ILLUME

PROJECT

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Georgia Power

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With subcontractors:
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ILLUME Advising, LLC is a forward-thinking consulting company at the rare intersection of insight and execution. Founded in 2013 by industry thought-leaders Anne Dougherty and Sara Conzemius, the company has quickly grown to include a deep bench of quantitative and qualitative research experts. ILLUME uses cutting edge research strategies to help build a resilient energy future to enrich lives, improve global health, and ensure a more secure and sustainable future.

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LIST OF ACRONYMS AND ABBREVIATIONS

ACRONYM/ABBREVIATION	DEFINITION
ARCA	Appliance Recycling Centers of America
CAC	Central air conditioner
CBCP	Center beam candle power
CDD	Cooling degree days
CF	Coincidence factor
CFM	Cubic feet per minute
COP	Coefficient of performance
DHW	Domestic hot water
DOE	US Department of Energy
DSM	Demand-side management
EFLH	Effective full-load hours
EISA	Energy Independence and Security Act
EM&V	Evaluation, measurement, and verification
HEIP	Home Energy Improvement program
HEEAP	Home Energy Efficiency Assistance program
HDD	Heating degree day
HOU	Hours of use
ISR	In-service rates
M&V	Measurement and verification
NPV	Net present value
NTG, NTGR	Net-to-gross, net-to-gross ratio
PCT	Participant cost test
QA/QC	Quality assurance and quality control
RCT	Randomized control trial
RIM	Ratepayer impact measure test
ROI	Return on investment
RRP	Refrigerator Recycling program
Temp✓	“TempCheck,” also referred to as Thermostat Demand Response
TMY3	Typical meteorological year
TRC	Total resource cost test
TRM	Technical Reference Manual
UCT	Utility cost test
UMP	Uniform Methods Project
US	United States
VFD	Variable frequency drive

EXECUTIVE SUMMARY

Georgia Power's demand-side management (DSM) portfolio contains six residential programs and five commercial programs that serve its customer base. In 2020 and 2021, the evaluation team led by ILLUME Advising conducted a comprehensive impact and process evaluation across all residential DSM programs. This executive summary includes program performance and evaluation results, key findings, recommendations, and discusses the implications of the COVID-19 pandemic on the evaluation. The remainder of this report includes individual chapters for each program, which include detailed findings and recommendations.

Summary of Program Performance

Hundreds of thousands of residential customers participated in Georgia Power's DSM programs in 2020 through offerings to numerous customer groups via several channels. To evaluate program impacts and performance, the evaluation team interviewed utility program and implementation staff, surveyed customers, and contractors, completed engineering and statistical analyses, and conducted on-site verifications. Figure 1 provides a visual overview of program performance in the cycle to-date. A summary of key evaluation metrics and performance for the programs across the residential portfolio follows (Figure 2). As a note, 2020 and 2021 program performance are frequently shown separately in this report, but any comparisons between the two program years should be made with considerable caution. The COVID-19 pandemic had a significant impact on Georgia Power's programs, most intensely in program year 2020, and the extent of the effect of the pandemic differed across each program. These values are provided to understand performance in each year, but comparing them may not be useful in all cases. The impacts of the COVID-19 pandemic are discussed in this report in detail, at both the portfolio and program level.

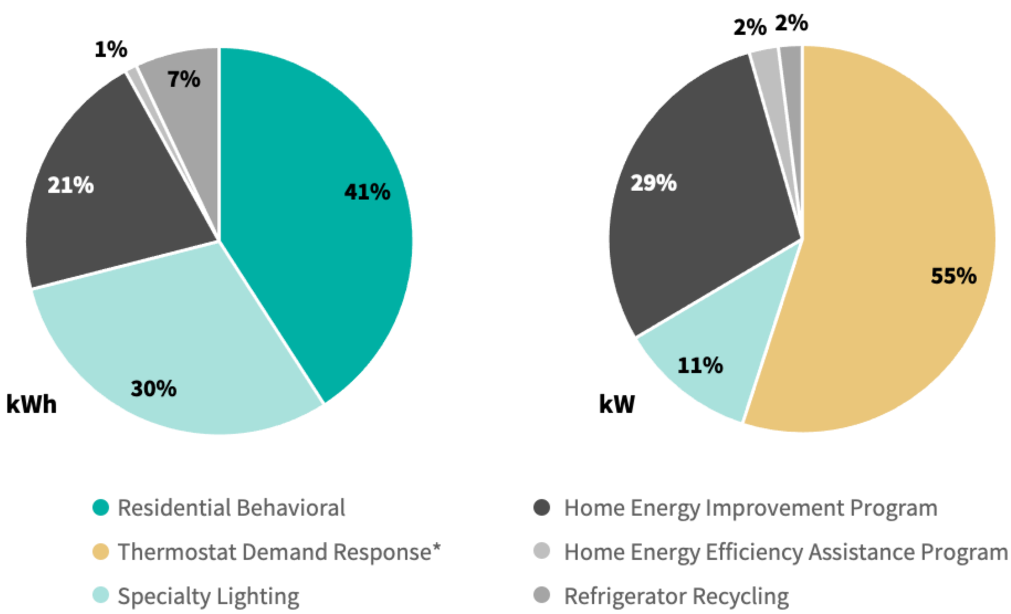
Figure 1. Reported Energy and Demand Savings

Total Reported Savings: 2020 – Q3 2021

kWh	2020	2021 (through Q3)
Residential Behavioral	26,302,769	25,405,836
Thermostat Demand Response	-	-
Specialty Lighting	34,566,354	18,652,683
Home Energy Improvement Program	19,915,618	13,019,266
Home Energy Efficiency Assistance Program	4,787,807	661,773
Refrigerator Recycling	780,215	4,603,013
	86,352,762	62,342,571

kW	2020	2021 (through Q3)
Residential Behavioral	-	-
Thermostat Demand Response*		10,031
Specialty Lighting	3,979	2,095
Home Energy Improvement Program	8,023	5,307
Home Energy Efficiency Assistance Program	799	444
Refrigerator Recycling	62	363

Contribution To Portfolio (Reported Savings): Q1 – Q3 2021

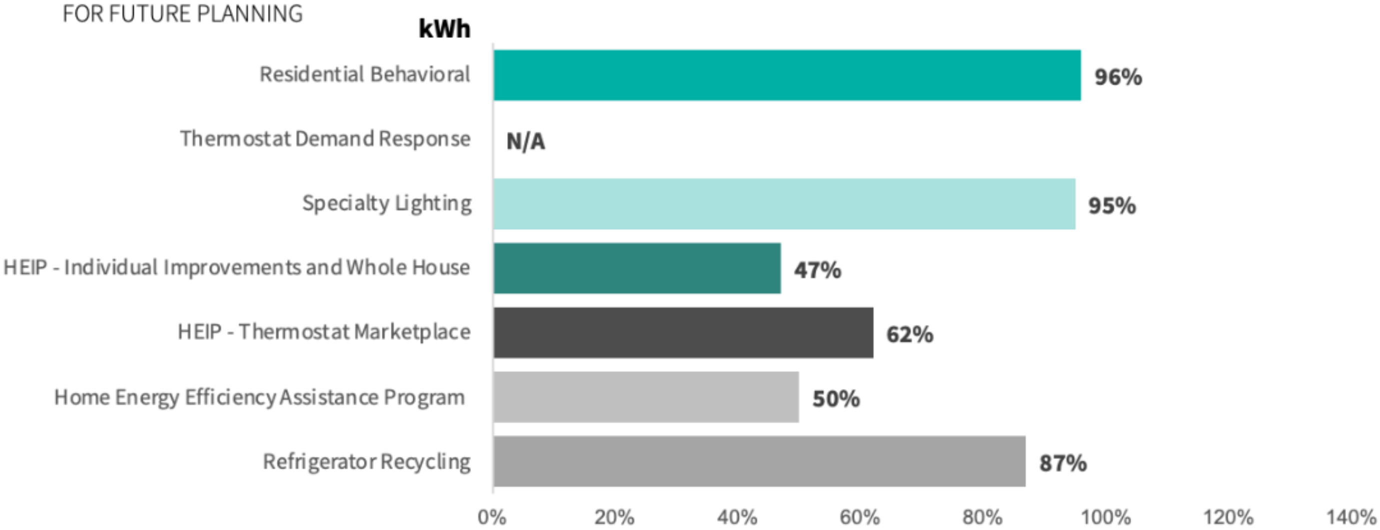


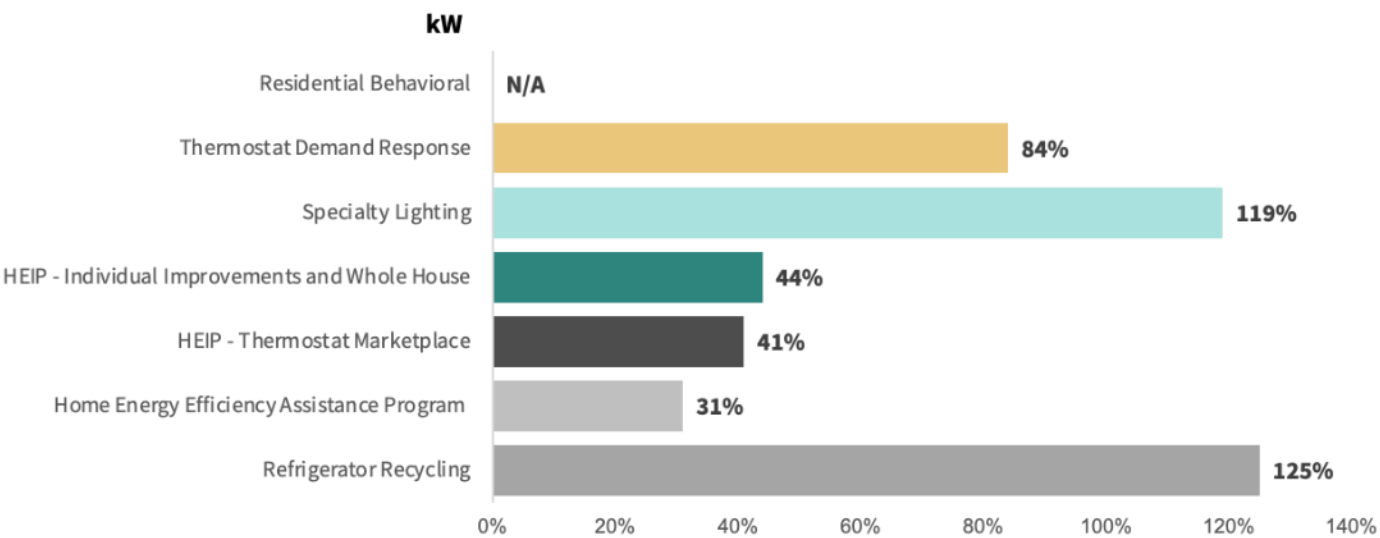
Thermostat Demand Response savings were initially reported erroneously in quarterly reporting. They have been corrected in this graphic to the average per-event kW savings reported by the program implementation team.

Figure 2. Key Evaluation Metrics

Realization Rates

FOR FUTURE PLANNING





Net To Gross

FOR FUTURE PLANNING

	kWh	kW
Residential Behavioral	N/A	N/A
Thermostat Demand Response	N/A	N/A
Specialty Lighting	36%	35%
HEIP - Individual Improvements and Whole House	71%	71%
HEIP - Thermostat Marketplace	77%	77%
Home Energy Efficiency Assistance Program	100%	100%
Refrigerator Recycling	50%	50%

As a note, net-to-gross ratios are not presented for two of the residential programs as this metric was not directly measured for these programs. For the Behavioral program, impact savings are inherently net due to the randomized control trial design. For the Thermostat Demand Response program (Temp✓), net-to-gross is not applicable for demand response programs. Additionally, the Home Energy Efficiency Assistance program (HEEAP) is income-qualified, and per industry standards net-to-gross is set at 100%[1].

COVID-19 Implications

Across the country, the COVID-19 pandemic and resulting state and local stay-at-home orders and social distancing mandates impacted utilities and energy efficiency program administrators by limiting the ability to implement these offerings, especially where they required face-to-face or in-home interactions (such as assessments, retrofits, and appliance pickups). Customer behavior, incomes, and priorities were also impacted, caused by circumstances such as virtual schooling, telework, and layoffs. In a survey conducted at the end of 2020 by Pew Research Center with workers across the US who said their job responsibilities could be done from home, 71% of those people indicated they were working from home most or all the time. Prior to the pandemic, this figure was 20%.[2] The pandemic has affected people differently depending on their demographics, including income and education. In 2021, as stay-at-home orders have been relaxed, the return to pre-2020 conditions and behaviors is also occurring at varying degrees and speeds across different demographics and populations.

For Georgia Power specifically, the pandemic occurred at an especially challenging time. In early 2020, Georgia Power was in the process of launching a new cycle of programs, with several new offerings and with new program implementers. By March of 2020, the pandemic forced Georgia Power to pause the implementation of programs, such as the Refrigerator Recycling program, HEIP, and HEEAP, which were still ramping up and had achieved little-to-no participation. Some offerings which did not require face-to-face interaction, such as measures available through the Online Marketplace, home energy reports, and demand response programs, were able to continue ramp up and launch, but did so against the backdrop of a pandemic not previously considered during program planning and design.

As 2020 progressed, Georgia Power was also able to adjust some program designs to be safer for their employees, customers, and program implementers, such as establishing outdoor appliance pickups for the Refrigerator Recycling program, and they moved programs from being paused to active implementation.

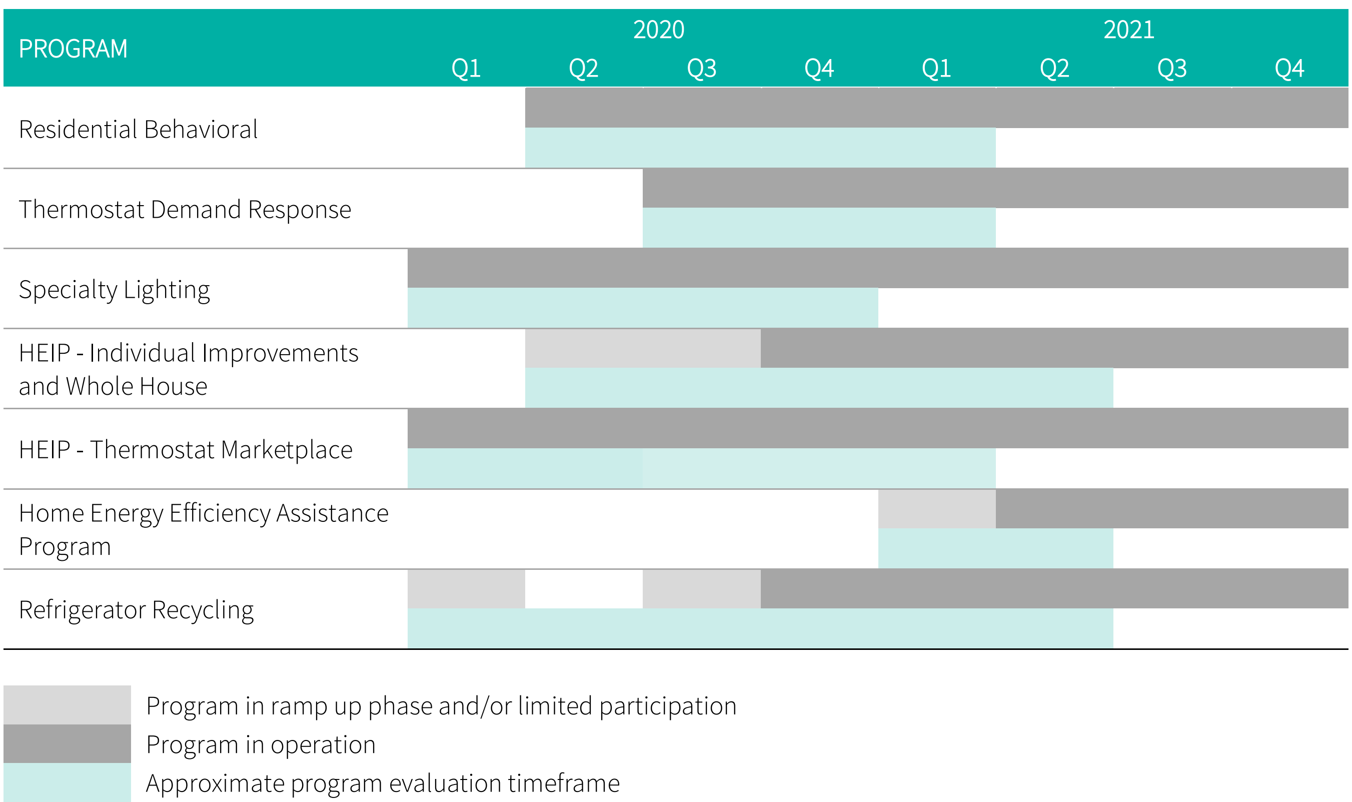
[1] As noted in the Uniform Methods Project: Estimating Net Savings chapter*: "Note that most low-income programs are not subject to NTG analysis (that is, are deemed at 1.0)."*
https://www.energy.gov/sites/prod/files/2015/02/f19/UMPChapter23-estimating-net-savings_0.pdf

[2] Pew Research Center, December 9, 2020. https://www.pewresearch.org/social-trends/2020/12/09/how-the-coronavirus-outbreak-has-and-hasnt-changed-the-way-americans-work/

While most HEIP contractors had very limited participation in 2020, one contractor was able to keep participating through the year. Additionally, the marketing for energy efficiency programs was limited in 2020 given program disruption. It did not begin in earnest until Q3 of 2020.

The impact to program implementation timelines and ramp up creates implications for the evaluation of these programs. Notably, it limits the ability to evaluate program performance across a full calendar year. To provide a comprehensive and forward-looking assessment, the program team customized the timeframe they evaluated for each program. In several cases, the evaluation team delayed the originally planned evaluation schedule to allow the program to launch and sufficient participation to take place. Table 1 shows the approximate timeframes in which each program was in operation, compared to the timeframe included in the evaluation.

Table 1. Program and Evaluation Timeframes



Beyond implementation timelines, the impacts of the COVID-19 pandemic on the ability to evaluate energy efficiency offerings more generally is complex and still being understood. Evaluation, research, and analysis nearly always have the potential for introduced and inherent biases and exogenous factors that may influence results. Ideally, evaluators attempt to control for these factors in analyses, such as through sample design. Where controlling for them is not possible, evaluators will attempt to identify and characterize the factors that may have influenced evaluation results.

For all program evaluations conducted this cycle, the evaluation team carefully considered the possible ways the unprecedented events of the COVID-19 pandemic and related factors may have impacted our results, and we document these where applicable in each program chapter. In general, readers should keep the following considerations in mind when interpreting evaluation results from this program cycle.

- **The pandemic delayed the program launch for several programs, which resulted in shortened evaluation periods.** For some programs (like HEEAP), the evaluation team was only able to evaluate the first few months of program performance It is generally ideal to evaluate programs once they have fully ramped up. This allows evaluators to understand program operations and investigate a larger pool of more "typical" participants when assessing both program processes and impacts (such as net-to-gross). This should be considered when interpreting results, and the evaluation team highlights such considerations where needed throughout this report,

- **The pandemic disrupted normal program operations to varying degrees across the portfolio.** For some programs (such as RRP and HEIP), program design, delivery, and/or operations were adapted to adjust to disruptions caused by the pandemic. Where possible throughout the report, the evaluation team provides context and interpretation of what this may mean when applying results to future program cycles, if design and delivery resume more "normal" operations.

- **The pandemic required the evaluation team to adjust our approach in several instances.** In addition to shifting our timelines, the evaluation team adjusted evaluation approaches for some programs due to COVID-19 protocols. For example, the evaluation team reduced the number of planned in-person on-site visits for HEIP and completed virtual on-sites and/or additional desk reviews instead, as a high number of on-sites could not be completed in the short timeframe in which it was safe to do so.

- **In a few instances, the pandemic (along with other factors) created too many exogenous factors to allow the program team to effectively evaluate some program impacts.** This primarily affected the HEIP Individual Improvements and Whole House pathways, where the evaluation team recommends referencing 2017 evaluation results for gross and/or net savings for some measures.

In addition to the considerations identified above, there is much that is still unknown about how the COVID-19 pandemic has influenced household energy use and behavior in the US In general, however, the evaluation team believes that the findings included in this report are reasonable estimates of current savings and can reliably be used for future planning, where applicable and in consideration of the caveats provided in each program chapter.

Portfolio Goals

As described above, 2020 was a challenging year for Georgia Power to implement its energy efficiency programs. Despite this, they were close to meeting their reported energy (kWh) savings goal in 2020 by allowing some programs (such as Specialty Lighting) to overachieve while others remained on pause. As of September 30, 2021, the programs are approximately two-thirds of the way towards achieving their 2021 goal compared to reported savings. As noted above, care should be taken when reviewing 2020 and 2021 performance to-date. They are provided separately to provide insight into performance by year, but given changing pandemic impacts over time and differing time periods, they may not be useful to directly compare.

Table 2 provides more detail on performance by program compared to goals.

Table 2. 2020 and 2021 Goals and Reported Savings (kWh)

PROGRAM	2020 GOAL	2020 ACTUAL	2021 GOAL	2021 ACTUAL (Q1 – Q3)
Residential Behavioral	38,096,432	26,302,769	38,096,432	25,405,836
Thermostat Demand Response	4,876,638 [a]	-	4,876,638 [a]	-
Specialty Lighting	18,031,408	34,566,354	18,031,408	18,652,683
Home Energy Improvement Program	19,212,617	19,915,618	19,212,617	13,019,266
Home Energy Efficiency Assistance Program	6,722,253	4,787,807	6,722,253	661,773
Refrigerator Recycling	8,478,877	780,215	8,478,877	4,603,013
Total	95,418,226	86,352,762	95,418,226	62,342,571
Percent Achieved (Reported)		90%		65%[b]

[a.] *Per Georgia Power staff, they do not report kWh savings for the Thermostat Demand Response program.*

[b.] *This value represents the first three quarters of 2021 (all data available at the time of reporting), and not a full year as reported in 2020.*

Summary of Verified Savings

The following four tables (Table 3 through

Table 6) provide the reported energy and demand savings for the cycle to-date (2020 through Q3 2021). As described previously, the evaluation team evaluated different time periods for each program, and each program chapter details the specific timeframe evaluated. The following tables apply the realization rates and net-to-gross values developed during the evaluations to the full program performance of the cycle-to-date as a means of comparing performance across programs. It is the evaluation team's understanding that evaluation results are applied to future cycles, and not applied to the current cycle, so these results are presented only for the purpose of understanding program impact and performance across the portfolio.

