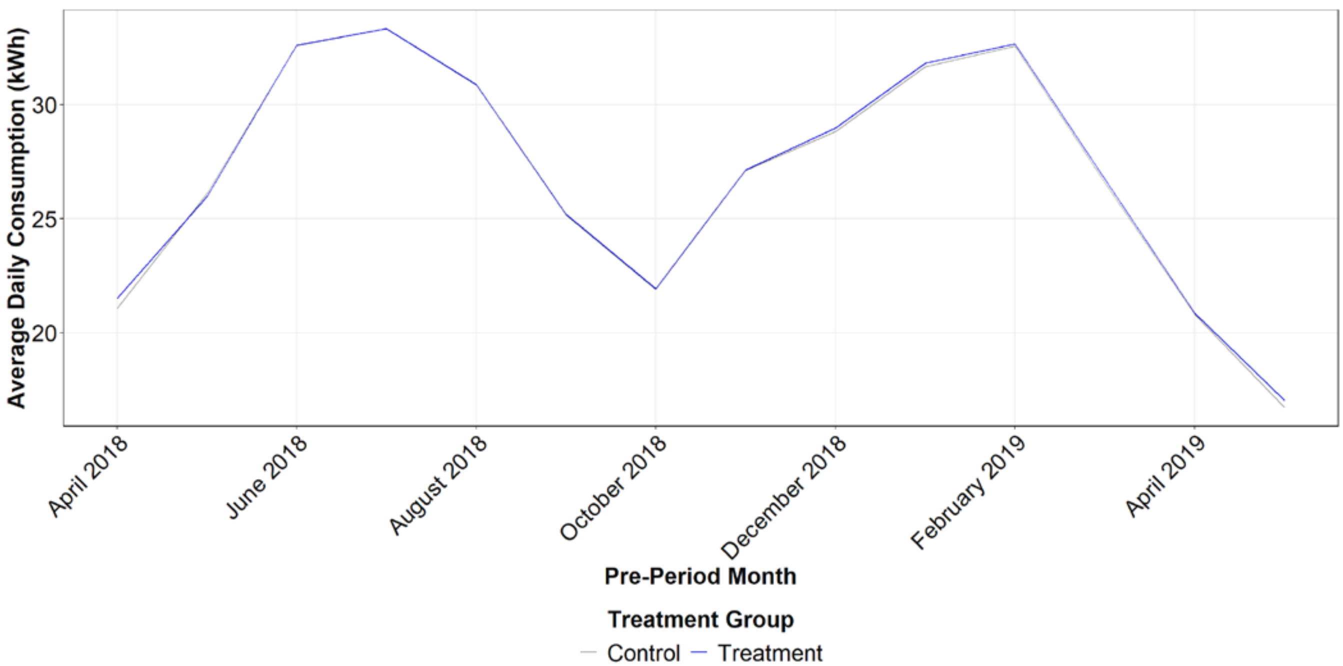
Group	Number of Accounts	Avg. Pre-Period ADC
Control	36,331	27.58
Treatment	97,616	27.56

Additionally, following industry best practices, Opinion Dynamics assessed the equivalency of the treatment and control groups by comparing the overall average and monthly ADC across the full pre-period. Figure 1

[1] While the evaluated cohort was initially limited to customers who only had electric service at the time of treatment/control assignment, a small number of customers in the database were flagged by Uplight as potentially being "dual-fuel" (having both gas and electric service with IPL). Per Uplight's recommendation, we removed these customers from the analysis.

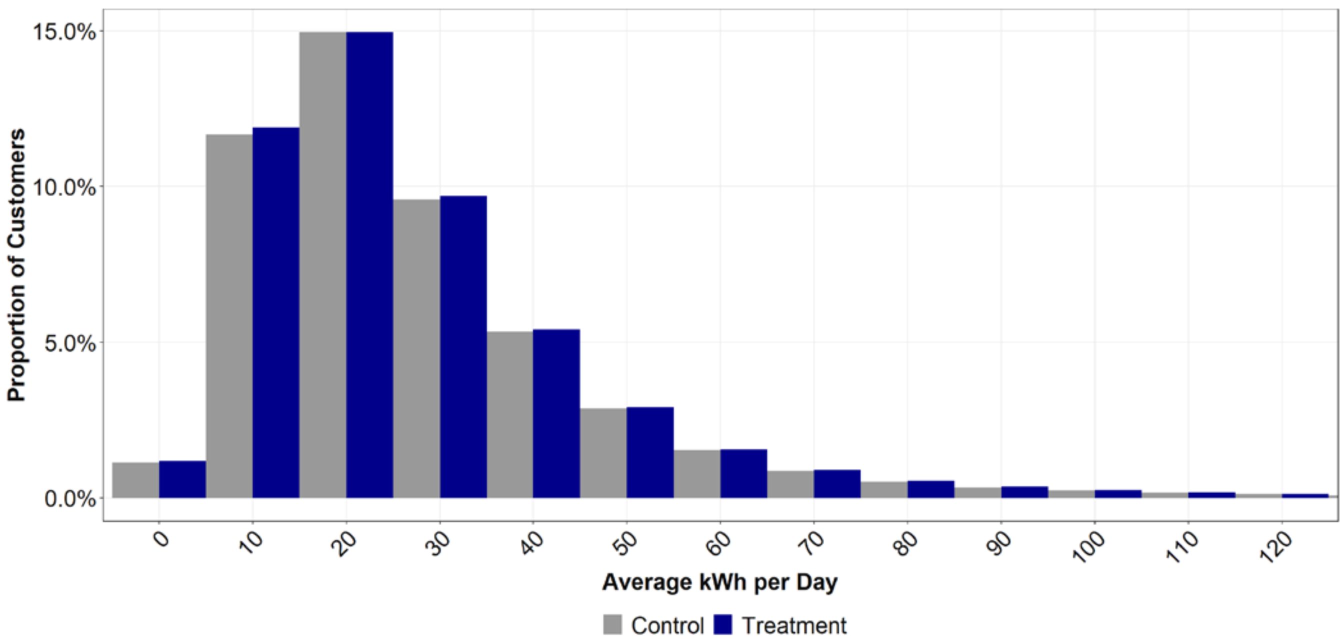
compares the pre-period ADC between treatment and control groups over time. As the figure shows, treatment and control groups have consistently equivalent pre-period usage.

Figure 1. ADC Comparison Over Time



In addition to comparing the average monthly ADC between treatment and control groups, we also examined the distribution of ADC between groups. Figure 2 shows the distribution of ADC in the treatment and control groups. The groups have nearly identical distributions, confirming treatment and control group equivalency.

Figure 2. Percent Distribution of Customers on ADC



Conclusions

The results of our analysis confirm that the treatment and control groups in the IPL HER program are equivalent, and that the program adheres to RCT design best practices and will support an unbiased evaluation of program performance.