Table 3. Portfolio Energy (kWh) Reported and Verified Savings

PROGRAM	REPORTED SAVINGS (KWH)		REALIZATION RATE	VERIFIED GROSS SAVINGS (KWH)	
	2020	2021 (THROUGH Q3)		2020	2021 (THROUGH Q3)
Residential Behavioral	26,302,769	25,405,836	96%	25,250,658	24,389,603
Thermostat Demand Response[a]	N/A	N/A	N/A	N/A	N/A
Specialty Lighting	34,566,354	18,652,683	95%	32,838,036	17,720,049
HEIP - Individual Improvements and Whole House	4,539,417	5,262,663	47%	2,133,526	2,473,452
HEIP - Thermostat Marketplace	15,376,201	7,756,603	62%	9,533,245	4,809,094

Home Energy Efficiency Assistance Program	4,787,807 [b]	661,773	50%	4,787,807[b]	330,887
Refrigerator Recycling	780,215	4,603,013	87%	678,787	4,004,621
Total	**86,352,762**	**62,342,571**		**75,222,059**	**53,727,704**

[a.] The Thermostat Demand Response program did not report energy (kWh) savings as the primary goal of this program is reducing peak demand (kW).
[ba.] For HEEAP, all 2020 verified savings were generated by one-time kit measures that were not evaluated, and reported savings passed through. The 2021 savings reflect normal program performance and where the realization rate is applied.

Table 4. Portfolio Energy (kWh) Verified Net Savings

PROGRAM	NET-TO-GROSS	VERIFIED NET SAVINGS (KWH)	
		2020	2021 (THROUGH Q3)
Residential Behavioral	N/A	25,250,658	24,389,603
Thermostat Demand Response[a]	N/A	N/A	N/A
Specialty Lighting	36%	11,821,693	6,379,218
HEIP - Individual Improvements and Whole House	71%	1,509,550	1,750,061
HEIP - Thermostat Marketplace	77%	7,340,598	3,703,002
Home Energy Efficiency Assistance Program	100%	4,787,807[b]	330,887
Refrigerator Recycling	50%	339,394	2,002,311
Total		**51,049,700**	**38,555,080**

[a.] The Thermostat Demand Response program did not report energy (kWh) savings as the primary goal of this program is reducing peak demand (kW).
[ba.] For HEEAP, all 2020 savings were generated by one-time kit measures that were not evaluated, and reported savings passed through. The 2021 savings reflect normal program performance and where the realization rate is applied.

Table 5. Portfolio Demand (kW) Reported and Verified Savings

PROGRAM	REPORTED SAVINGS (KW)		REALIZATION RATE	VERIFIED GROSS SAVINGS (KW)	
	2020	2021 (THROUGH Q3)		2020	2021 (THROUGH Q3)
Residential Behavioral	-	-	-	N/A	N/A
Thermostat Demand Response	10,031 [a]		84%	8,426	
Specialty Lighting	3,979	2,095	119%	4,735	2,493
HEIP - Individual Improvements and Whole House	1,627	2,080	44%	716	915
HEIP - Thermostat Marketplace	6,396	3,227	41%	2,623	1,323

Home Energy Efficiency Assistance Program	799 [b]	444	31%	799[b]	138
Refrigerator Recycling	62	363	125%	77	454

[a.] *Thermostat Demand Response savings were initially reported erroneously. They have been corrected in this table to the average per-event kW savings reported by the program implementation team.*
[b.] *For HEEAP, all 2020 savings were generated by one-time kit measures that were not evaluated, and reported savings passed through. The 2021 savings reflect normal program performance and where the realization rates are applied.*

Table 6. Portfolio Demand (kW) Verified Net Savings

PROGRAM	NET-TO-GROSS	VERIFIED NET SAVINGS (KW) 2020	2021 (THROUGH Q3)
Residential Behavioral	N/A	N/A	N/A
Thermostat Demand Response	N/A	8,426	
Specialty Lighting	35%	1,657	873
HEIP - Individual Improvements and Whole House	71%	507	648
HEIP - Thermostat Marketplace	77%	2,019	1,019
Home Energy Efficiency Assistance Program	100%	799[a]	138
Refrigerator Recycling	50%	38	227

[a.] *For HEEAP, all 2020 savings were generated by one-time kit measures that were not evaluated, and reported savings passed through. The 2021 savings reflect normal program performance and where the realization rates are applied.*

Summary of Recommendations

Based on the 2020 evaluation findings, the evaluation team proposes recommendations intended to improve program uptake, processes, and performance within Georgia Power's DSM portfolio. This section includes high-level, summarized versions of the key recommendations from each program chapter.

Behavioral

- **For future planning, the evaluation team does not recommend using current evaluated per-household savings for full future cycles, as they will likely underestimate savings over the full cycle.** The evaluation results represent very early program performance, and home energy report programs tend to ramp up in savings over time. Behavior programs tend to be relatively consistent in the savings they generate, so consider other options for developing estimates for future planning such as conducting a secondary literature review of home energy report generated savings by year.
- **Consider conducting further research** to understand why the 2014 Legacy Wave continues to save, the 2016 Legacy Income-qualified Wave has lagged in savings, and the 2018 Legacy Wave has such

high program participation rates. This research could provide insight into strategies to maximize savings for the longest time possible from home electric reports.

- Conduct research on the differences between the electronic Home Electric Reports and print reports to see what affects readership and drivers of readership. To accomplish this, consider conducting interviews with recipients to learn more about why they liked the report and which medium they prefer and why.
- Plan to provide AMI data for demand savings analyses that are part of future evaluations to better understand more precise estimates of peak demand savings by seasonality.
- Ensure that recipients are aware that they can update their Home Profile by reminding them of the benefits, highlighting the link, and sending an electronic Home Electric Report to more recipients. Ask all waves to add their email address if not on file.

Temp✓ (Thermostat Demand Response)

- Plan to achieve 84% of the savings provided in the implementer's post-event summaries. Due to differences in the data source and methodology, demand response event impacts differed between the implementer and the evaluation team. As such, the evaluation team recommends the program managers plan to achieve 84% of the implementer's reported savings per participant.
- Investigate factors that influence demand response program cost-effectiveness and consider changes to improve cost-effectiveness. The evaluation team identified certain changes that could improve cost-effectiveness: the approach for incorporating control customers into the cost-effectiveness screening, the appropriate cost estimate, and the approach for incorporating energy savings into the program. More generally, many states are actively updating their demand response cost-effectiveness tests, and as such, the evaluation team provided a summary in the program chapter of factors being considered in demand response cost-effectiveness protocols in other states.
- When recruiting new participants in this program, consider including pilot participant testimonials to highlight the fact that the program is typically low impact and that when issues arise, it is easy to override an event. This type of information might alleviate stress for potential enrollees. In addition, consider highlighting the number of events a season they may experience.
- Ensure that program details about customer benefits are clear in the marketing and enrollment materials. Language on the Georgia Power program page describes grid-level savings, but potential enrollees may not understand that the savings will not be reflected on their bill. Consider conducting research surrounding the program language about savings and benefits. Research could include interviews, focus groups, or A/B testing to understand how to best communicate the purpose of the program and how it will individually benefit participants. Per program staff, Georgia Power has clarified messaging in 2021 about this program to reduce customer confusion.
- Ensure that program instructions are clear in event notifications. Participants may need more help understanding how to opt out of the event and a clearer definition of what it means to opt out.

Consider conducting research surrounding this language and the timing of providing these definitions and instructions. For example, it may be helpful to provide an opt-out refresher in the email notifying people of the events. Per program staff, they have already clarified this process in marketing and program materials.

- Georgia Power should consider working with stakeholders to allow Georgia Power to claim benefits from the control group, or if not, requesting the implementers forego withholding the control group to enable a higher proportion of enrollees to contribute to the program savings. While the control group enables the implementer and evaluators to estimate savings more accurately, the added level of accuracy is most valuable while the program launches and foregoing the control group moving forward could enable Georgia Power to claim greater program savings in future years with the same number of enrollees.
- Georgia Power should consider requesting the implementers identify enrollees who are routinely unable to participate in events. Some demand response enrollees may routinely be unable to contribute to program savings, for example, due to ongoing connectivity issues. Program managers and implementers could consider contacting these customers and requesting the customers reconcile the issues. To motivate customers to act, program managers could consider providing seasonal incentives to customers who are actively participating in events.

Residential Specialty Lighting

- Remove reflectors from the Retail and Marketplace pathways of the program. More than 90% of reflectors sold in the US are LEDs. Program efforts should focus on bulb types with lower LED shares, such as globes and candelabras.
- Focus on store types where LED market shares are lower. Home improvement stores like Home Depot have higher LED market shares than grocery, dollar, and discount stores. Costco does not sell inefficient lighting. By moving program dollars out of Home Depot, Costco, and other home improvement or club stores, the program could expect a lower freeridership rate.
- Continue distributing LEDs through food banks. The freeridership rate for this program component is 0%. Shifting more program dollars into this component will help Georgia Power further engage low- and moderate-income customers (while also serving to boost the overall net-to-gross ratio of the program).
- Plan for retail lighting programs to continue through at least the end of 2022 but be prepared to terminate the program should the EISA backstop be reinstated. Though uncertainty remains, it appears reasonable to assume that the expanded GSL definition and 45 lumens/Watt efficiency standard will be in effect by sometime in 2023 or 2024.
- Adjust per-unit savings values to account for cross-sector sales. Assuming 100% residential operating parameters will undersell the savings for bulbs that may cross sectors, as commercial hours of use and coincidence factors are higher than residential hours of use and coincidence factors. For LED

bulbs sold through the Online Marketplace or distributed through food banks, savings assumptions should reflect purely residential operating parameters. For LED bulbs sold through retail stores, savings assumptions should reflect cross-sector sales.

Home Energy Improvement Program (HEIP) – Individual Improvements and Whole House

- For future planning, the evaluation team recommends using 2020-2021 EM&V gross savings results for Individual Improvements and the Multifamily pathway, but using the 2017 EM&V gross savings results for the Whole House single family pathway. The Whole House single family pathway operated differently than designed in 2020 and early 2021, as program participation was dominated by one contractor who serves a lower-income rental population in a specific geographic area. This created challenges in evaluating savings for the Whole House single family component of the program. For net-to-gross, the evaluation team recommends using the 2017 EM&V net-to-gross results for future planning for HEIP Individual Improvements, Whole House single family, and Multifamily pathways. Recommendations for the Thermostat Marketplace pathway are discussed separately.
- Apply realization rates to Beacon home energy assessment savings estimates or explore modifications to the tool to reflect the realistic energy and bill savings participants can expect from their project. Impact evaluation results have consistently underperformed the electric savings assumptions in Beacon since the evaluation of Georgia Power's 2010 DSM Portfolio. This strategy would ensure that Georgia Power's claimed savings and earnings more closely reflect evaluation findings. In addition, this may establish more realistic savings expectations for participants.
- Consider approaches to allow for more accurate estimates of savings for Individual Improvements measures. The evaluation team identified improvements that can be made to estimate energy and demand savings more accurately for several measures. When possible, use site-specific information to estimate project savings, and consider using more granular calculations to scale savings more accurately to customer characteristics (such as actual CFM achieved).
- Reassess the assumptions used to develop current savings estimates across both pathways. There are several opportunities to realign assumptions that feed into reported energy savings. For Whole House, the evaluation team believes there may be opportunities to improve the accuracy of assumptions that underpin the utility bill disaggregation feature. The evaluation team believes that water heating, appliances, and other baseload is underrepresented in Beacon and heating and cooling consumption are overstated.
- Resume QA/QC when and/or where it is safe. Evaluation activities uncovered quality control issues for the most active contractor and additional projects. These issues are already being addressed by the program delivery team, which should continue to explore available options such as follow-up telephone interviews with customers or other virtual QA/QC options when in-person visits are not possible.
- Consider offering multiple tiered savings options through the Whole House path. Dual participation between the Whole House and Individual Improvements paths was common during the first 15

months of the 2020 to 2022 program cycle. The most common dual participation strategy was an air sealing Individual Improvements measure followed by a Whole House project. However, there are complex interactive effects between air sealing and Whole House measures like attic insulation that are better addressed through building simulation software. Ultimately, a tiered incentive strategy for Whole House projects that allows contractors and participants to earn higher incentive payments for different levels of home energy reduction could eliminate the need for dual participation across program paths. In addition, lower savings thresholds could increase participation for customers who cannot reach the current savings requirement, either because their home is already too efficient or due to financial issues.

Home Energy Improvement Program (HEIP) – Thermostat Marketplace

- Educate customers about the most efficient way to program and use their smart thermostat. Provide educational materials encouraging customers to program an efficient schedule on their thermostat and, if available, opt-in to the thermostat's learning and optimization features. Raising awareness that frequent adjustments to the temperature may lead to less efficient operation of their HVAC system, resulting in lower energy and bill savings, may encourage customers to adjust less frequently.
- Target customers with the potential to achieve the highest savings. To encourage higher participation from customers with manual thermostats, add information to marketing materials that highlights the higher savings that can be achieved when replacing a manual thermostat. Target electrically heated homes by marketing to customers with high billed consumption during winter months. In addition, consider designing marketing materials to appeal to customers with heat pumps or other types of electric heating equipment.
- Consider changes to the way savings are claimed for smart thermostats. There was no statistically significant difference in energy savings between smart thermostats installed in single family and multifamily homes. However, homes with electric heat are expected to save more than homes with fossil fuel heat, due to differences in HVAC electricity consumption during the heating season for each fuel type. These results suggest a single deemed savings value could be used across home types, and that Georgia Power should instead explore the viability of splitting the thermostat measure and savings by heating fuel.
- Provide messaging that lists contractors recommended by Georgia Power who can support smart thermostat installations. An advantage to encouraging contractor installations is that they can provide customers with helpful information regarding the most efficient way to use their smart thermostat. They can also raise awareness and educate customers about other Georgia Power energy efficiency programs during the thermostat installation and encourage them to participate in those programs as well.
- Evaluate thermostats in the next program cycle using a robust, industry-standard methodology, such as one leveraging a matched comparison group, to determine if savings remain consistent in future

years, especially if current economic and customer behavior conditions (such as higher work-from-home rates) persist.

Home Energy Efficiency Assistance (HEEAP)

- Assess processes and assumptions currently used to estimate savings for measures offered through HEEAP. These measures include air sealing, ceiling insulation, duct sealing, and HVAC servicing. In the HEEAP chapter, the evaluation team provides detailed recommendations to ensure the claimed energy and peak demand savings estimates are as accurate as possible. Like HEIP, the evaluation team recommends using project-specific data to accurately scale savings to project and home parameters (such as actual CFM, home square footage, etc.).
- Capture additional information in the tracking data. To facilitate more accurate assessment of savings, capture information such as baseline and installed R-values for insulation, full details for work performed for HVAC tune ups, and test-in/test-out values for duct sealing.
- Monitor key metrics for program participants once participation has increased. In addition to implementing scalable savings for air sealing measures, once participation has ramped up Georgia Power should monitor key metrics, customer characteristics, and baseline information for customers across all measures to better understand and characterize customers who participate in this program. This will help ensure assumptions are aligned with actual participation.
- Consider program participants, or potential program participants, who may need additional assistance with the application or scheduling processes. Ensure clear communication channels are available for participants to follow up with any questions, and to ensure that these channels are easy to navigate for all participants.
- Provide fields on the application to capture additional contact information of anyone who assisted with the application.
- After COVID-19 restrictions are relaxed, consider whether to continue allowing contractors to conduct the home assessments themselves, depending on program delivery priorities and needs. While contractors prefer this method, there may be additional considerations (such as increased need for QA/QC of contractor quality and performance) needed with this approach.

Refrigerator Recycling (RRP)

- Consider additional ways to message to participants with older and less efficient appliances to encourage them to participate in the program. One idea, used by other utilities, is to offer an “oldest refrigerator” contest with a prize for whoever recycles the oldest refrigerator (or freezer).
- Consider reviewing program metrics over time, to determine if there are areas or demographics of customers the program has not saturated. Program participants tended to be older (51% over 60), which is common for appliance recycling programs. However, it is possible there are other pockets of

customers, such as younger new homeowners, who also have secondary appliances they no longer want and may be good candidates for targeted marketing.

- Continue to ensure the free pickup aspect of the program is highlighted in all marketing efforts, as well as the fact that the appliances are disposed of in an environmentally friendly manner, as customers value these aspects of the service as much as the incentive itself. At the time of this report, the Georgia Power program website does highlight the free appliance removal.
- To maximize net savings, consider ways to target customers who would be most likely to keep their appliance in the absence of the program. Older customers (70+) tended to be more likely to indicate they would have kept the appliance in the absence of the program, compared to customers between the ages of 50 and 69.
- Maintain incentives at current levels and explore whether it is cost-effective to increase them. While customers indicated the free pickup was very important in their decision to participate overall, the incentive appeared to be more important for those customers who said they would have kept their appliance in the absence of the program (i.e., low freeriders).

PROGRAM OFFERINGS

Georgia Power's DSM portfolio consists of six customer programs in the residential sector. The 2020 program year marked the first year of a three-year program cycle and beginning this year Georgia Power brought the implementation of some programs in-house. A brief description of each program's offering follows:

- Through the Behavioral program, Georgia Power sends Home Electric Reports to select customers in six waves. These reports are intended to encourage customers to adjust their behavior to be more energy efficient through education and recommendations. The reports are sent to randomly selected customers so that the evaluation team can statistically calculate and validate savings. This program is administered by Uplight.
- Through the Temp✓ program (also called Thermostat Demand Response), Georgia Power manages the load from participants' heat pumps by controlling their Wi-Fi enabled thermostats during demand response events when there is a need to lower peak demand. Georgia Power provides a $50 Mastercard gift card to participants who enroll in the program through a Bring-Your-Own-Device channel. This program is administered by Uplight.
- Through the Residential Specialty Lighting program, Georgia Power aims to reduce overall energy use of Georgia Power customers, as well as their peak demand contributions, by promoting the adoption of LED lighting. This program design is upstream of customers, meaning it relies on a network of participating retailers, food bank distributions, and the Georgia Power Online Marketplace to provide discounts on efficient lightbulbs. In addition to discounting the purchase price of lamps, the program includes a marketing campaign designed to increase awareness and acceptance of efficient lighting products. The retail component of the program is administered by CLEAResult, while the Online Marketplace is administered by Uplight.
- Through the Home Energy Improvement Program (HEIP), Georgia Power offers several distinct program channels designed to serve different customers in the residential class:
  - Whole House Single Family: Qualified customers who complete a home energy assessment and recommended improvements to achieve a 25% electric energy reduction receive a rebate for 50% of the cost of the improvements, up to $1,150 per year.
  - Whole House Multifamily: Encourages residential property owners to have a home energy assessment conducted, and to implement energy efficiency measures with the goal of lowering tenant bills, improving renter comfort, and increasing renter retention. Qualified projects can receive rebates for 50% of the cost, up to $575 per housing unit.
  - Individual Improvements: Offers incentives for energy efficiency upgrades in single family homes on an a la carte basis. Some measures required participants to use an approved program contractor, while other measures can be self-installed or installed by a licensed professional not

affiliated with the program. Customers can receive a rebate for 50% of the cost of the improvements, up to $600 per year.

- Marketplace Thermostats: Part of the Individual Improvements pathway, this offering allows residential customers to shop for and purchase smart, Wi-Fi enabled thermostats at up to 50% off the retail price. Thermostat rebates are offered at 50% of the eligible thermostat cost, up to $75 for single family homes and $38 for multifamily homes.

- Through the Home Energy Efficiency Assistance program (HEEAP), Georgia Power works with a network of approved contractors to deliver no-cost home energy improvements to income-qualified residential customers. Households with an income level 200% or less of the US Federal Poverty Guidelines are eligible to submit an application that involves completing a high-level preliminary review process. Participants work with both Georgia Power and contractors to complete an assessment, identify recommendations for improvements, and complete the installation of energy efficient equipment. This program is managed in-house by Georgia Power.
- Through the Refrigerator Recycling program (RRP), Georgia Power offers free pickup and a $35 incentive to single family customers for their secondary, working refrigerators and freezers. By picking up and recycling these units in an environmentally safe manner, the program creates cost-effective, long-term energy and peak demand savings, ensuring the appliances are removed from the grid completely. The program also raises customer awareness of the economic and environmental costs of these older appliances. The program is implemented by Appliance Recycling Centers of America (ARCA), who coordinates the scheduling, pickup, and recycling of appliances through the program. In 2020, this program shifted to outdoor pickups to address safety needs during the COVID-19 pandemic.

EVALUATION OBJECTIVES AND METHODOLOGY

The evaluation team conducted a comprehensive evaluation across all residential programs; the process can be broken into two key areas of research, which are summarized below:

Impact Evaluation. The evaluation team verified measure installation, determined evaluated (or verified) savings, and measured freeridership and participant spillover to produce net savings impacts (as applicable per program). This research includes conducting engineering desk reviews of project savings calculations, statistical analyses to estimate savings, completing site visits to observe project conditions, and/or surveying participants to understand program metrics.

Process Evaluation. The evaluation team investigated program processes, participation barriers, and the program experiences of customers and trade allies. This research used telephone and online surveys with program actors (trade allies, participants, and other supporting actors), and interviews with program and implementation staff to better understand program performance. This research gives stakeholders insight into the aspects of success or potential improvement for each program and provides context for impact findings.

Research Questions

The evaluation team examined a common set of research questions to guide the evaluation. Impact activities for most programs included an assessment of these research areas, where applicable:

- Data tracking review
- In-service rates (ISRs)
- Measure verification
- Freeridership
- Spillover

Process activities for most programs included an assessment of these research areas:

- Program design, delivery, and administration
- Marketing and awareness strategies
- Program processes (including application processes)
- Drivers of participation and barriers to participation
- Quality control processes
- Future program plans
- The impact of the COVID-19 pandemic on participants and program operations

Impact Evaluation Approach

To determine portfolio impacts, the evaluation team completed the following activities where applicable by program:

- Compared tracking data, program documents, and savings reports for alignment and accuracy
- Reviewed savings values, calculations, assumptions, and sources
- Calculated verified gross savings values for programs and the portfolio
- Estimated net-to-gross ratios from participant surveys, regression or billing analyses, or secondary sources
- Calculated verified net savings values for programs

The team employed statistical and engineering-based analysis techniques to achieve these results, adjusting program-reported gross savings using the information gathered through database and document reviews, engineering reviews of tracking data and project documents, TRM and past evaluation deemed savings calculation reviews, on-site visits, and regression analysis.

The evaluation team defined these key savings terms as follows for the impact evaluation:

- **Reported gross savings:** Annual gross savings for the evaluation period, as reported by Georgia Power and/or the program implementer in the quarterly and annual savings documentation.
- **Evaluated verified gross savings:** Annual gross savings adjusted to include the best available inputs and methodology available at the time of the evaluation.
- **Realization rate:** The percentage of savings the program realized, calculated using the following equation:

$$Realization\ Rate\ (\%) = \frac{Verified\ Gross\ Savings}{Reported\ Gross\ Savings}$$

- **Evaluated net savings:** Evaluated verified savings, adjusted for net-to-gross (i.e., freeridership and participant spillover, where applicable).

Process Evaluation Approach

For the process evaluation, the evaluation team conducted interviews with program and implementation staff to document how each program worked, to identify and understand the important influences on the program's operations, and to gain insight into factors influencing the program's performance. For all programs, the evaluation team also conducted surveys and interviews with program participants and in some cases participating contractors to understand their perspectives and experiences with a given program. The evaluation team also conducted a general population survey with customers to understand attitudes and barriers towards energy efficiency.

Research Activities

The evaluation team designed the 2020 – 2021 research activities to address the key researchable issues by program. As discussed above, the evaluation team adjusted evaluation timelines, and in some cases evaluation approaches and researchable issues, to adapt to the challenges presented by the COVID-19 pandemic. However, the team was still able to conduct a comprehensive review across all programs in their current state of design and delivery. Table 7 and Table 8 detail the impact and process research activities completed for each evaluation.

Table 7. 2020 Impact Evaluation Activities

PROGRAM	DATABASE REVIEW	ENGINEERING REVIEW/ ANALYSIS	ON-SITE VISITS	NTG ESTIMATION	ISR	REGRESSION/ BILLING ANALYSIS
RESIDENTIAL						
Behavioral	X			X (results are net)		X
Temp✓	X			N/A		X
Residential Lighting	X	X		X	X	
HEIP	X	X	X	X (secondary)		X
HEEAP	X	X		N/A		
Refrigerator Recycling	X	X		X		

Table 8. 2020 Process Evaluation Activities

PROGRAM	STAFF INTERVIEWS	MATERIALS REVIEW	PARTICIPANT SURVEYS AND INTERVIEWS	CONTRACTOR INTERVIEWS
RESIDENTIAL				
Behavioral	X	X	X	
Temp✓	X	X	X	
Residential Lighting	X	X	X	
HEIP	X	X	X	X
HEEAP	X	X	X	X
Refrigerator Recycling	X	X	X	

Below we provide a high-level description of the tasks completed as part of the evaluation. More detailed information on the approach for each evaluation is included in each program chapter.

Staff Interviews

The evaluation team interviewed Georgia Power program managers and implementation staff in early to mid-2020 to understand how each program was designed and delivered, what worked well, and what could be improved. The interviews covered wide-ranging topics such as program design and administration, communication and data tracking processes, marketing strategies, contractor and participant interactions, and challenges and successes. On an ad-hoc basis, the evaluation team re-interviewed program staff again in 2021 as needed, as program design or delivery was adjusted or programs that were on pause launched.

Database and Materials Review

The evaluation team reviewed Georgia Power's program tracking databases, invoices, reporting documents, and other documentation to assess the quality of information and to identify potential anomalous entries and missing values. The evaluation team conducted a database and document review for all programs, including these specific activities:

- Verified that all customer and vendor information needed to conduct primary research was available and complete
- Confirmed that all measure-specific data included the necessary details in the proper formats to enable impact evaluation, and documented where information was missing or incomplete
- Reviewed program operation manuals as well as examples of marketing collateral, outreach materials, and other related activities where available

Engineering Review and Analysis

For several programs, including HEIP, Residential Lighting, and HEEAP, the evaluation team used program tracking data to identify key project parameters and calculate verified per-unit gross savings, relying on algorithms from technical reference manuals (TRMs) from various jurisdictions. These TRMs included but were not limited to Georgia Power's 2019 TRM. This approach was used, in part, because the reported gross per-unit savings come from various sources, including results from prior cycle evaluations, building simulation models, and algorithms. Where appropriate, the same algorithms used to determine reported savings were used to calculate verified savings with updates to parameters based on primary data collection. However, in cases where reported savings was determined through prior evaluations or building simulations, or when the algorithmic approach in the Georgia Power TRM did not line up well with the available data, the evaluation team used algorithms and approaches from alternative sources.

Verification and Metering Site Visits

For HEIP, the evaluation team focused on-site activities on verifying program measures installed through the Whole House path, given these projects are typically the most complex of residential projects. This year, these projects often also included Individual Improvements measures. Due to social distancing restrictions caused by COVID, the evaluation team significantly reduced the number of planned on-sites completed and instead increased the number of project documentation and desk reviews completed. The team was ultimately able to complete several on-sites with customers in the summer of 2021, once COVID-related restrictions were relaxed. The team also completed several virtual on-sites. These on-site visits primarily focused on confirming and verifying the following:

- The installation of rebated measures
- Home and customer characteristics, such as HVAC system and fuel type
- Where possible, baseline conditions

These on-sites also included a brief interview with the participant to understand the process to participate from their perspective, and any relevant information about their experience.

Regression Analysis

Several programs used regression or statistical analysis to estimate impacts. For the Refrigerator Recycling program, the evaluation team followed the US Department of Energy's (DOE's) Uniform Methods Project (UMP) evaluation protocol for refrigerator recycling and used a multivariate regression model to estimate the gross unit energy consumption for refrigerators and freezers recycled though the program. After a secondary literature review of available regression models based on primary in situ data collection, the evaluation team used Georgia Power's regression model developed for the 2011 evaluation report using in-situ data from customers in Georgia. We used program tracking data, provided by Georgia Power, in the regression modeling. The evaluation team multiplied the coefficient set, created through the model, by attributes specific to Georgia Power's tracking data to predict energy consumption for each unit recycled through the program.

For the Behavioral program, Thermostat Demand Response, and HEIP - Thermostat Marketplace the evaluation team performed consumption data regression analysis (or billing analysis). These industry-standard techniques use energy consumption data (from monthly energy bills or AMI data reads) to estimate participant consumption in the absence of the program using either matched comparison groups or randomized controlled trial design to calculate energy and/or demand savings as the difference between modeled and actual consumption.

Customer and Contractor Surveys and Interviews

To support the impact and process evaluations, the evaluation team conducted surveys. We designed the surveys to collect data about market awareness of Georgia Power's energy efficiency programs, product installation rates, customer behavior and equipment use, participant satisfaction with program components, and barriers to participation. The surveys informed process and impact research questions, such as freeridership and participant spillover.

The evaluation team provided an incentive to respondents for participating in surveys and in-depth interviews. For in-depth interviews, respondents were provided a $50 incentive in the form of an electronic gift card. For surveys, respondents were entered into a drawing for a $100 electronic gift card.

Sampling

The evaluation team used a sampling approach to develop sample frames for participant, general population, and contractor research. For each quantitative survey effort, the evaluation team designed the survey samples to achieve minimum ±10% precision at 90% confidence at the program level. In-depth interview samples are qualitative only and were not designed to be statistically representative.

Table 9 shows the population and sample sizes, as well as the number of completes for surveys.

Table 9. Population and Sampling Characteristics

PROGRAM	RESPONDENT GROUP	TYPE OF RESEARCH	POPULATION (COUNT OF UNIQUE PARTICIPANTS)	INCLUDED IN SAMPLE FRAME	TARGET COMPLETES	ACHIEVED COMPLETES
RESIDENTIAL						
Behavioral	Participants	Surveys	335,582	3,006	300	332
Temp✓	Participants	Surveys	14,444	14,444	250	3,469
Residential Lighting	Participants	Surveys	3,570	1,440	120	254
HEIP – Individual Improvements and Whole House	Participants	Surveys	1,721	1,721	200	258
HEIP – Thermostat Marketplace	Participants	Surveys	27,790	1,500	140	213
HEIP/HEEAP	Contractors	In-Depth Interviews	119	119	10	9
HEEAP	Participants	In-Depth Interviews	11	11	5	4
Refrigerator Recycling	Participants	Surveys	3,363	578	140	216
General Population	Georgia Power Customers	Surveys	3,571,052	3,500	250	250

Net-to-Gross Methods

A net-to-gross (NTG) ratio is made of two components: freeridership and spillover. Freeridership is the percentage of savings that would have occurred in the absence of the program because participants would have behaved the same (purchasing the same measures) without the influence of the program. Spillover occurs when customers purchase energy efficient measures or adopt energy efficient building practices without participating in a utility-sponsored program. The evaluation team used the following equation to calculate a NTG ratio for each program:

$$Program\ NTG\ Ratio = 100\% - Freeridership + \ Spillover$$

In previous evaluation cycles, Georgia Power was allowed to claim nonparticipant spillover. Also called “freedrivership,” nonparticipant spillover attempts to capture savings generated in the market due to the influence of the program. Commonly, this is measured by surveying market actors (such as contractors) to understand the impact that utility messaging, training, and support have made in contractor recommendation, sales, and stocking practices for energy efficient equipment, and/or by surveying nonparticipating customers. Starting in the 2020 – 2022 cycle, Georgia Power is no longer able to claim nonparticipant spillover, so this was not measured in this evaluation. Because NTG ratios developed for past evaluations did include this metric, comparison should be made carefully and primarily focus on freeridership and participant spillover (where applicable).

The evaluation team employed several different approaches to estimate net savings for programs this cycle (Table 10). Our approach for each program is discussed in more detail in each program chapter and corresponding appendices.

Table 10. NTG Approach Used for Each Program

PROGRAM	NTG APPROACH
Behavioral	Billing analysis (results are net)
Temp✓	N/A - net-to-gross not applicable to DR programs
Residential Lighting	Regression model (lift analysis)
HEIP – Individual Improvements and Whole House	Referenced 2017 results (self-report)
HEIP – Thermostat Marketplace	Billing analysis (results are net)
HEEAP	Deemed at 100%
Refrigerator Recycling	Self-report using customer surveys from 2020 – 2021 data

1. RESIDENTIAL BEHAVIORAL PROGRAM

Program Design and Delivery

The Residential Behavioral program provides paper and electronic Home Electric Reports (HERs) to select Georgia Power customers. HERs detail the customer's electric energy usage—including their historical consumption data as well as a comparison to other households—and provide low-cost and no-cost tips to save energy. HERs also promote and encourage participation in other Georgia Power energy efficiency programs. Customers participating in the program may receive a physical paper report through the mail, while others with a valid email address receive a monthly electronic HER (eHER).

The program uses a randomized controlled trial (RCT) design by randomly assigning customers to a treatment or control group. Participants in the treatment group receive an HER while participants in the control group do not. The participant population is divided into eight waves based on when they began receiving the HER.

Changes from Previous Cycle Design

In May 2020 Georgia Power relaunched their Residential Behavioral program using Uplight as the new implementer. As of Q3 2021, there are eight waves in the Residential Behavioral program. Uplight launched five new waves and took over three existing legacy waves from the past implementer. The general structure and content of the Uplight HERs are consistent with industry-standard home energy reports. They include a home energy comparison and energy saving tips, and direct people to Georgia Power's programs.

In 2020 there were six waves in the Residential Behavioral program: three legacy waves and three Uplight waves launched in 2020. One of the legacy waves is an income-qualified wave. One of the 2020 Uplight waves is a transition wave that moved from print and eHERs in 2020 to only eHERs in 2021. In May 2021 Uplight launched two additional waves, which are not evaluated in this report. Table 11 describes each of the waves in the Residential Behavioral program with their legacy status, their report medium, and whether they are included in this evaluation.

Table 11. 2020 and 2021 Residential Behavioral Waves

WAVE NAME	LEGACY STATUS	EHER	PRINT
2014 Legacy Wave	Legacy	Treatment customers with emails	All treatment customers
2016 Legacy Income-Qualified Wave	Legacy	Treatment customers with emails	All treatment customers
2018 Legacy Wave	Legacy	Treatment customers with emails	All treatment customers
2020 Standard Wave	New	Treatment customers with emails	All treatment customers
2020 Digital Transformation Wave	New	All	All treatment customers in 2020; none in 2021
2020 Digital Only Wave	New	All	None

There are three types of waves in the Residential Behavior program. First, there is a “standard” wave. Treatment customers in these waves receive a print HER in the mail; if they have an email address on file, they are also sent an eHER. Second, there is a “transformation” wave. These treatment customers start receiving both the print and eHER. In 2021, they stopped receiving the print HER and were only sent eHERs. Finally, there is the digital only wave where treatment customers only receive an eHER. Table 11 describes the type of report treatment each wave receives.

The cadence of the report delivery changed between program years. The timing and cadence of the 2020 reports were adjusted to compensate for a later start date. The program start was delayed for a few reasons: 1) onboarding a new implementer; 2) administrative and scoping delays (i.e., Master Service Agreement (MSA) and Technology Organization approval); 3) the COVID-19 pandemic. Uplight resumed a more typical cadence in 2021 when they sent reports over the course of a full calendar year (see Figure 3 and Figure 4).

Figure 3. Cadence of Print Reports by Wave

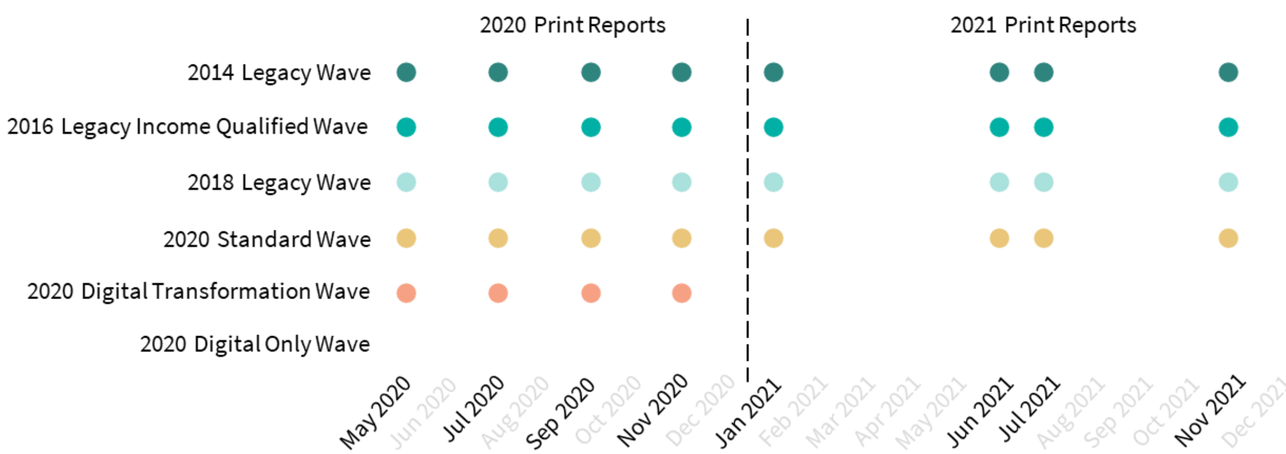
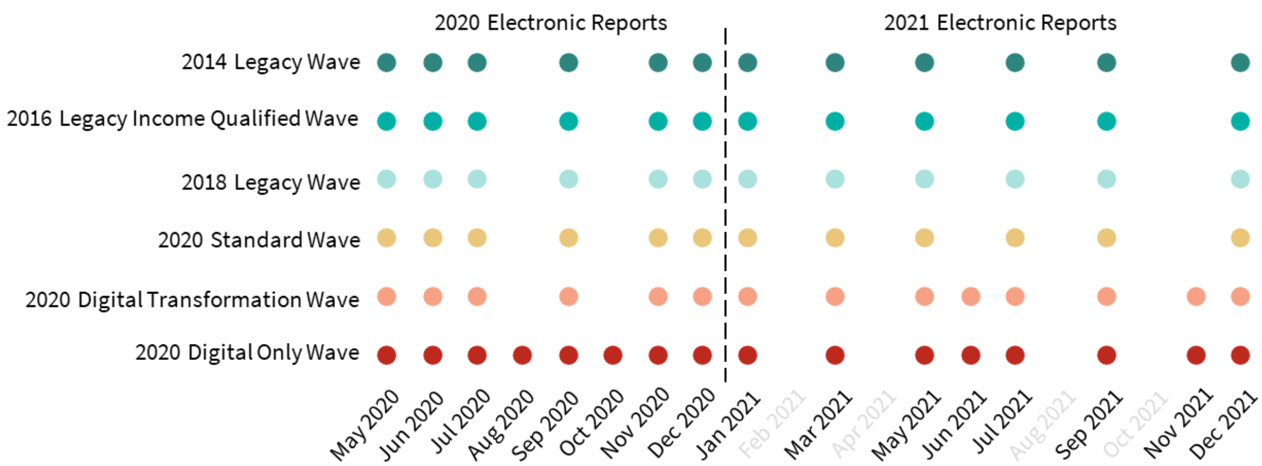


Figure 4. Cadence of eHERs by Wave



Implications of the COVID-19 Pandemic

The evaluation team recognizes that this evaluation occurred during a timeframe in which the COVID-19 pandemic impacted daily life for residential customers in Georgia. Like most of the Georgia Power programs which were paused during the transition to new implementers in early 2020, the Behavioral program did not begin in earnest until Q2 of 2020, resulting in the entirety of performance for this program cycle occurring during the on-going COVID-19 pandemic.

Evaluation research and analysis nearly always have the potential for introduced and inherent biases and exogenous factors that may influence results. Ideally, evaluators attempt to control for these factors in analyses, such as through sample design. Where controlling for them is not possible, evaluators will attempt to identify and characterize the factors that may have influenced evaluation results. For all program evaluations conducted this cycle, the evaluation team has carefully considered possible ways the unprecedented events of the COVID-19 pandemic and related factors may have impacted our results. There is much that is still unknown about how the COVID-19 pandemic has influenced household energy use and behavior in the US, and it is likely that the pandemic has affected households differently depending on household size, location, employment status, and other demographic factors (such as income, race, age, etc.). Additionally, whether and at what speed these factors return to pre-2020 conditions are occurring at varying degrees and speeds across different demographics and populations.

The Residential Behavioral program incorporates a randomized controlled trial design as part of its delivery mechanism. This means that control and treatment customer groups were selected prior to program implementation. Because of the large size of the treatment and control groups, and more heterogenous participation design, the evaluation team expects that exogenous factors (such as changes in customer behavior, household characteristics, or equipment use due to the pandemic) are *controlled for*, meaning that these exogenous factors should be affecting both the control and the treatment groups relatively equally.[3] However, given the unprecedented nature of the pandemic, there may be factors or considerations that are not measurable or quantifiable by the bounds of this evaluation, and therefore, all results of evaluations completed during this timeframe should be interpreted with this in mind.

Program Performance

To assess program performance, the evaluation team estimated energy savings generated by the current program implementer. This does not include any rollover or persistence savings claimed in 2020 that were generated by the previous program implementer. The Residential Behavioral program (as operated beginning in 2020) saved 14,229 MWh in 2020 and 8,633 MWh in Q1 of 2021 for a total program savings of 22,862 MWh.[4] The 2020 savings fell short of the 2020 program goal of 38,096 MWh. This was largely driven by delays to the program launch as Georgia Power ramped up a new implementer, as well as disruptions caused in general by the COVID-19 pandemic. The evaluation team found a 96% realization rate, when comparing evaluated savings to the current implementer-reported savings. The program achieved average household savings of 0.69% per household.

Table 12 summarizes energy savings for the program during 2020 and Q1 of 2021 compared to program savings goals.[5] The reported and verified savings represent savings generated beginning mid-year in 2020; the following sections provide more information on the evaluation period and approach.[6] The evaluation team also calculated demand savings, although the Residential Behavioral program does not have demand savings goals to report for comparison. More information about demand savings and our methods can be found in the Demand Reduction section.

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[3] As discussed in this chapter, our survey found no statistically significant demographic differences between treatment and control customer demographics based on survey responses, which supports this statement.

[4] This value represents the realization rate multiplied by the reported savings. We modeled program savings between June 2020 and March 2021. Because the results span calendar years, we calculated the realization rate (modeled savings dived by the implementer reported savings) and applied it to the implementer reported savings for each calendar year.

[5] Reported savings exclude the previous implementer's savings reported in January 2020 and July 2020 to ensure that the savings captured in this table and this chapter represent savings generated by Uplight only. The evaluation team worked with the implementation team to determine which months of reported savings represented Uplight-generated savings. The program overall reported 26,302,769 kWh savings in 2020. All implementer savings values were found in the files named, "GPC_savings_DATE_external". For the Q1 2021 savings values we included the implementer's reported savings in March though they were not included in the Q1 2021 scorecard.

[6] Both verified savings values have been adjusted to remove any double-counted savings. A description of how we calculate the double-counted savings can be found in the Cross-Program Participation section.

Table 12. 2020 and 2021 Residential Behavior Program Savings and Demand Reduction Summary (kWh)

METRIC	TIME PERIOD	ANNUAL GROSS SAVINGS GOAL	REPORTED SAVINGS [a]	VERIFIED GROSS ADJUSTED	VERIFIED NET ADJUSTED	OVERALL REALIZATION RATE
Electric Energy Savings (kWh/yr.)	2020	38,096,432	14,822,033	14,228,655	14,228,655	96%
	Q1 2021	38,096,432	8,993,381	8,633,345	8,633,345	
Summer Peak Demand Reduction (kW)	N/A	N/A	N/A	2,865	2,865	N/A

[a] Reported savings exclude the previous implementer's savings reported in January 2020 and July 2020. Savings captured in this table represent savings generated by Uplight only.

Research Questions

The evaluation team conducted qualitative and quantitative research activities to answer the following key research questions for the program:

Impact Questions

- How did the program perform against savings goals?
- What is the impact of HERs on energy use?
- Does receiving HERs result in higher participation in other energy efficiency programs? If yes, what is the impact of double-counted savings?

Process Questions

- Are treatment group customers aware of the HERs?
- To what extent do treatment group customers read and interact with the HERs?
- How satisfied are treatment group customers with the reports overall and with the different sections of the HERs?
- Does receiving HERs affect satisfaction with Georgia Power?
- To what extent do HERs channel customers into other energy efficiency programs?
- What portion of customer opted out of the program?
- Is there any difference in program experience for the digital only versus print and digital groups?
- Is there any difference in program experience for the new versus legacy waves?

Impact Evaluation

This section details each step of the impact evaluation and the evaluated savings for the Residential Behavioral program. The evaluation team conducted a billing analysis and cross program participation analysis for the time between June 2020 and March 2021. In the previous section, we reported savings separately for 2020 and Q1 of 2021. In this section we report our modeled savings during the time between

June 2020 and March 2021 to fully capture the effect of the Uplight reports. We report these savings for all six waves, including the legacy waves, after the first Uplight report was sent. The implementer created randomized groups by randomly assigning customers to either the treatment or the control group. The evaluation team verified the groups were similar by comparing their energy use in the pre-period. Because of the nature of RCT study design, we also assume it is likely the groups are equivalent on other unmeasured, behavioral characteristics such as their level of interest in saving energy; the RCT with opt-out program design limits the threat of selection bias.[7]

The control group acts as a baseline or counterfactual, providing an estimate of the treatment group's energy consumption in the absence of the program. The RCT design allows both the implementer and evaluators to estimate program impacts by comparing changes in whole home energy use between the treatment and control groups. Evaluation experts often refer to the RCT as the "gold standard" for behavioral program evaluations.[8]

A key feature of the RCT design is that the analysis yields net savings, not gross savings. There is no option for customers to receive the HERs outside of the program. Thus, there is no freeridership, and no net-to-gross adjustment to the billing analysis results is necessary. We refer to the net savings from the billing analysis as "unadjusted net savings" to distinguish from final "adjusted net savings," which do not include double-counted savings from cross-program participation (uplift).[9] Total program unadjusted net savings were 22,881 MWh. After removing double-counted savings from cross program participation the total adjusted net program savings are 22,862 MWh (Table 13).

[7] Selection bias may exist in opt-in program designs, in which customers who choose to participate in a program may differ systematically from customers who do not participate.

[8] State and Local Energy Efficiency Action Network. 2012. Evaluation, Measurement, and Verification (EM&V) of Residential Behavior-Based Energy Efficiency Programs: Issues and Recommendations. Prepared by A. Todd, E. Stuart, S. Schiller, and C. Goldman, Lawrence Berkeley National Laboratory. http://behavioranalytics.lbl.gov

[9] Because we calculate savings at the whole-home level, we are capturing any differences in energy usage between the pre- and post-periods and the treatment and control groups. This means that if any customer in the HER program participates in another Georgia Power EE program, we will also capture those energy savings. However, savings from other Georgia Power EE programs are claimed within each programs' savings calculations, meaning our calculations of savings are double counting the program savings. For example, if a treatment customer purchases a smart thermostat from the Georgia Power Marketplace, both the Behavioral program billing analysis and the Thermostat Marketplace billing analysis will capture those savings. Therefore, we removed double-counted savings for the final adjusted net savings. More can be found in the Cross-Program Participation section.

Table 13. Verified Adjusted MWh Savings by Wave

WAVE	TOTAL VERIFIED ENERGY SAVINGS (MWH)	TOTAL VERIFIED ADJUSTED ENERGY SAVINGS (MWH)
2014 Legacy Wave	954[a]	954
2016 Legacy Income-Qualified Wave	825	813
2018 Legacy Wave	11,595[a]	11,594
2020 Standard Wave	3,060[a]	3,058
2020 Digital Transformation Wave	5,494[a]	5,494
2020 Digital Only Wave	953[a]	950
Total	22,881[a]	22,862 [b]

[a.] *Statistically significant, $p < 0.10$.*

[b.] *Note that totals may not add up due to rounding*

Billing Analysis

The evaluation team applied several steps for our Residential Behavioral program billing analysis.

- Data cleaning: The evaluation team identified treatment and control group billing data to exclude from the analysis. We cleaned the data by removing duplicate reads, negative reads, reads in the top 1% of energy usage, and reads after move-out/inactive date.
- Equivalency check: The evaluation team verified that the distribution of average monthly energy usage prior to receiving the HERs was sufficiently similar between the treatment and control groups, consistent with the random assignment of customers to each group.
- Regression analysis: The evaluation team verified program impacts using two alternative statistical models: a post-program regression (PPR) analysis with lagged participant controls and a linear fixed effects regression (LFER) analysis. Both models control for individual respondent differences, but the PPR achieves this by including lagged participant controls for each participant as an explanatory variable while the LFER removes each participant's average energy consumption before modeling. The evaluation team applied both models to monthly energy usage data obtained from respondent bill records. As per industry standards, we report the results of the PPR model as the official impact estimates; the LFER model serves as a check on those results. We provide more details in Appendix 1A: Algorithms and Assumptions.
- Cross-program participation analysis: The evaluation team estimated the cross-program participation in other energy efficiency programs due to actions suggested by HERs through a post-only differences approach applied to tracking data from other programs. Post-only differences are a direct comparison of program uptake in the post-period as a percentage of respondents from treatment and control groups. We provide more details in the Cross-Program Participation section.

Data Cleaning

As shown in Table 14, the evaluation team cleaned the billing data to ensure that data used in the billing analysis contained sufficient pre-period and post-period months in the analysis periods and that the usage values were not missing and were not outliers. The attrition rates were low for both treatment and control customers in every wave.

Table 14. Participants Filtered Out by Data Sufficiency Checks for Electric Customers

STEP	WAVE	CONTROL ACCOUNTS	TREAT ACCOUNTS	CONT PCT ACCTS REMOVED	TREAT PCT ACCTS REMOVED
Raw Data	2014 Legacy Wave	5,006	6,290	-	-
	2016 Legacy Income-Qualified Wave	4,504	16,382	-	-
	2018 Legacy Wave	12,632	63,190	-	-
	2020 Standard Wave	25,000	52,578	-	-
	2020 Digital Transformation Wave	25,000	75,000	-	-
	2020 Digital Only Wave	25,000	25,000	-	-
Final Cleaned Data	2014 Legacy Wave	5,006	6,290	0.00%	0.00%
	2016 Legacy Income-Qualified Wave	4,504	16,382	0.00%	0.00%
	2018 Legacy Wave	12,630	63,176	0.00%	0.00%
	2020 Standard Wave	24,976	52,542	0.00%	0.00%
	2020 Digital Transformation Wave	24,983	74,938	0.00%	0.00%
	2020 Digital Only Wave	24,984	24,981	0.00%	0.01%

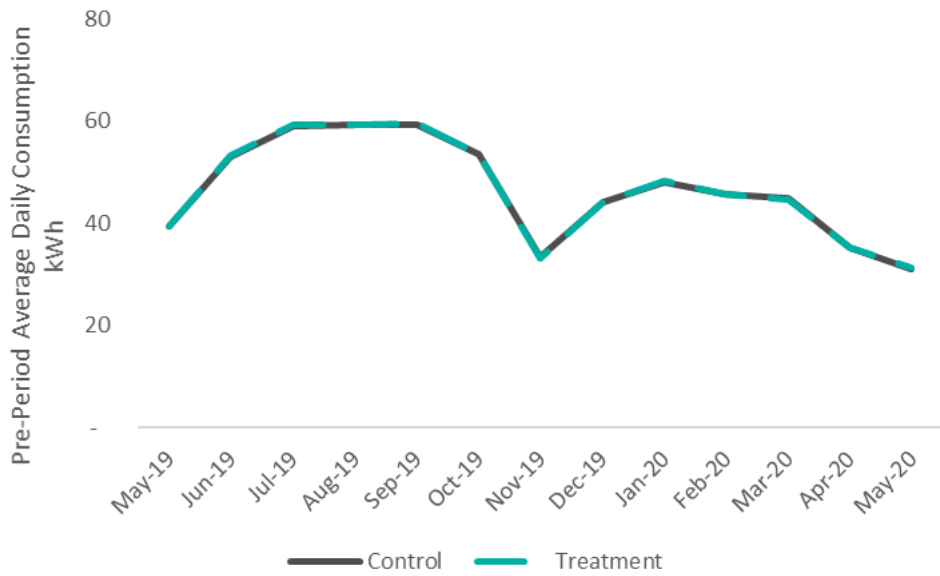
Equivalency Check

Because the treatment and control groups are randomly assigned, pre-period energy use should theoretically be equivalent between the groups. The evaluation team performed an equivalency check of the energy usage patterns of the treatment and control groups of each wave in the year preceding the report rollout to confirm that the data in each case were consistent with an RCT evaluation approach. All waves passed equivalency checks.

The evaluation team employed two methods to assess the equivalency of treatment and control energy usage:

- Visual inspection of overlaid plots of monthly mean energy use for treatment and control groups. Figure 5 shows the pre-period usage for the 2020 Standard Wave. If the waves were not equivalent the usages lines would not be perfectly overlapped. We reviewed these graphics for each of the waves and only include the 2020 Standard Wave as an example.
- T-tests of the monthly differences in mean energy use between treatment and control groups in each month. A significant difference ($p < 0.05$) indicates that pre-period usage is dissimilar between groups.

Figure 5. 2020 Standard Wave Treatment and Control Pre-Period Usage



In addition to checking for equivalency in pre-period usage, we looked at the differences in weather between the treatment and control group pre- and post-treatment to see if they experienced equivalent weather. There is no difference between the treatment and control groups in the pre- or post-periods. When plotting the heating and cooling degree days in the pre- and post-periods we found that the three new waves (2020 Standard, 2020 Digital Transformation, and 2020 Digital Only Waves) had nearly identical weather in the pre- and post-periods (Table 15). When reviewing the locations of the participants in the new waves we found that they are in the same metropolitan areas. The implementer said that this was not intentional. When pulling future waves, the implementer should ensure that the waves are geographically diverse.

Table 15. Heating and Cooling Degree Days in Pre- and Post-Periods by Wave

	COOLING DEGREE DAY PRE	COOLING DEGREE DAY POST	HEATING DEGREE DAY PRE	HEATING DEGREE DAY POST
2014 Legacy Wave	2.7	3.1	8.9	8.3
2016 Legacy Income-Qualified Wave	4.0	3.8	5.5	7.4
2018 Legacy Wave	3.3	3.3	6.2	7.9
2020 Standard Wave	4.3	3.8	6.0	7.3
2020 Digital Transformation Wave	4.3	3.8	6.0	7.3
2020 Digital Only Wave	4.3	3.8	6.0	7.3

Regression Analysis

We estimated that the Residential Behavioral program saved 22,881 MWh of electricity in the evaluation period (June 2020 through March 2021) (Table 16 and Figure 6). All waves show energy savings, and five of the six waves have statistically significant savings. The modeled savings for the 2016 Income-Qualified wave was not statistically significant. The 2014 and 2018 Legacy waves have average household savings that are over 1% of their baseline energy usage; all the 2020 waves have savings that are about 0.5% of baseline energy usage. For all rows identified where the confidence interval crosses zero the savings are not statistically significant. In other words, we found statistically significant savings for all but the 2016 Legacy Income-Qualified wave when we modeled for energy savings and this finding was consistent across multiple model specifications. These savings values do not adjust for cross-program participation savings from participation in other Georgia Power offerings; we calculated those adjustments through a cross-program participation analysis and present the results in a subsequent section.

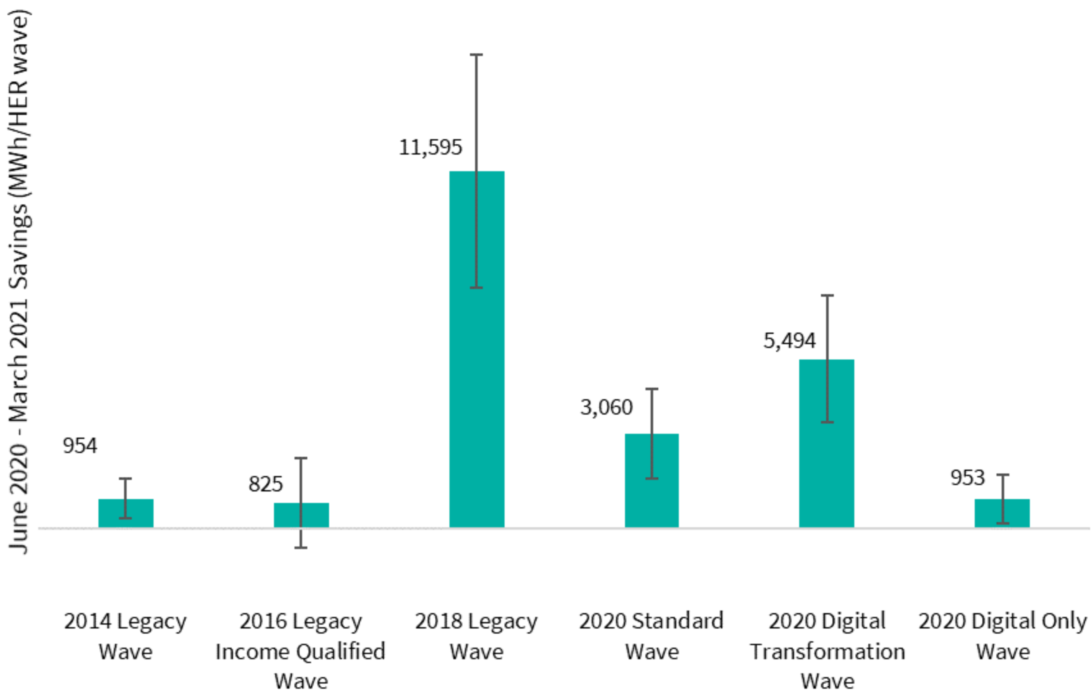
Table 16. Electric Savings by Wave (kWh) for the Evaluation Period (Program Launch to March 2021)

WAVE	TREATED HOUSEHOLDS	VERIFIED KWH	90% CI KWH	PERCENT OF BASELINE USAGE
2014 Legacy Wave	6,057	953,971[a]	318,950.25 / 1,588,991.45	1.35%
2016 Legacy Income-Qualified Wave	15,560	825,013	-638,009.84 / 2,288,035.28	0.47%
2018 Legacy Wave	59,216	11,594,848[a]	7,815,273.99 / 15,374,422.97	1.09%
2020 Standard Wave	50,274	3,060,482[a]	1,591,450.44 / 4,529,512.8	0.42%
2020 Digital Transformation Wave	70,651	5,494,043[a]	3,442,933.38 / 7,545,151.86	0.54%
2020 Digital Only Wave	23,608	952,596[a]	152,415.4 / 1,752,777.12	0.28%
Total	225,366[b]	22,880,953[b]		

[a] *Statistically significant, $p < 0.10$.*

[b] *Note totals may not add up due to rounding*

Figure 6. Program Savings by Wave



Error bars represent a 90% confidence interval.

Since the program is an RCT design, these results are the unbiased, best estimates of true savings values. The evaluation team reported confidence intervals for all waves and for all waves used the point estimate as the *best* estimate of savings. However, we cannot rule out that the savings are a different value within the confidence interval. For example, the 2020 Standard Wave confidence interval for electric savings ranges from 2,051 MWh to 7,545 MWh, yet the evaluation team reports the center point (5,494 MWh) as the evaluated savings. The evaluation team applied the same approach across all waves, even when the interval included zero.

In general, industry research suggests that participants of residential behavior-change programs save between 1.2% and 2.2% of household electric usage per year; most waves exhibit a one- or two-year ramp-up period, with savings continuing at the ramped-up level for at least the following five years. The 2014 wave still shows savings despite being seven years past its launch; the 2016 wave, however, is just within the five-year window but, across models, we did not find statistically significant savings for this wave. The new waves should start to experience a "ramp-up" effect of behavioral programs, whereby savings increase at their highest rate during the first 6 to 12 months of treatment and then begin to slow in the subsequent 12 to 24 months.[10, 11]

The evaluation team is not able to determine why the 2014 Legacy wave has higher percent-of-baseline savings and why the 2016 Legacy Income-Qualified wave does not have statistically significant savings. As an older wave, the Legacy 2014 wave experienced typical program attrition. It is possible that those who have stayed in the program have higher savings potential or are more affected by the behavioral nudges in the reports. Perhaps, as treatment group participants have moved or opted-out of the program, the savings have become more concentrated. Conversely, the 2016 wave is an income-qualified wave, and there are different behavioral, housing, and demographic characteristics of this population that may lead to lower savings – especially during the COVID-19 pandemic.

Cross-Program Participation

Customers who receive HERs may participate in other energy efficiency programs (e.g., appliance recycling or equipment rebates) at higher rates than their respective control groups. Program theory suggests that receiving reports with messaging about energy use and cross-program promotions leads to increased participation in other programs. Since other residential programs claim savings (and count all participants and measures), there is a risk of double-counting savings from participation if they are captured in HER net savings and claimed by other programs. Therefore, we also (1) assessed the lift in other program participation due to the Residential Behavioral program treatment (participant uplift), and (2) removed the co-generated savings to avoid double-counting savings across the portfolio (savings adjustment). Consistent with industry convention, we remove the co-generated savings from the Residential Behavioral program. The convention of removing savings from the Behavioral program is intended to avoid double-counting savings, but not to diminish the uplift benefit of HER programs.

Table 17 shows electric savings that can be attributed to participation in other Georgia Power energy efficiency programs. The team found higher savings from other energy efficiency programs among control customers than treatment customers (i.e., negative cross-program participation savings). In total, across all waves and programs the control group saved 7,714 kWh more than the treatment group due to participation in other energy efficiency programs.

[10] M. Khawaja and J. Stewart, "Long-Run Savings and Cost-Effectiveness of Home Energy Report Programs" Waltham, MA: Cadmus (2014). https://cadmusgroup.com/papers-reports/long-run-savings-cost-effectiveness-home-energy-report-programs/

[11] Sussman, R., and M. Chikumbo, "Behavior Change Programs: Status and Impact." American Council for an Energy-Efficient Economy (2016). https://aceee.org/sites/default/files/publications/researchreports/b1601.pdf

Table 17. Cross Program Participation Electric Savings as a Percentage of Total Wave Savings

	CROSS PROGRAM PARTICIPATION SAVINGS (KWH)	PERCENTAGE OF TOTAL BEHAVIORAL PROGRAM SAVINGS
2014 Legacy Wave	-967	-0.10%
2016 Legacy Income-Qualified Wave	12,232	1.48%
2018 Legacy Wave	1,150	0.01%
2020 Standard Wave	2,393	0.08%
2020 Digital Transformation Wave	-25,209	-0.46%
2020 Digital Only Wave	2,687	0.28%
Total	**-7,714**[a]	**-0.03%**[a]

[a] *Note totals may not add up due to rounding.*

The rate of participation between treatment and control groups differs at the wave level. For example, the treatment group in the 2020 Digital Only wave participated at a higher rate than the control group while the control group in the 2020 Digital Transformation group participated at a higher rate. There was a statistically significant difference between the treatment and control groups' rates of participation in two of the six waves. To account for double-counted savings, we adjusted savings at the wave level if the treatment group participated at a higher rate. We did not adjust modeled savings results for the 2014 Legacy wave or the 2020 Digital Transformation wave. The control group in the 2020 Digital Transformation wave drove much of the negative savings at the program level.[12] Note that we calculated a per-home value for comparison to average per-home savings from the Residential Behavioral program, though only a subset of treatment households participated in energy efficiency programs. Table 18 shows the adjustment to the program savings by wave after removing the double-counted savings.

Table 18. Adjusted Program Savings

WAVE	VERIFIED KWH	VERIFIED NET SAVINGS (KWH)
2014 Legacy Wave	953,971[a]	953,971
2016 Legacy Income-Qualified Wave	825,013	812,781
2018 Legacy Wave	11,594,848[a]	11,593,698
2020 Standard Wave	3,060,482[a]	3,058,089
2020 Digital Transformation Wave	5,494,043[a]	5,494,043
2020 Digital Only Wave	952,596[a]	949,909
Total	**22,880,953**[b]	**22,862,492**[b]

[a] *Statistically significant, $p < 0.10$.*

[b] *Note totals may not add up due to rounding.*

[12] The control group in this wave may have installed higher-saving measures than the treatment group which led to this.

Program Uplift

Overall, the Residential Behavioral program produced negligible lift in program participation overall, but it varied distinctly by wave. Some waves have statistically significant results, including the 2018 Legacy wave and the 2020 Digital Transformation wave. Table 19 details the participation lift between treatment and control customers. Between June 2020 and March 2021, the largest percentage lift in program participation occurred in the Georgia Power Marketplace for the 2018 Legacy wave (0.34%). Per marketing schedules provided by Uplight, the Georgia Power Online Marketplace was promoted consistently on both HER and eHER reports throughout the evaluation period.

Table 19. Program Uplift by Wave

	TREATMENT PARTICIPATION RATE	CONTROL PARTICIPATION RATE	PARTICIPATION LIFT
2014 Legacy Wave	1.88%	1.78%	0.10%
2016 Legacy Income-Qualified Wave	1.05%	0.98%	0.08%
2018 Legacy Wave [a]	2.36%	2.02%	0.34%
2020 Standard Wave	1.38%	1.31%	0.07%
2020 Digital Transformation Wave [a]	1.66%	1.50%	0.17%
2020 Digital Only Wave [a]	1.68%	1.50%	0.18%

[a] *Statistically significant, $p < 0.10$.*

Upstream Lighting Cross-Program Participation

The cross-program participation savings analysis does not include Georgia Power's upstream lighting program. In upstream lighting programs, utilities work directly with manufacturers, distributors, retailers, or a combination to offer built-in discounts on energy-efficient products, rather than paying incentives directly to program participants. Because of this design, these programs do not track detailed participation data such as respondent names and billing account numbers, which are typically available for utility rebate programs. Consequently, the evaluation team could not identify HER treatment and control group respondents who participated in an upstream lighting program. Obtaining the data necessary to adjust for upstream programs requires expensive primary data collection that relies on home visits or customer surveys and requires respondents to recall their lighting purchases. We asked respondents in the participant survey if they had purchased lightbulbs in the last year. There was no statistically significant difference between the treatment and control group in their purchase of bulbs generally or their purchase of LED bulbs.

In a recent secondary literature review presented to the Michigan utilities, an evaluation team found ten evaluations of HER programs from 2013 to 2018 that addressed the effects of upstream lighting.[13] Five of these evaluations relied on surveys (three phone, one online, one in-person), one relied on an on-site home inventory, three on secondary literature, and one used a deemed savings factor. The on-site inventory found the highest rate of cross-program participation savings at 2.6%. Three reported no difference in purchases between treatment and control customers. Others ranged from -0.9 kWh/household/year to 11.1 kWh/household/year. The evaluators presenting to Michigan utilities concluded that most efforts to calculate the cross-program participation rate of upstream programs result in 0% or negative results or the differences are statistically insignificant.

Given these data limitations, the evaluation team did not estimate cross-program participation savings from upstream programs. Because adjustments to electric savings due to other programs are small, this omission should not affect the total claimed savings significantly.

Demand Reduction

In addition to energy (kWh) savings, the evaluation team calculated peak demand savings (kW) for the Residential Behavioral program (Table 20). For this evaluation, the evaluation team developed high-level estimates for both winter and summer peak demand savings by examining the average daily demand savings for the months in which Georgia Power's peak periods occurred in the evaluation period (January 2021 and July 2020).

We calculated demand using the Difference in Differences model coefficients for average daily savings for the system peak months. We used the average daily value for each of the months we examined and divided by 24 hours to get the hourly demand reduction at the household level for each wave.

$$Household\ Daily\ kWh\ Savings = treatment_{ij} + post_{ij} + \ treatment_{ij} * post_{ij}$$

$$Hourly\ kW\ Reduction = \frac{Household\ Daily\ kWh\ Savings}{24\ hours}$$

Table 20 displays the demand reduction estimates for all waves in the program year, at both the individual level and the program level. For all households, the summer demand reduction is 2,865 kW and the winter demand reduction is 3,719 kW. Like the billing analysis results for program savings, for all rows identified where the confidence interval crosses zero the savings are not statistically significant. In other words, we did not find statistically significant demand reduction in summer or winter at the wave level for nearly all waves.

[13] *Avoiding the Double-Counting of Savings in Michigan's Behavioral EWR Programs: Current Practice & Future Options.* April 16, 2019. https://www.michigan.gov/documents/mpsc/Avoiding_Double_Counting_-_20190416_652854_7.pdf

Table 20. Demand Reduction Estimates for All Waves

	WAVE	TREATMENT COUNT	DEMAND REDUCTION (KW/HOUSEHOLD)	TOTAL DEMAND REDUCTION (KW/WAVE)	90% CONFIDENCE INTERVAL (KW/WAVE)
Summer	2014 Legacy Wave	6,187	0.03	180	-89 / 448
	2016 Legacy Income-Qualified Wave	16,280	0.01	185	-408 / 779
	2018 Legacy Wave [a]	59,507	0.02[a]	1,445[a]	115 / 2,774
	2020 Standard Wave	51,870	0.01	691	-143 / 1,526
	2020 Digital Transformation Wave	73,745	0.00	348	-788 / 1,483
	2020 Digital Only Wave	24,619	0.00	16	-448 / 480
	Overall Program (Summer)	232,208[b]	0.01	2,865[b]	
Winter	2014 Legacy Wave	6,224	0.01	62	-226 / 350
	2016 Legacy Income-Qualified Wave	16,264	0.02	290	-435 / 1,014
	2018 Legacy Wave [a]	60,007	0.03[a]	1,726a	149 / 3,304
	2020 Standard Wave	51,889	0.01	343	-594 / 1,279
	2020 Digital Transformation Wave	73,864	0.01	710	-568 / 1,987
	2020 Digital Only Wave	24,621	0.02[a]	589a	67 / 1,112
	Overall Program (Winter)	232,869[b]	0.02	3,719[b]	

[a.] *Statistically significant, p < 0.10.*

[b.] *Note that totals may not add up due to rounding.*

Realization Rate

After completing regression analyses to measure savings and adjusting estimates for cross-program participation, the evaluation team calculated an overall realization rate based on the full evaluation period (2020 – Q1 2021). Overall, the evaluation team found evaluated energy savings (kWh) to be closely aligned with implementer reported savings. The realization rate for energy savings across the evaluation period is 96%, as shown in Table 21. As the program does not report demand savings, no realization rate is reported.

Table 21. Overall Program Realization Rate (kWh)

METRIC	YEAR	REPORTED KWH [a]	VERIFIED KWH	OVERALL REALIZATION RATE
	2020	14,822,033	14,288,655	96%

Electric Energy Savings (kWh/yr.)	Q1 2021	8,993,381	8,633,345

[a] Reported savings exclude the previous implementer's savings reported in January 2020 and July 2020 to ensure that the savings captured in this table and this report are for Uplight only. In communication with Uplight, the evaluation team decided to remove the reported July 2020 savings because these savings captured June 2020 and the program would not have had an impact yet.

Process Evaluation

The evaluation team performed the process evaluation using a document review and participant survey.

Home Electric Report Review

The Home Electric Report has seven modules: "Estimated Cost," "How Am I Doing," "How Does My House Use Energy," "Who Am I Being Compared To," "How Can I Save More," "Your Electric Use Over Time," and "Home Energy Education."[14] Currently, there are no differences in report content between the eHER and the print report. Visually, the eHERs do not have some modules side by side, but instead they are on top of each other.

- Estimated Cost: provides the actual kWh usage for the billing period and the estimated cost for electric use.
- How Am I Doing: compares recipients' homes to the "average" home and the "efficient" home.
    - Who Am I Being Compared To: provides a simple description of the homes included in the "My Home Comparison" module. It includes statistics of those they are being compared to including group size, range of square footage, range of year built, and heating type (i.e., gas or electric). It also includes a phone number, and a link for recipients to contact the customer service team to provide them with more information about their homes.[15]
- How Does My House Use Energy: provides a breakdown of the end uses in which the recipient is *forecasted* to use energy in the next billing cycle. The categories are heating, lighting, kitchen, hot water, electronics, laundry, other, and cooling.
- How Can I Save More and Home Energy Education: shares two energy saving tips and two pieces of information about energy and residential energy use provided by Georgia Power. These tips range from providing tips on electrical safety to information on how to sign up for outage alerts. Each month recipients receive different modules. The How Can I Save More sections are selected for each report from a large pool of Georgia Power approved tips. The Home Energy Education tips include cross-

[14] Screenshots of the report sections can be found in the Participant Feedback section.

[15] As of the March 2021 data request, the ILLUME team did not receive an example report that included a web link to this page. But, in email communications with the implementer, they described including the link to edit the Home Profile in the email reports.

promotion of other Georgia Power energy efficiency programs and information supplied by Georgia Power. These tips can be segmented by customer propensity or other selection criteria. These tips can be repeated when trying to impact program goals.

- Your Electric Use Over Time: displays a line graph of energy (kWh) usage for the past year that includes data for the "average" and "efficient" homes. On the x-axis there is also the average temperature for the month. The sentence below the graphic provides recipients with a written description of the graph comparing this month to the same month last year and providing them with an estimate of how much the recipient has spent on energy relative to efficient homes in the area.

Valid Email Review

We reviewed the customer data to see how many treatment customers had valid email addresses, and therefore could receive the eHER. Treatment customers in the three Legacy waves and the 2020 Standard wave received an eHER if they had a valid email address with Georgia Power. We found that all three Legacy waves and the 2020 Standard wave were missing between 14% to 40% of valid email addresses (Table 22). The 2018 Legacy Wave had the lowest proportion without an email address.

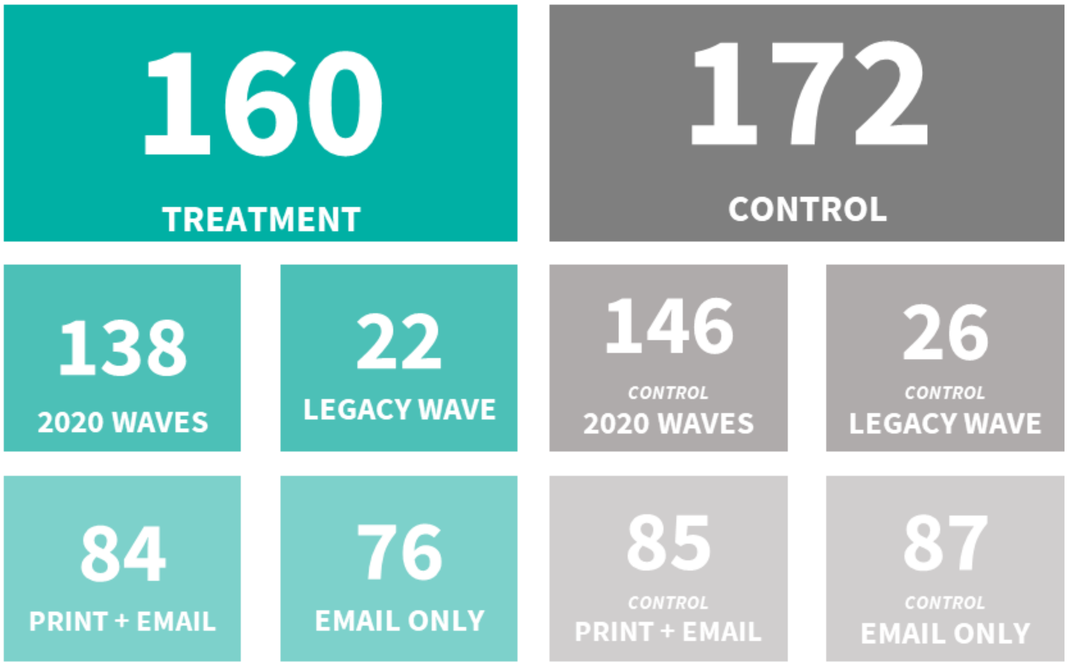
Table 22. Proportion of Customers Without a Valid Email

WAVE	TREATMENT
2014 Legacy Wave	25%
2016 Legacy Income-qualified Wave	40%
2018 Legacy Wave	14%
2020 Standard Wave	22%
2020 Digital Transformation Wave	0%
2020 Digital Only Wave	0%

Participant Feedback

The evaluation team surveyed 332 customers who participated in the program. We asked treatment respondents about their experience with the report and asked all respondents, including those in the control group, about their experiences with Georgia Power and energy efficiency. Figure 7 describes the breakdown between treatment and control respondents, the type of reports each treatment respondent received, and whether they were in a legacy or Uplight wave.[16]

Figure 7. Participant Survey Disposition



The following sections describe the results related HER readership and satisfaction, the effect of the reports on energy saving and Georgia Power programs, Georgia Power satisfaction overall, COVID-19, and participant demographics. For each section, we reviewed the responses by treatment and control, Uplight and Legacy, and print and email (all Legacy waves, 2020 Standard Wave, and 2020 Digital Transformation Wave) and email-only (2020 Digital Only Wave). We report on differences between the groups when they are statistically significant. We did not have enough responses to calculate statistically significant differences between the Uplight and Legacy waves. Statistically significant differences reported in this section are significant at the 90% confidence level; we specify in all cases where there is a statistically significant difference.

The sampling strategy oversampled the 2020 Digital Only wave to make comparisons among eHER only recipients and both eHER and print report recipients. For reporting any population estimates, we weighted responses to be proportional to the treatment population. When comparing the 2020 Digital Only Wave to all

[16] Note that control group customers are “in” waves despite never receiving a report.

other waves, we applied weights to the 2020 Standard, 2020 Digital Transformation, and Legacy waves so that the distribution of respondents across those waves matched the population distributions of those waves.

HER Readership and Satisfaction

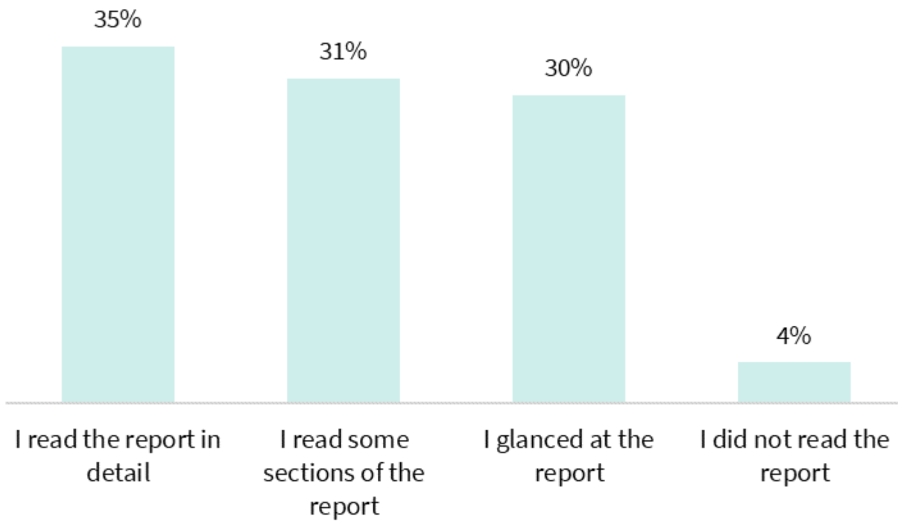
The evaluation team asked several questions to understand respondent recall and satisfaction with various aspects of the HERs.

More than three-quarters of treatment respondents (85%) recall receiving the HER. More print and email respondents recall receiving the HER (87%) than the email-only respondents (74%). In past evaluations of the Georgia Power Home Electric Report, we found similar results. In the 2020 HER Pilot, we found that 77% of respondents who received only an eHER recalled receiving the report, but 92% of those who received a print report recalled receiving it. In the 2018 evaluation, we found that only 80% of respondents recalled receiving the report.

Among respondents who received both the print and eHERs, the proportion of which reports they recall receiving were about equal. One-third remember receiving both email and print, one-third remember email only, and one-third of people remember paper only. Of those who remember receiving the print and email HER, ten reported that they read both formats equally, seven respondents only read the eHER, and four only read the paper report.

About two-thirds of respondents who recalled receiving the HER said that they either read the report in detail (35%) or sections of the report (31%). About one-third (30%) reported that they only glanced at the report and 4% said they did not read the report at all (Figure 8). A higher proportion in the 2017 (81%) and 2014 (72%) evaluations said they either skimmed or read the report in detail. However, it should be noted that this question phrasing was changed to improve respondent comprehension for this evaluation cycle, so comparisons between this year’s readership and past cycles should be assessed with that consideration in mind.

Figure 8. HER Readership (n = 127)



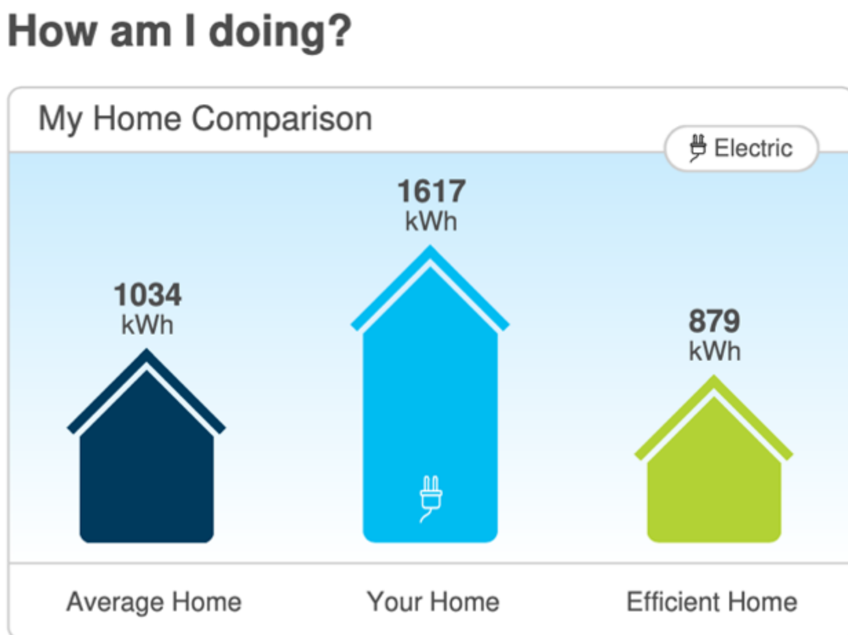
Source: Participant survey. Question D4." Which of the following statements best describes what you did with the last report you received?"

Among the respondents who read at least some sections of the HER, 50% said they discussed it with their friends or family and 38% said they saved the report. Among respondents who glanced at or did not read the report, the majority (52%) said they did not read it because they were too busy. Over one-third (35%) of this group said they did not read the report because they did not think the report looked useful.

How am I Doing

Nearly all (98%) treatment respondents remember seeing an image comparing their home's energy usage to the average home and an efficient home (Figure 9). About two-thirds of treatment respondents reported that the HER claimed they used more energy than the average or efficient households (65%). A similar proportion of the treatment respondents found the infographic on home electricity usage comparison to be very to extremely informative (65%).

Figure 9. How Am I Doing Section Example

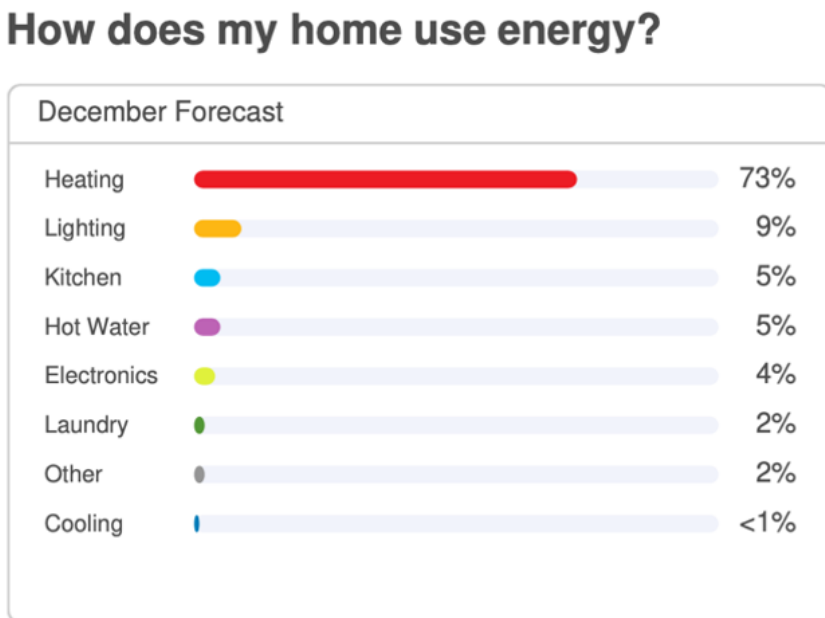


To reduce survey fatigue, we randomly assigned treatment respondents to one open-ended question. Twenty-one respondents were asked for feedback on what could be improved in the “How am I Doing” section. Five said they had no suggestions for improvements. Other respondents said they wanted more details on how the comparison was calculated (n = 3) and more tips on how to reduce their energy consumption (n = 1).

How Does My Home Use Energy?

Just over three-quarters (78%) of respondents remembered the “How Does my Home Use Energy” section (Figure 10). Of those who recalled this section, three-quarters (75%) reported that the section was very or extremely informative. Eleven respondents were asked for feedback on what could be improved in the “How Does My Home Use Energy” section. Two said they had no suggestions for improvements. One respondent said, “Compare my home to other users with pools.” This type of response is common on HER surveys. Respondents want to know that they are being compared to those who look most like them in terms of house size, age, high-energy using appliances or features, and family or behavioral factors like size, employment, or hobbies.

Figure 10. How Does My Home Use Energy Section Example



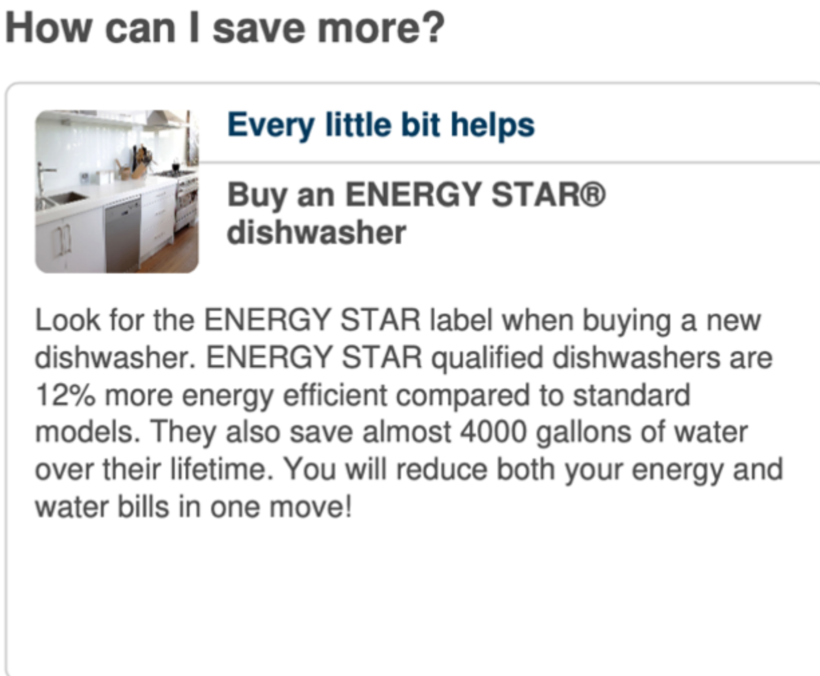
How Can I Save More?

About two-thirds of respondents who read their HER recalled seeing the "How Can I Save More" section (60%) (Figure 11). There was a statistically significant difference between the email-only and print and email groups in their recall of this section. A higher proportion of the email-only group (83%) recalled this section while only 59% of the print and email group did.

About two-thirds of those who recalled it found this section to be very or extremely informative. This section is more text heavy than other sections and has fewer colorful graphics. Conducting usability studies on this report section could help make improvements that would increase recall and help determine why there is a higher proportion of the email-only group who recalled the section.

Sixteen respondents were asked for feedback on what could be improved in the "How Can I Save More" section. Two said they had no suggestions for improvements. A few respondents said that they wanted more details on how the comparison was calculated (n = 2), wanted more tips on how to reduce their energy consumption (n = 1), and did not like the aesthetics of the graphic (n = 1).

Figure 11. How Can I Save More Section Example

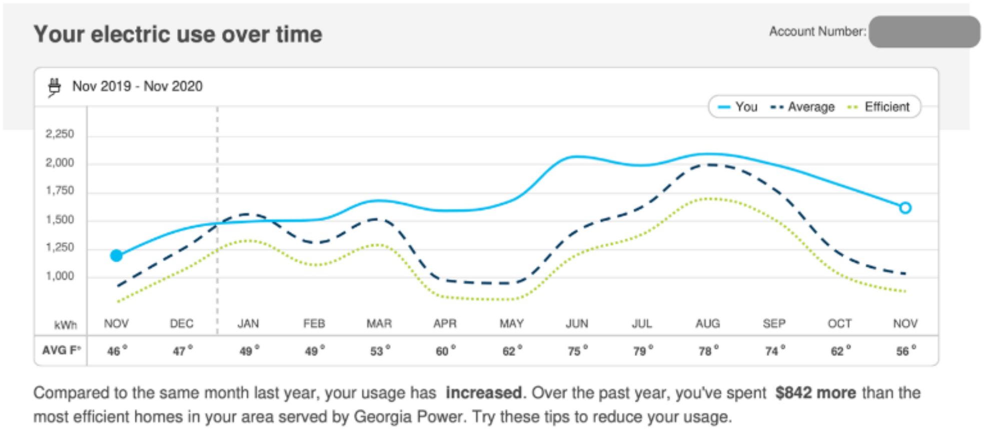


Your Electric Use Over Time

Over 90% of respondents recalled seeing "The Electric Use Over Time" section (Figure 12). Nearly three-quarters of respondents (70%) who recalled this section found it to be very informative. Sixteen respondents were asked for feedback on what could be improved in the "The Electric Use Over Time" section. Five said they had no suggestions for improvements. When asked how the section could be improved, a few respondents said they wanted more details on how the comparison was calculated (n = 2) and more tips on how to reduce their energy consumption (n = 1). Quotes from these respondents are below.

> *"Possibly have specifics connected to dollar amounts. Also saying that for every $10 I save, $1 will go towards the bill of someone else who can't pay. I'm motivated to read things if it will benefit others."*
>
> \- Georgia Power HER survey respondent – looking for more information

Figure 12. Your Electric Use Over Time Section Example



Home Energy Education

About two-thirds of respondents (60%) recalled seeing the "Home Energy Education" section of the HER (Figure 13). About two-thirds of respondents who recalled it thought that this section was very informative. Of the 11 respondents who were asked how to improve the "Home Energy Education" section, four had no suggestions for how to improve this section (there were no additional suggestions).

Figure 13. Home Energy Education Section Example

General Report

More than three-quarters of treatment respondents (88%) found the explanation on how comparison homes were selected to be helpful. Of the respondents who did not find the comparison to be helpful (n = 11), four provided feedback. They described not trusting the comparison because their living situations "did not show up in the reports." This included a small number of customers who felt that their specific heating fuel or home types (such as mobile homes) were not as easily compared. Only 10% of treatment respondents who received their HER had updated their Home Profile before. Of those who said they had not updated their Home Profile (n = 72), the most common reasons treatment respondents had never updated their Home Profile before were they were not interested (n = 14) in doing so and they did not know they were able to do so (n = 12) (Table 23).

Table 23. Reason for Not Updating Home Profile

RESPONSE [a]	FREQUENCY
Not interested in results	14
Did not know I could	12
Do not have time	5
Did not know how to update it	4
Already accurate	3
Unable to make changes to home energy (renter)	1

[a.] *Multiple response possible*

Attitudes on Energy Efficiency and Energy Usage

We asked respondents about their value systems when it came to energy efficiency and conservation to understand whether the reports were having an effect. We found that there are no statistically significant differences between treatment and control respondents on any of the following value statements:

- Care that their energy consumption today will have an impact on future generations (75%)
- Personal contribution to energy efficiency conservation makes a difference (60%)
- Interested in learning ways to reduce their carbon footprint (53%)
- Family's comfort and convenience are more important than conserving energy (70%)

In addition to value statements, we asked respondents what they needed from Georgia Power and in general about their energy usage, to understand if receiving a HER would influence knowledge for making homes more energy efficient, having the information needed to understand their energy use, and knowledge about the actions to take to reduce their energy use. However, the treatment and control groups are not statistically different for any of these elements:

- Know what actions to take to reduce energy usage (77%)
- Would like more information to help them understand household energy use (49%)
- Know what to do to make home more energy efficient (49%)

However, there is a higher proportion of the email-only group (57%) who reported knowing what to do to make their home more energy efficient than the print and email group (44%). This is an instance where the email-only respondents have higher energy saving behaviors than the print group.

The most common primary fuel respondents used to heat their homes was electricity (58%). There is no statistically significant difference between the treatment and control groups. However, there is a statistically significant difference between the email-only and print and email groups. There was a higher proportion of the email-only group who had electric heat (70%) than the print and email group (56%). While this difference is statistically significant, it could still be a result of sampling error. We may have, by chance, received responses from a different proportion of electrically heated homes than the total treatment population. In addition, this information was gathered via self-report. Respondents do not necessarily report reliably on their heating fuel type.

It may be helpful to have more information on the heating fuel mix for participants. If there are differences by wave, or if there is a higher proportion of electrically heated homes in the Georgia Power territory, the implementer could adjust recommendations to account for this type of energy usage. This could be an additional encouragement for filling out the Home Profile. If recipients fill out their Home Profile and they have electric heat, they could get more personalized information.

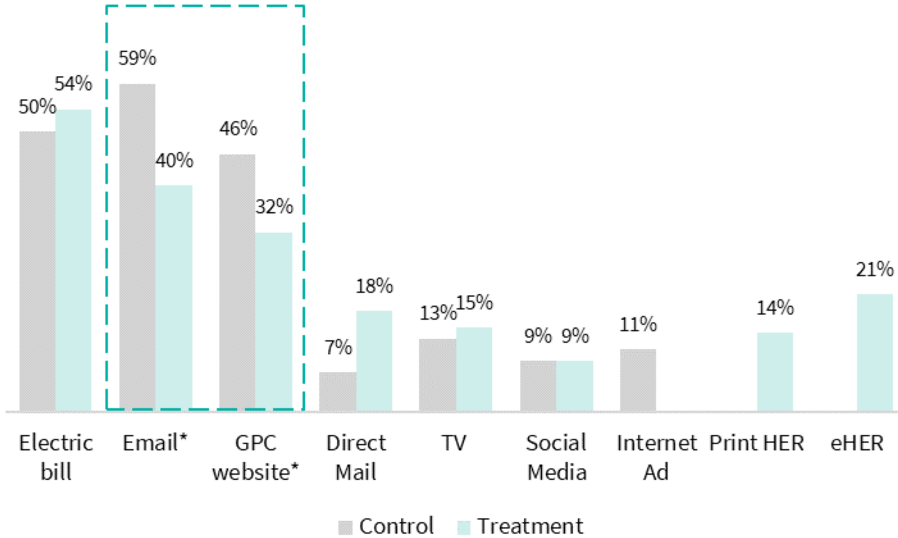
Engagement with Georgia Power

The evaluation sought to understand how the HERs affected customer engagement with Georgia Power, including customer awareness and recall of Georgia Power communications and energy efficiency programs.

Most respondents had seen or heard tips from Georgia Power about energy savings (86%). There is a statistically significant difference between the treatment and control group. A higher proportion of treatment respondents (91%) had seen or heard tips than the control respondents (80%). This indicates that the HERs are effectively increasing participant recall of energy saving information from Georgia Power.

The top sources for receiving tips from Georgia Power were electric bills, emails from Georgia Power, and the Georgia Power website. There was a higher proportion of the control group who recalled receiving energy saving tips via their emails and the Georgia Power website (Figure 14). Nearly one quarter of the treatment group (21%) received tips from Georgia Power via the eHER and 14% received tips from the print report.

Figure 14. Source of Awareness by Treatment Status (n = 283)



Source: Participant survey. Question B2. "In the past year, where have you seen or heard tips on how to save energy in your home?"
*Statistically significant, p < 0.10

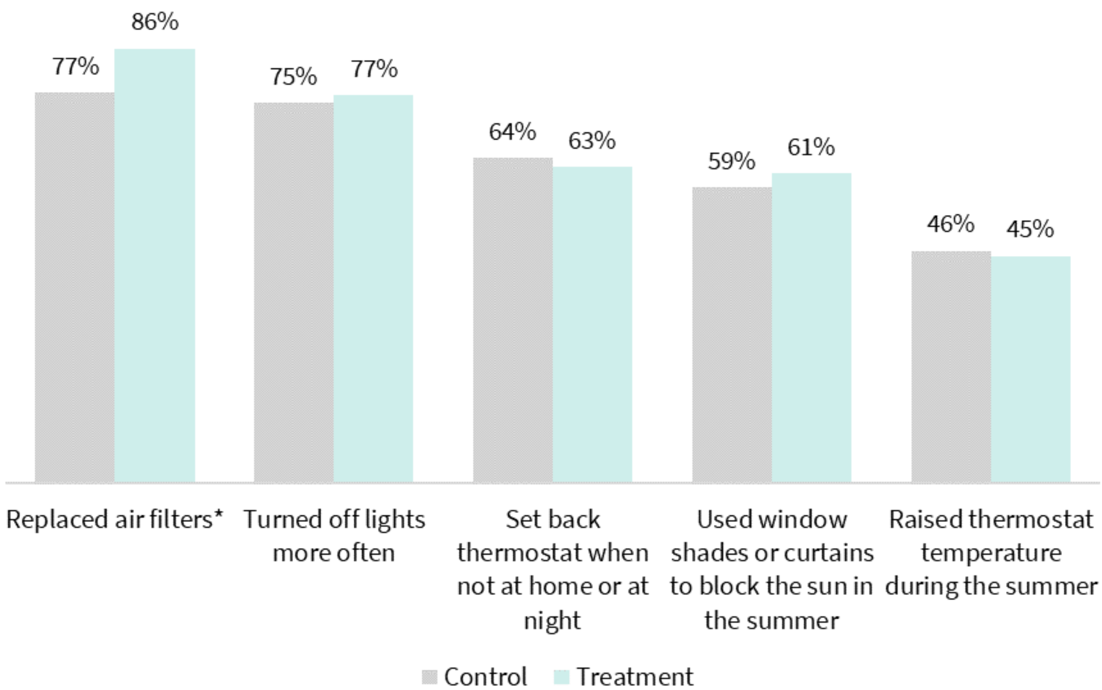
In addition to an increased recall of energy-saving information, a higher proportion of treatment respondents (96%) reported looking at their bill at least once a month than the control respondents (86%); this difference is statistically significant. This suggests that the treatment group was more engaged than the control group in their bills.

Overall, respondents had a relatively high recall of Georgia Power energy efficiency programs. About three-quarters of respondents (71%) were aware of Georgia Power programs, rebates, and incentives before taking the survey. More than half the respondents from each group recalled being aware of Georgia Power's Home Energy Improvement Program and the Refrigerator Recycling program. However, none of the differences between treatment and control were significant.

Energy Saving Behavior

The evaluation team asked both treatment and control respondents to describe the actions they took to conserve energy in their home. The top actions respondents took were replacing air filters (82%), turning off lights more often (76%), and setting back their thermostat when they were not home (64%). More than three-quarters (86%) of treatment respondents reported changing their air filters and 77% of control respondents did (Figure 15).

Figure 15. Top Five Energy Saving Actions Taken by Treatment and Control (n = 157)

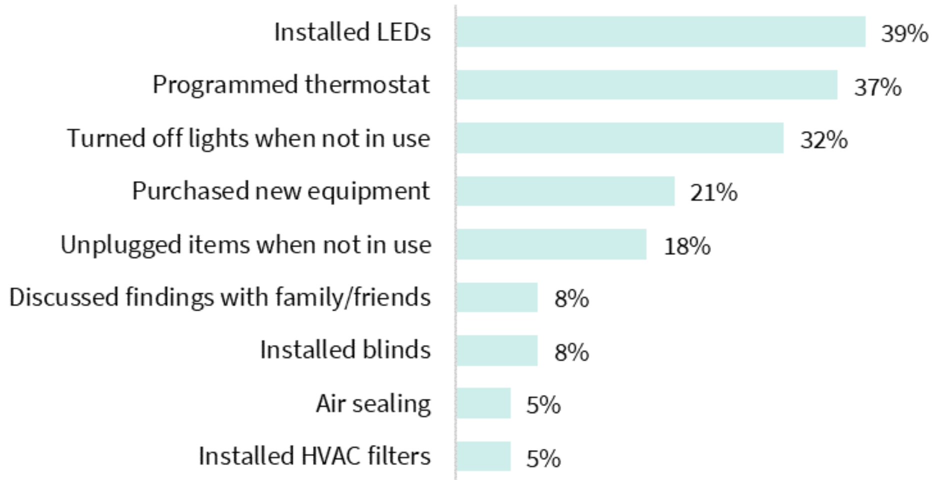


Source: Participant survey. Question C3. "In the past year, has your household taken any of the following actions to save energy?"
*Statistically significant, p < 0.10

Most respondents reported that they purchased lightbulbs in the past year (88%). Most respondents who reported purchasing new bulbs reported purchasing LED bulbs (82%). Few respondents reported purchasing CFLs, halogen, or incandescent bulbs.

We also asked the treatment group explicitly which actions they took because of reading the HERs. Nearly half of treatment respondents (45%) reported taking some action to improve the energy efficiency of their home after reading the last report. More email-only respondents (69%) reported taking energy efficiency actions than the print and email respondents (42%). This is an instance where the email-only respondents had higher energy saving behaviors than the print group. Of the treatment respondents who reported taking actions after reading the reports, the most common actions were installing LED bulbs, programming thermostats, and turning off lights when not in use (Figure 16).

Figure 16. Actions Taken by Treatment Respondents After Reading Report (n = 66)



Source: Participant survey. Question E18. "What actions did you take?"

Georgia Power Satisfaction

About two-thirds of all respondents (66%) reported being very satisfied with Georgia Power.[17] The mean satisfaction rating on a scale of one to five, one being not at all satisfied and five being extremely satisfied, was 3.8. There was no statistically significant difference between the treatment and control group in terms of satisfaction with Georgia Power.

When asked about why they are satisfied with Georgia Power respondents said that Georgia Power is easy to work with (34%), the power is reliable (26%), and they thought that the power was a good price (16%). A quote from a satisfied respondent is below.

> *"[Georgia Power is] reliable and responsive. We like the communication when there are outages. We like the daily emails on usage and warnings if exceeding our preset thresholds. Very easy to pay bills online. Overall great product, service and support."*
>
> \- Georgia Power HER survey respondent

[17] "Very satisfied" includes responses that are both "very" and "extremely" satisfied.

Respondents who were less satisfied with Georgia Power were so because they thought that the power was too expensive (23%). A quote from a less satisfied respondent is below.

> *"My bill is always so high even when we replaced our (insulation) with foam. Spent a fortune on that. Have really good windows. In the wintertime we use a blanket to sit and watch tv and in the summer always have to use a fan to cool down. Will not lower our thermostat. Not much more we can do."*
>
> \- Georgia Power HER survey respondent

Report Satisfaction

Respondents were moderately satisfied with the report overall. Over 70% of respondents reported that they would recommend the HER to a friend or colleague. In addition, 70% of respondents said that their positive opinion about Georgia Power has not changed since receiving the reports and 22% said that their opinion about Georgia Power has grown more positive.

Respondents were asked which sections they recalled and asked to rate how informative they found each section on a scale of one to five, one being not at all informative and five being extremely informative. Respondents stated that they found the report sections to be informative and generally recalled seeing the sections. Nearly all respondents thought that each section of the report was at least somewhat informative; the majority thought that each section was very informative.[18] The sections with the lowest recall were the "How Can I Save More" (62%) and "Home Energy Education" (61%); the sections with the lowest informative score were "How am I Doing" (65%) and "Home Energy Education" (61%) (Figure 17).

[18] "Very informative" includes responses that are both "very" and "extremely" informative.

Figure 17. Respondent Recall and Perceived Informativeness of Each Section

REPORT SECTION	RECALL SECTION	FIND SECTION "VERY" OR "EXTREMELY" INFORMATIVE
How am I doing?	100%	65%
How does my home use energy?	78%	81%
How can I save more?	62%	66%
Your electric use over time	91%	69%
Home energy education	61%	61%

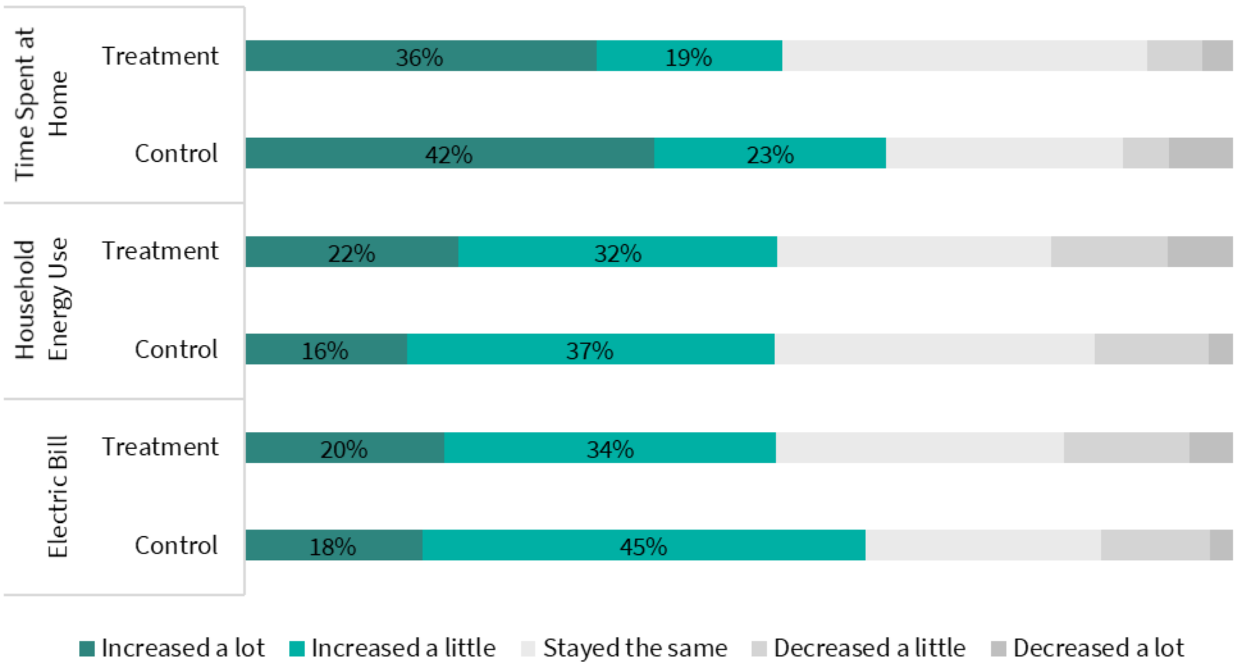
Source: Participant survey. We asked if they recalled a section, showed them a screenshot of the report section, and how informative they thought each of the sections were. "Do you remember seeing <<description of section>>? We provided the image below [screenshot of report] as an example." And "How informative would you say the <<section name>> section was?"

Effects of COVID-19

To understand how customers perceived the effects of the COVID-19 pandemic on their household and energy use, the survey asked respondents several questions. Overall, respondents reported they have spent more time at home since 2019. About two-thirds (60%) of respondents said there has been an increase in the time spent at home in each week compared to 2019. There is a statistically significant difference between the treatment and control respondents in the amount of time their households have spent at home. A higher proportion of the control group (65%) reported that their time spent at home increased (a little or a lot, combined) compared to the treatment group (54%). While those who said their time spent at home had increased was significantly different between the treatment and control groups, the differences between the individual components were not. In other words, differences for those who said their time at home increased a lot were not statistically significant between treatment and control.

Given the overall increase in time spent at home, respondents also reported that they felt their household energy use and household energy bills went up. About one-half (54%) said that their energy use increased since the start of the pandemic and 58% said their energy bills increased (Figure 18).

Figure 18. Changes to Household Since COVID-19 (n=330)



Source: Participant survey; questions F1, F2, F3. Respondents were asked to rank the following statements from "decreased a lot" to "increased a lot": "Compared to this time in 2019, would you say the time your household spends at home has…. ", "Compared to 2019, would you say your household energy use has…", and "Since 2019, would you say your electricity bill has…. "

The evaluation team also found that 37% of respondents reported making a home improvement since the beginning of the COVID-19 pandemic. The most common amount spent on a home improvement was over $10,000 (28%).

More than three-quarters of survey respondents (80%) did not experience a change in employment status in 2020. While nearly a quarter of control group respondents (24%) did experience a change in employment in 2020, only 15% of treatment group respondents experienced the same; this difference is statistically significant. More than one-third of survey respondents (42%) from both groups work or attend school from home and 30% of respondents are retired.

Demographics

Respondents from the treatment and control group were not statistically different across any demographic characteristics. Respondents were generally older, had higher levels of education, and earned more than the median household income in Georgia ($58,700).[19] In addition, they lived in homes that are medium sized and typically built after 1980. Over one-half of respondents (52%) reported that they lived in homes between 1,500 and 3,000 sq ft. Nearly one-half of respondents (47%) have lived in their homes for more than ten years and 84% of respondents own their own home in 2020. Most survey respondents (93%) live in single family homes. Over half (53%) of respondents earned a household income $75,000 or more, higher than the median household income in Georgia.

Almost half of survey respondents (49%) are older than 56 years old; 9% are between 26 and 35 years old. The average age of survey respondents was higher than the median age of Georgia residents. Nearly three-quarters (73%) of survey respondents were white, 22% were Black, and 10% were Hispanic.[20] There was also a higher proportion of white and primarily English-speaking survey respondents compared to the ethnic distribution proportions in Georgia. The general population of Georgia is more diverse: 60% of the population is white, 33% is Black, 10% is Latino, and 4% is Asian.[21] Nearly all survey respondents (99%) primarily speak English at home, while only 6% primarily speak Spanish, and less than 1% primarily speak Mandarin. Table 24 displays the survey respondents' age, income, and ethnicity compared to the average/median resident of Georgia.[22] The average age of survey respondents was higher than the median age of Georgia residents.

Table 24. Respondent Demographics Compared to State of Georgia

CATEGORY	SURVEY	GEORGIA
Age	50% are 56 and over	14% are 65 and over
Income	50% make at least $75k	Median Income is $59k

[19] United States Census Bureau. (2019). Quick Facts Georgia. Retrieved from United States Census Bureau Quick Facts: https://www.census.gov/quickfacts/GA

[20] Note, survey respondents could choose multiple races or ethnicities. We provided eight race/ethnicity options in the survey and an "other," please specify category. For the full breakdown of the respondent race/ethnicity see Appendix 1B: Survey Demographics.

[21] United States Census Bureau. (2019). Quick Facts Georgia. Retrieved from United States Census Bureau Quick Facts: https://www.census.gov/quickfacts/GA

[22] *Ibid.*

Ethnicity	73% are White	60% of population is White

Conclusions and Recommendations

Conclusion 1: The Residential Behavioral program produced an estimated 22,881 MWh of electricity savings between June 2020 and March 2021.

Energy savings from five out of the six waves are statistically significant. The Legacy 2014 wave shows the highest savings as a percentage of baseline energy use. The Legacy 2016 Income-Qualified wave does not have statistically significant savings.

Recommendations:

- Continue to monitor Legacy Waves to ensure they maintain savings; especially the Legacy 2016 Income-Qualified wave. In addition, as the COVID-19 pandemic changes and continues to affect Georgia residents, monitor savings generated through the program.
- If Georgia Power is interested in learning about the differences between waves, the evaluation team can conduct further research to understand why the 2014 Legacy wave continues to save, the 2016 Legacy Income-Qualified Wave has lagged in savings, and the 2018 Legacy wave has such high program participation rates. Further research could include in-depth interviews, general population surveys, or quick hit surveys attached to the Home Profile. In addition, we could conduct an analysis to understand the heating fuel mix of and between the waves. If there are differences by wave, or if there is a higher proportion of electrically heated homes in the Georgia Power territory, it would be helpful for the implementer to understand to adjust recommendations to account for this type of energy usage. Future research with the treatment and control groups could also help tease out the differences and long-term effects of the COVID-19 pandemic.
- Ensure that recipients are aware that they can update their Home Profile by reminding them of the benefits, highlighting the link, and sending an eHER to more recipients. This will allow the implementer to gather more information about each recipient and it could be used to discern differences between the waves.
- For future planning, the evaluation team does not recommend using current evaluated per-household savings for full future cycles, as they will likely underestimate savings over the full cycle. The evaluation results represent very early program performance, and home energy report programs tend to ramp up in savings over time. Behavior programs tend to be relatively consistent in the savings they generate, so consider other options for developing estimates for future planning such as conducting a secondary literature review of home energy report generated savings by year.

Conclusion 2: Customers who receive both a print and eHER are more likely to recall receiving the report than the eHER only recipients.

A higher proportion of the print and eHER group recall receiving the HER (87%) than the email-only recipients (74%). We have seen similar results in a Georgia Power Home Electric Report pilot.

Recommendations:

- **Conduct research on the differences between the eHER and print reports to see what affects readership.** First, review how many emails are read. For example, review open rates or check email subject lines to see if they are making it through spam filters. Program staff noted that these checks are conducted monthly. Results from these checks would be helpful to future evaluation teams. Second, conduct usability studies on elements of the report, such as subject lines and report envelopes, to understand why people open reports.
- **Consider conducting an internal review on email addresses.** We found that all three Legacy waves and the 2020 Standard wave are missing between 14% and 40% of valid email addresses. Reviewing the current email list and ensuring that email addresses are correct and up to date could ensure that those who receive an eHER are receiving it in their inbox. The implementer could add a survey or call to action in the report to ask for recipients to update or confirm their email address on file. This call to action could be included in the ask to update the Home Profile.

Conclusion 3: While the email-only group may have lower recall of the reports overall, a higher proportion reported taking some action than the print and email waves, had higher recall of some report sections, and had a greater knowledge of how to address energy efficiency in their home.

Despite having a lower overall recall rate, the email-only group was more engaged and affected in some respects than the print and email group (of those who recalled receiving the reports). While there were few demographic differences that we could see between the groups, there may be some unobservable differences between the email-only and print and email groups. Additionally, the format of the eHER may lend itself to be more convenient or easier to share. We have seen similar results in a Georgia Power Home Electric Report pilot.

Recommendations:

- **To better understand drivers of readership, consider conducting interviews with recipients to learn more about why they liked the report and which medium they prefer and why.** Conducting in-depth interviews with eHER only and print and eHER recipients will allow for richer information on report preferences. It could also provide insight into any differences between the waves and how best to adjust the reports to improve readership and recall in both mediums. Additionally, it may be helpful to conduct a systematic comparison of the previous implementer's reports to the current reports to understand where they are different. The evaluation team found somewhat lower readership rates this cycle, although changes to question wording may limit the ability to directly compare across years. Additional monitoring and research could be useful if it is desired to increase readership rates over time.
- **Ask all waves to add their email address if not on file.** While overall recall may be higher for the print and email group, it may be that the eHER can lead to a different, or higher, impact on energy usage and energy saving behavior. As previously stated, not all treatment customers in the Legacy saves and the 2020 Standard save have valid emails on file. The program may benefit if more treatment customers could receive the eHER. The implementer could add a survey or call to action in the report to ask for recipients to add their email address to start receiving the eHER. This call to action could be included in the ask to update the Home Profile.

- **The implementer should monitor this trend; in future evaluations, this should be assessed again.** If there is a greater impact from the eHERs, consider increasing the number of eHERs sent to print and email respondents.

Conclusion 4: The evaluation team found summer peak demand savings of 2,865 kW, and 3,719 kW in winter.

The evaluation team estimated high-level demand savings generated by the program and found slightly higher estimates of peak demand savings in winter compared to summer.

Recommendations:

- **In future evaluations, consider conducting demand savings analyses using AMI data to estimate more precise peak demand savings by seasonality**. The current evaluated demand savings results give high-level, directional demand savings estimates of peak demand savings during the winter and summer peaking months. However, these estimates used monthly billing data estimates, which don't allow the granularity to estimate demand savings for the exact peak day or period used by Georgia Power. If more granular estimates are desired, future evaluations could use AMI data. Georgia Power should also ensure their AMI data is read at the decimal level to ensure precise estimates of savings can be assessed. According to program staff, this is already being considered.
- **If Georgia Power is interested in using the HERs to produce demand savings, consider adding specific language and recommendations about strategies to reduce demand to the reports.** The implementer could add educational information about demand response programs and peak demand to the reports. This demand module could describe the system peak months and hours and provide information to recipients about the importance of load shape management. The reports do currently include recommendations to participate in Temp✓; if higher participation is desired, reports could more heavily recommend participating in the Georgia Power demand reduction programs like Temp✓.

2. TEMP✓ - DEMAND RESPONSE PROGRAM

Program Design and Delivery

Georgia Power's Residential Thermostat Demand Response (DR) program, Temp✓, is a new offering to the portfolio, building on the DR pilot that was tested in 2019. Georgia Power hired Uplight as the program implementer for the Temp✓ program for the 2020 – 2022 cycle. Through the program, Georgia Power manages the load from participating customers' heat pumps through thermostats when there is a need to lower peak demand. Georgia Power offers a $50 Mastercard gift card to participating customers who enroll through a Bring-Your-Own-Device (BYOD) channel. Also, before November 2020, Georgia Power separately offered a $50 instant rebate to participating customers who purchased their thermostat on Georgia Power's Marketplace for enrolling in this program. However, Georgia Power stopped offering the instant rebate in the marketplace channel in November 2020 to improve the customer experience.

To qualify:

- The participating customer must be a Georgia Power customer, as verified with customer data and an account number.
- The participating customer must reside in a single family or multifamily home with an individual electric meter.
- To the extent it is verifiable, the participating customer must have a heat pump.

During this evaluation timeframe, the program offered two channels for participation. Under a Bring-Your-Own-Device (BYOD) channel, the program markets to customers with existing smart thermostats. The program reaches these customers through the thermostat brand (e.g., Google Nest) or by identifying customers who previously received a smart thermostat rebate through the Home Energy Improvement Program. Outside of the BYOD design, the program marketed to customers who purchased a new smart thermostat through the Georgia Power Marketplace. However, Georgia Power stopped offering the instant rebate in the Marketplace channel in November 2020 to improve the customer experience.

Table 25 describes the participation and savings goals for each year in this evaluation cycle. As a DR program, the purpose of this program is to provide demand reduction rather than energy savings, and as such, the program only has demand reduction goals, and no energy savings goals.

For this type of program where customers enroll their device or devices in the program, participation may refer to customers or devices. To differentiate the two, the evaluation team specifies the unit throughout this report chapter. For example, we use phrases such as "participating customer," "participant device," "enrolled customer," and "enrolled device" to specify whether we are referring to customers or devices. The evaluation team also uses the term "participation" to refer generally to both participating customers and devices.

Table 25. Thermostat DR Planned Participation and Energy Saving Goals

MEASURE	ENERGY SAVINGS (KWH PER UNIT)	DEMAND SAVINGS (KW PER UNIT)	2020 NUMBER OF PARTICIPANT DEVICES	2021 NUMBER OF PARTICIPANT DEVICES	2022 NUMBER OF PARTICIPANT DEVICES
Smart Thermostat DR – Marketplace	n/a	0.979	11,500	11,500	11,500
Smart Thermostat DR – BYOD	n/a	0.979	15,000	15,000	15,000
Total Demand Savings			25,944	25,944	25,944

Source: Georgia Power program summaries included in the request for proposals (RFP).

Changes from Previous Cycle Design

In 2018, Georgia Power launched the Bring Your Own Thermostat (BYOT) Pilot to assess the magnitude of demand impacts and energy savings from a thermostat-based DR program. The pilot tested DR events in both summer and winter using Nest's Rush Hour Rewards program. Georgia Power recruited 1,318 participating customers with 1,818 participant devices in August 2018 for its BYOT Pilot. The BYOT pilot promised to hold no more than 15 events each summer and each winter, and no more than three in one week. The pilot implementer notified participating customers of energy rush hours prior to each event through the mobile app and on the Nest device — the night before for morning events and at least an hour before afternoon events. During pre-cooling or pre-heating, the Nest app and thermostat displayed a gold gear and the words "Pre-Cooling" or "Pre-Heating." During the event, the Nest app and thermostat displayed the message, "Energy demand is high. If you change the temperature, you'll leave this Rush Hour" to confirm the user wished to stop participating in the event. After the event, participating customers could access information about the event through the mobile app or an email report.

In 2020, Georgia Power expanded this program to include over 14,000 participating customers with almost 19,000 participant devices. The program changed from a brand-specific DR implementation to a brand-agnostic implementer. The program now allows ecobee, Nest, and Emerson Sensi thermostats. The Temp✓ program set the maximum number of events at ten per season rather than a maximum of 15 during the pilot. All other primary aspects of the Temp✓ program are the same as the BYOT pilot.

Implications of the COVID-19 Pandemic

The evaluation team recognizes that this evaluation occurred during a timeframe in which the COVID-19 pandemic impacted daily life for residential customers in Georgia. The Temp✓ program was a new offering to the portfolio in 2020, and the first events were called in summer of 2020.

Evaluation research and analysis nearly always have the potential for introduced and inherent biases and exogenous factors that may influence results. Ideally, evaluators attempt to control for these factors in analyses, such as through sample design. When controlling for them is not possible, evaluators will attempt to identify and characterize the factors that may have influenced evaluation results. For all program evaluations conducted this cycle, the evaluation team carefully considered possible ways the unprecedented events of the COVID-19 pandemic and related factors may have impacted our results. There is much that is still unknown about how the COVID-19 pandemic has influenced household energy use and behavior in the US, and it is likely that the pandemic has affected households differently depending on household size, location, employment status, and other demographic factors (such as income, race, age, etc.). Additionally, whether and at what speed these factors return to pre-2020 conditions are occurring at varying degrees and speeds across different demographics and populations.

For the Temp✓ evaluation specifically, the team does not expect that our evaluation or results were heavily impacted by the COVID-19 pandemic. This program incorporates a randomized controlled trial design as part of its delivery mechanism, in which the control and treatment customer groups were randomly assigned prior to each event. Because of the large size of the treatment and control groups and more heterogeneous participation design, the evaluation team expects that exogenous factors (such as changes in customer behavior, household characteristics, or equipment use due to the pandemic) are *controlled for*. This means these exogenous factors should be affecting both the control and the treatment groups relatively equally. Additionally, the design of the Temp✓ program is such that the evaluation is measuring only demand savings generated during Georgia Power-induced events. This provides less opportunity for introduced error in the form of differences in customer behavior or choice.

Program Performance

As of the time of this evaluation, the Temp✓ program had not reached its program goals, but the verified net savings were better aligned with the reported savings. The difference between the program goals and both the reported and verified savings reflects lower participation rates than expected during this evaluation period. However, the program continues to enroll additional customers, and may be closer to its goal by the end of the planning cycle. Table 26 summarizes savings for the program, including program savings goals. Because the program uses a randomized controlled trial (RCT) design, the evaluation models produce net savings. As a DR program, the purpose of this program is to provide demand reduction rather than energy savings, and as such, the program only has demand reduction goals, and no energy savings goals.

Table 26. Temp✓ Program Savings Summary

METRIC	TIME PERIOD	GROSS SAVINGS/ IMPACT GOAL	REPORTED SAVINGS/ IMPACT	VERIFIED GROSS SAVINGS/IMPACT	VERIFIED NET SAVINGS/ IMPACT	RETROSPECTIVE REALIZATION RATE
Electric Energy Savings (kWh/yr.)	2020	n/a	n/a	n/a	n/a	n/a
	Q1 2021	n/a	n/a	n/a	n/a	n/a
Demand Reduction (kW)	2020	25,944	10,031	8,137	8,137	81%
	Q1 2021	25,944	10,031	8,137	8,137	81%

Research Questions

The evaluation team conducted qualitative and quantitative research activities to answer the following key research questions for the program:

Impact Questions

- Are the average savings assumptions accurate, and if not, how, and why should they be adjusted (e.g., due to connectivity issues)?
- Do the shed period demand savings occur at the time of Georgia Power's system peak hours?
- How did the program perform against participation and savings goals?
- Is the thermostat demand response technology working as planned?
- What factors drive savings, and if necessary, how, and why should savings assumptions be adjusted? For example:
  - What impact do connectivity and opt-outs have on savings?
  - How do savings vary by thermostat brand?
  - How do savings vary by time of day or season?
  - What impact does the customer's choice of tariff have on savings?
  - What impact does the HVAC type have?

Process Questions

- How are customers learning of the program?
- What influences customers' decisions to participate in the program?
- What are customers' behaviors during event periods?
- Are customers aware of and affected by DR events?
- How satisfied are customers with the process, the smart thermostats (if received through the program), and their experiences in general with the program and individual events?
- What factors influence customer opt-outs?
- What successes and challenges are the program managers and implementation team experiencing?

Impact Evaluation

This section details each step of the impact evaluation and the program's associated electric energy savings and peak demand reduction. It provides overall savings, participating customer and device counts, savings by season, and research into the factors that drive savings.

Verified Savings Approach

The results in this section reflect an analysis of hourly interval usage data from Georgia Power, event-specific participation files, enrollment data, and weather data. The program was implemented as a randomized control trial (RCT), where a control group was withheld from treatment to serve as a baseline or counterfactual.

Ultimately, the evaluation team used a multivariate regression model in combination with the program design to estimate impacts. The evaluation team followed our typical process for hourly usage or consumption analysis evaluation, by implementing different models for each of the following:

- Primary Evaluation Model: a regression that best aligns with typical evaluation analysis (more details on the model are in Appendix 2A: Impact Analysis Methodology).
- Robustness Checks: multiple regressions with minor changes to the model specification to provide an indication as to the sensitivity of the results.
- Exploratory Analysis: multiple regressions where impacts are separated by various characteristics (e.g., event-level results and results by thermostat brand).

These methods are described in greater detail in Appendix 2A: Impact Analysis Methodology Below, we provide additional background and context to the overarching program design, and the structure and approach of our evaluation and analysis.

Participating Customer and Device Definitions

Demand response programs have multiple levels of participation. In this subsection, the evaluation team describes enrolled customers and devices, event eligibility, and treated participating customers and devices.

For this type of program where customers enroll their device or devices in the program, participation may refer to customers or devices. To differentiate the two, the evaluation team specifies the unit throughout this report chapter. For example, we use phrases such as "participating customer," "participant device," "enrolled customer," and "enrolled device" to specify whether we are referring to customers or devices. The evaluation team also uses the term "participation" to refer generally to both participating customers and devices.

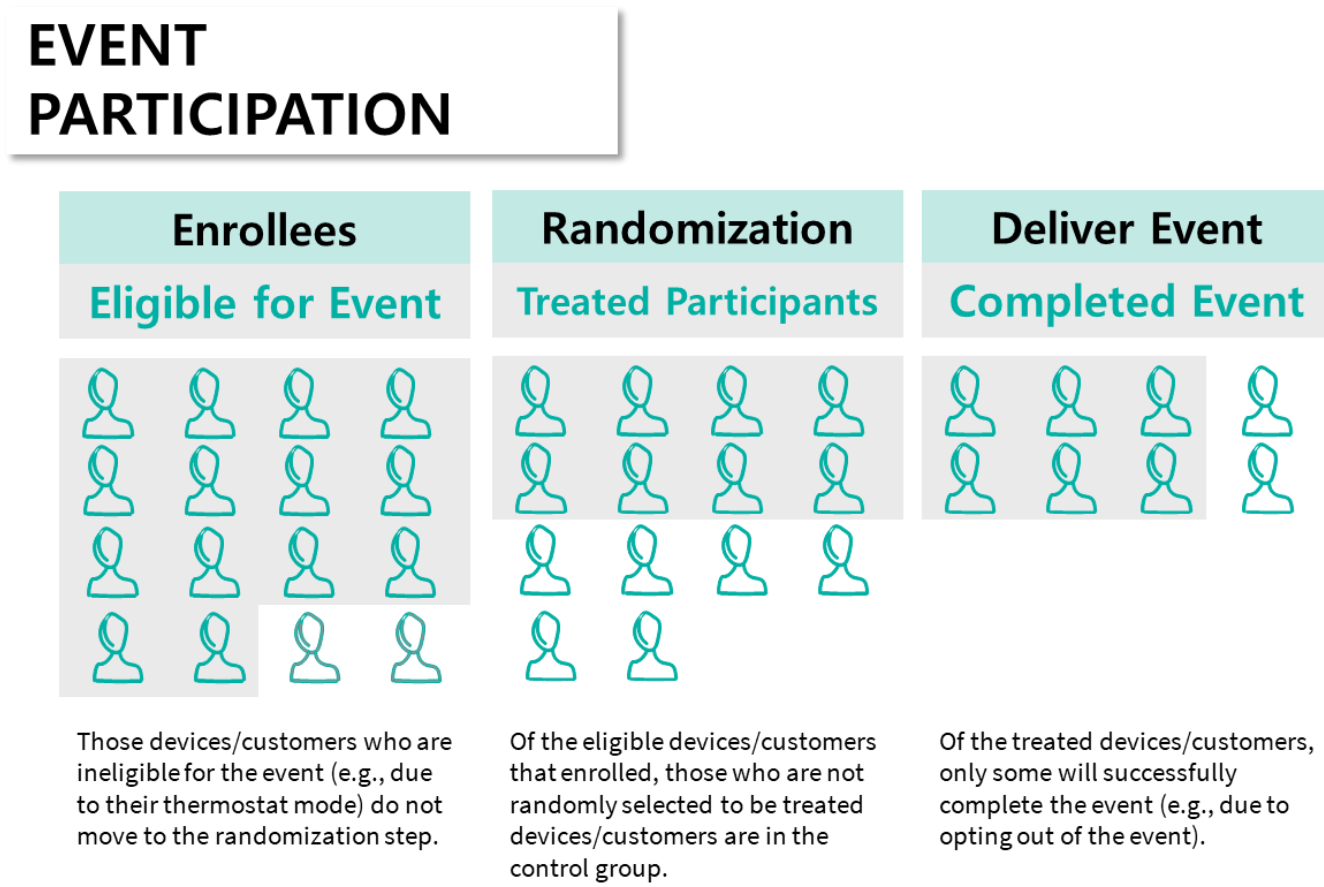
Figure 19 describes the definitions of participating customers. Customers enroll their device or devices in the program through the BYOD or Marketplace channel.[23] After customers enroll their device or devices in the program, the implementer identifies enrolled devices that are eligible for an "event," where an event is a series of hours within a day during which the implementer will adjust thermostat settings to achieve savings. Some enrolled devices or customers may not be eligible for an event for a variety of factors (e.g., issues with their HVAC mode). Because this program uses an RCT design, the implementer then randomly assigns eligible enrolled customers and their devices as treatment or control for each event, where the implementer will send signals to adjust the thermostat settings for treated participating customers while leaving control customers' thermostats unadjusted. Finally, some treated participating customers and their devices may not successfully

[23] Georgia Power stopped offering incentives through the Marketplace channel in November 2020 and plan to only use the BYOD channel for the next planning cycle.

complete the event; for example, they may opt out, experience connectivity issues, or have their thermostat set to an incompatible mode (e.g., set to off or cool mode in the winter). However, the evaluation team notes that savings may exist for customers who opt out of events in cases where they participated for at least a portion of the event. Savings for customers who opt out during an event are included in our evaluation results.

Throughout this report, the evaluation team's definition for treated participating customers most closely aligns with the implementer's definition of treatment locations, where some percent of treatment locations or participating customers will not start an event due to ineligible device settings, connectivity issues, or opt-outs.

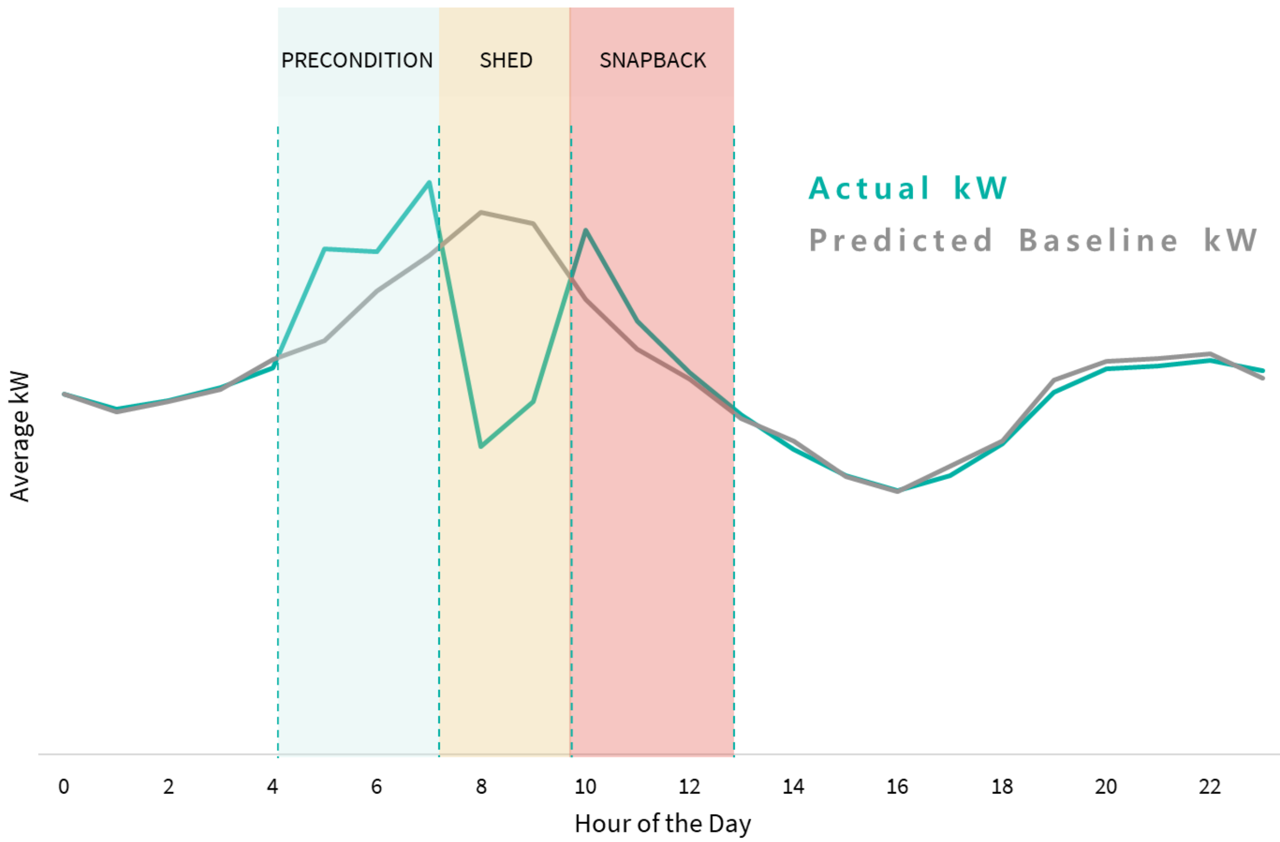
Figure 19. Definitions of Event Participation



Event Period Definition

The evaluation team analyzed three periods during the DR event: 1) preconditioning, 2) shed, and 3) snapback. Preconditioning is the period just before demand is curtailed when the algorithm sets the thermostat to pre-cool or pre-heat. Shed is when the algorithm sets the thermostat to reduce usage. This is the period that is analyzed to evaluate the program level savings. Snapback occurs immediately after the shed period has ended, when the thermostat returns to its originally scheduled temperature setting. In most cases, this results in HVAC systems cycling on to compensate for the event and creates an increase in load for participating customers. These three periods are visually clear in usage data patterns (Figure 20): during preconditioning there is an increase in usage, during shed there are clear savings, and during snapback there is an increase in usage.

Figure 20. Event Period Definitions



Description of Data Received

The team collected four files with information on participation rates and/or *ex-ante* savings for this evaluation: planning documents, enrollment data, post event summaries, and event participation files. We used these files, in conjunction with the participating customers' AMI data and survey responses, to evaluate the program. describes the types of information we received, the provider, and a description of the information. We refer to these sources throughout this report.

Table 27 describes the types of information we received, the provider, and a description of the information. We refer to these sources throughout this report.

Table 27. Description of Information Received

INFORMATION SOURCE	PROVIDER	DESCRIPTION
Georgia Power Planning	Georgia Power	Represents planned participation and savings estimates.

Enrollment Data	VisionDSM	Provides customer characteristics for all enrollees.
Post Event Summaries	Implementer	Event-level savings and participation counts provided by the implementer following an event.
Event-Specific Participation Files	Implementer	Designates treatment and control assignments for eligible enrolled customers for each event.

Verified Savings Results

Georgia Power's Temp✓ program achieved average shed period savings of 8,137 kW per event, which reflects a retrospective realization rate of 81% compared to the implementer's post event summaries. Table 28 shows program-level demand savings from Georgia Power's program planning, the implementer's post event summaries, and ILLUME's evaluation results. It also shows the retrospective realization rate for the evaluation results over the implementer's post event summaries.

At the time of this evaluation, the implementer's post event summaries and the evaluation results are notably lower than Georgia Power's planned savings, which is primarily due to differences in actual versus planned program participation (see the Participation Counts section for more details).

The retrospective realization rates between the post event summaries and evaluation results vary between 71% and 86%, with an average of 81%. While the evaluation results reflect somewhat lower participation levels than the post-event summaries, the retrospective realization rate is primarily due to differences in savings per participating customer or device. Note that customers continue to enroll in Temp✓, and the program may be closer to its goals by the end of the planning cycle.

Table 28. Retrospective Event Level Realization Rate for Shed Period Savings

EVENT DATE	TOTAL PLANNED SAVINGS (KW)	IMPLEMENTER POST-EVENT SUMMARY TOTAL SAVINGS (KW)	EVALUATION TOTAL SAVINGS (KW)	RETROSPECTIVE REALIZATION RATE (EVALUATION OVER POST-EVENT SUMMARIES)
9/3/2020	25,944	10,740	8,747	81%
9/10/2020	25,944	7,876	5,614	71%
12/9/2020	25,944	10,680	8,728	82%
12/17/2020	25,944	8,570	7,022	82%
1/29/2021	25,944	12,289	10,572	86%
AVERAGE	**25,944**	**10,031**	**8,137**	**81%**

The evaluation team verified participation for 96% of the customers included in the implementer's post event summary and estimated 84% of the savings per treated participating customer. Combining these ratios led to a retrospective realization rate of 81%. The implementer and evaluation team used different impact evaluation methods, which likely explains the difference between their results. The implementer estimated savings using runtime and then applied a reasonable demand value (i.e., 3 kW) to the runtime savings, while the evaluation team uses a multivariate regression with interval usage data to directly estimate savings. The evaluation team's method does not require an assumed HVAC demand value and accounts for non-program related factors that could influence demand, such as weather conditions and unobservable household characteristics. Table 29 shows the number of treated participating customers and demand savings for five events at the customer level. It presents these results for the implementer's post event summaries, the evaluation, and the ratio between them, which yields the realization rate recommended for planning. Table 30 provides similar information, but at the device-level.

Table 29. Comparison of Evaluation Results and Implementer's Post Event Summary for Participating Customers and Locations

EVENT CHARACTERISTICS			NUMBER OF TREATED PARTICIPATING CUSTOMERS [a]			SHED PERIOD SAVINGS (KW PER CUSTOMER)			
DATE	SHED START TIME	SHED DURATION (HOURS)	REPORTED: IMPLEMENTER POST EVENT SUMMARY	EVALUATION ESTIMATE	RATIO (EVALUATION OVER REPORTED)	REPORTED: IMPLEMENTER POST EVENT SUMMARY	EVALUATION ESTIMATE	EVALUATION PRECISION [b]	PLANNING REALIZATION RATE (EVALUATION OVER REPORTED)
9/3/2020	3pm	3	8,530	8,498	100%	1.26	1.03	7%	82%
9/10/2020	2pm	3	8,722	7,346	84%	0.90	0.76	9%	85%
12/09/2020	7am	2	8,149	8,129	100%	1.31	1.07	8%	82%
12/17/2020	8am	2	8,244	8,224	100%	1.04	0.85	9%	82%
1/29/2021	7am	2	9,401	9,326	99%	1.32	1.13	8%	86%
AVERAGE	-	**2.4**	**8,609**	**8,305**	**96%**	**1.15**	**0.97**	-	**84%**

[a] *The evaluation team shares location counts and savings by location from the implementer post event summary for comparison to the evaluation results at the customer account level. The evaluation team's definition for treated participants most closely aligns with the implementer's definition of treatment locations, where some percent of treatment locations or participants will not start an event due to ineligible device settings, connectivity issues, or opt-outs.*

[b] *The evaluation team estimates demand response impacts on an hourly basis and combines the error from the hourly impacts by preconditioning, shed, and snapback with a simplified approach. We assume no collinearity or relationship between covariates, which may lead to slight underestimates of precision.*

Table 30. Comparison of Evaluation Results and Implementer's Post Event Summary for Participating Devices

EVENT CHARACTERISTICS			NUMBER OF TREATED PARTICIPANT DEVICES			SHED PERIOD SAVINGS (KW PER DEVICE) [a]		
DATE	SHED START TIME	SHED DURATION (HOURS)	REPORTED: IMPLEMENTER POST EVENT SUMMARY	EVALUATION ESTIMATE	RATIO (EVALUATION OVER REPORTED)	REPORTED: IMPLEMENTER POST EVENT SUMMARY	EVALUATION ESTIMATE	PLANNING REALIZATION RATE (EVALUATION OVER REPORTED) [b]
9/3/2020	3pm	3	11,409	11,355	100%	0.94	0.77	82%
9/10/2020	2pm	3	11,632	9,850	85%	0.68	0.57	84%
12/09/2020	7am	2	10,662	10,628	100%	1.00	0.82	82%
12/17/2020	8am	2	10,764	10,740	100%	0.80	0.65	82%
1/29/2021	7am	2	12,174	12,121	100%	1.01	0.87	86%
AVERAGE	-	2.4	11,328	10,939	97%	0.89	0.74	83%

[a.] *The evaluation team provides device level results to support Georgia Power's program planning and has not estimated precision for the device leve l estimates. However, the level of modeling error should be similar between customer level and device level estimates unless the number of devices per customer in the tracking data is inaccurate.*

[b.] *The realization rates calculated at the device level differ from those at the customer level (Table 29) due to slight data discrepancies. As this evaluation was conducted at the customer level because we used customer-specific AMI data, we are more confident in the customer level estimate. Therefore, we recommend a future planning realization rate of 84% throughout this report.*

Participant Counts

In this section, the evaluation team provides participation counts by event, as well as an investigation into event completion and customer opt-outs.

Participant Counts by Event

Georgia Power's Temp✓ program enrolled over 14,000 customers with almost 19,000 devices by January 29, 2021. Of these, the evaluation team verified 9,326 customers were enrolled and identified for receiving the event algorithms for the January 29, 2021, event (additional information on differences between the number of enrolled versus treated customers is described in the next section). Table 31 shows participating customer counts for each event and on average across the five events included in this evaluation. It shows the number of customers enrolled by the time of each event, the number of customers identified for treatment in the implementer's post event summary, the number of customers identified for treatment in the implementer's event-specific participation files, the number of customers who are both enrolled and identified for treatment, and lastly, the number of treated participating customers included in the evaluation team's interval usage data modeling. The evaluation team used the number of customers who were both enrolled and identified for treatment when estimating total program impacts. We found that there was a discrepancy/inconsistency with the customers who were identified in the implementer's event-specific participation files and those in the VisionDSM at the time of the event. For example, one participating customer may show up in the implementer file as having participated in the event but does not appear in the VisionDSM file. The evaluation team has not identified the source of this issue, but it may reflect data management issues or customers who enrolled in the program via the instant rebate yet were subsequently removed due to ineligible HVAC types.

Table 31. Event-Level Disposition Table

EVENT DATE	ENROLLED CUSTOMER	NUMBER TREATED CUSTOMERS (IMPLEMENTER'S POST EVENT SUMMARY)	NUMBER TREATED CUSTOMERS (IMPLEMENTER'S EVENT-SPECIFIC PARTICIPATION FILE)	NUMBER TREATED & ENROLLED CUSTOMERS	NUMBER TREATED CUSTOMERS INCLUDED IN MODELING
9/3/2020	10,341	8,530	8,530	8,498	6,963
9/10/2020	10,560	8,722	8,722	7,346	7,100
12/09/2020	13,216	8,149	8,145	8,129	6,722
12/17/2020	13,317	8,244	8,237	8,224	6,804
1/29/2021	14,444	9,401	9,339	9,326	7,552
AVERAGE	12,376	8,609	8,595	8,305	7,028

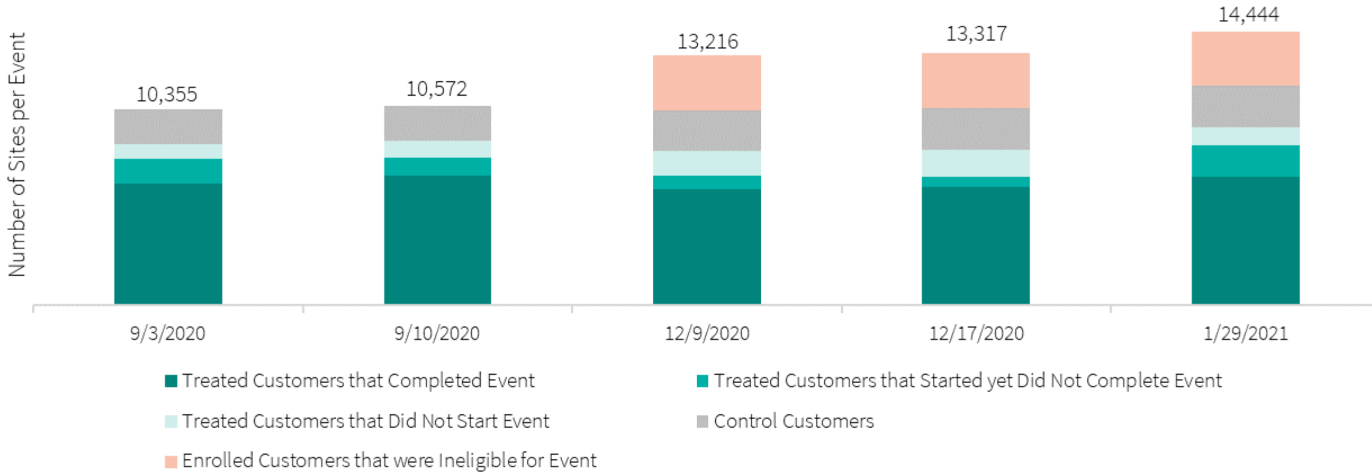
Participant Event Completion

The nature of participation is somewhat unique for DR programs. While over 14,000 Georgia Power customers enrolled in the Temp✓ program with almost 19,000 devices by the event on January 29, 2021, only 9,326 customers were enrolled and identified for receiving the event algorithms and only about 6,800 customers completed the event algorithms. In other words, about 75% of treated participating customers and about 50% of all enrolled customers completed the event algorithms on average across the five events in this evaluation. Adding complexity, some customers who did not complete the event algorithms still contributed demand savings, because they may have opted out in the middle of the event or opted out unintentionally by using even more efficient setpoints.

Customers may not complete the event algorithms because they are excluded from the event prior to the event, the event algorithms may not reach the customer's device, or the customer adjusts their device such that it opts them out of the event during the event. Implementers chose eligible enrolled customers based on HVAC types or thermostat modes, and after determining eligibility, they reserved some eligible customers for a control group prior to each event. Similarly, some treated participating customers never received the event due to connectivity issues and other treated participating customers chose to opt out of the event, which can occur prior to or during the event.

Figure 21 shows the breakdown of enrolled customers for each of five events. While enrollment increased for the winter events, the number of customers completing the event algorithms was relatively stable throughout the five events. The increase in ineligible enrolled customers during the winter events may reflect devices that are not controlling active heating systems or controlling heating systems that use non-electric energy sources. The Georgia Power team noted that some thermostat brands enroll devices by customer location rather than device. As such, customers with one device controlling an electric heat pump can enroll additional devices that may not control an electric heating source. Similarly, the implementer noted that they added a field to their dataset for whether customers were eligible for winter events before the event on December 9, 2020. In summary, due to the enrollment process for some thermostat brands, customers may enroll devices that are not controlling electric heat pumps and the implementer flags these devices as ineligible for winter events. The evaluation team expects the number of customers completing the event algorithms to increase for any summer events in 2022 and beyond.

Figure 21. Event-Level Breakdown of Participating Customer Event Completion



Seasonal Savings Results

In this section, the evaluation team summarizes seasonal impact findings during preconditioning, shed, and snapback across three winter events and two summer events. In addition, the evaluation team combines demand savings and duration for each of the event periods to estimate energy savings (kWh) generated by the events which are not captured in the program's reported savings.

Winter Demand Response Events

During winter DR events, Georgia Power achieved an average per customer preconditioning period demand increase of 0.34 kW, average shed savings of 1.02 kW, and a snapback demand increase of 0.12 kW. These impacts equate to 0.53 kWh of average per customer daily energy savings during winter events. While the energy savings (kWh) estimate is statistically significant, the magnitude of energy savings is relatively small compared to the uncertainty (i.e., 81% precision at 90% confidence). Table 32 shows average results during preconditioning, shed, and snapback across three winter events. This table also provides the average number of hours, treated participating customers, per customer demand savings, modeling precision, and per customer energy savings.

Table 32. Estimated Customer-Level Average Demand Reduction for Winter DR Events

SEASON	PERIOD	NUMBER OF HOURS	AVG TREATED CUSTOMERS PER EVENT	PER CUSTOMER KW SAVINGS	MODEL PRECISION [a]	PER CUSTOMER DAILY ENERGY SAVINGS (KWH)
Winter	Preconditioning	3	8,560	-0.34	23%	-1.01
Winter	Shed	2	8,560	1.02	8%	2.04
Winter	Snapback	4	8,560	-0.12	65%	-0.50
TOTAL CUSTOMER DAILY ENERGY SAVINGS [b]					81%	0.53

[a] The evaluation team estimates demand response impacts on an hourly basis and combines the error from the hourly impacts by preconditioning, shed, and snapback with a simplified approach. We assume no collinearity or relationship between covariates, which may lead to slight underestimates of precision.

[b] While Georgia Power claims energy savings from the purchase of smart thermostats in the Home Energy Improvement Program, the evaluation of that program excludes Temp✓ event days. As such, while small, Georgia Power does not currently claim energy savings from Temp✓ event days.

Summer Demand Response Events

During summer DR events Georgia Power achieved an average per customer preconditioning period demand increase of 0.46 kW, average shed savings of 0.90 kW, and a snapback demand increase of 0.20 kW. These impacts equate to an average per customer daily energy savings of 0.98 kWh during summer events. Table 33 shows average results during preconditioning, shed, and snapback across two summer events. This table also provides the average number of hours, treated participating customers, per customer demand savings, modeling precision, and per customer energy savings.

Table 33. Estimated Customer-Level Average Demand Reduction for Summer DR Events

SEASON	PERIOD	NUMBER OF HOURS	AVG TREATED CUSTOMERS PER EVENT	PER CUSTOMER KW SAVINGS	MODEL PRECISION [a]	PER CUSTOMER DAILY ENERGY SAVINGS (KWH)
Summer	Preconditioning	2	7,922	-0.46	15%	-0.92
Summer	Shed	3	7,922	0.90	8%	2.69
Summer	Snapback	4	7,922	-0.20	36%	-0.79
TOTAL CUSTOMER DAILY ENERGY SAVINGS [b]					38%	0.98

[a] The evaluation team estimates demand response impacts on an hourly basis and combines the error from the hourly impacts by preconditioning, shed, and snapback with a simplified approach. We assume no collinearity or relationship between covariates, which may lead to slight underestimates of precision.

[b] While Georgia Power claims energy savings from the purchase of smart thermostats in the Home Energy Improvement Program, the evaluation of that program excludes Temp✓ event days. As such, while small, Georgia Power does not currently claim energy savings from Temp✓ event days. .

Thermostats per Participating Customer

As shown in Table 34, Georgia Power's Temp✓ program enrolled customers had about 1.3 enrolled devices per customer on average for each of the five events included in this evaluation. The evaluation team estimated that savings per customer were 0.97 kW, resulting in an average demand reduction per thermostat of 0.74 kW.

Table 34. Thermostats per Customer

EVENT DATE	ENROLLED CUSTOMERS	ENROLLED DEVICES	DEVICES PER CUSTOMER
9/3/2020	10,341	13,834	1.34
9/10/2020	10,560	14,092	1.33
12/09/2020	13,216	17,354	1.31
12/17/2020	13,317	17,495	1.31
1/29/2021	14,444	18,916	1.31
AVERAGE	**12,376**	**16,338**	**1.32**

Drivers

In this section, the evaluation team presents findings into the factors that may drive per-customer savings. We present results by thermostat brand, HVAC type, customer tariffs, and the technology operations.

Thermostat Brand

The evaluation team found similar shed savings between three thermostat brands, with relatively minor differences that could reflect other customer characteristics that correlate with thermostat brand, such as the number of thermostats per customer and customer behavior during the events.

HVAC Equipment Type

Where data was available with adequate sample size, the evaluation team found similar shed savings between HVAC types. However, there was some degree of greater variation in the winter events. Table 35 shows the number of enrolled customers, the number of customers modeled, the per customer shed savings, and modeling precision across HVAC types with adequate sample size. This data was only available for Sensi and ecobee thermostats. Similarly, each thermostat brand structured their HVAC type data differently, and it is difficult to assess the accuracy of this information. The evaluation team notes that there are a variety of heat pump configurations for heating, which may be driving the higher degree of variation in savings during winter events compared to summer events. For example, some heat pumps can operate in coordination with existing forced air furnaces, while other heat pumps include their own auxiliary electric resistance heating.

Table 35. Savings by Season and HVAC Type

SEASON	HVAC TYPE	NUMBER OF CUSTOMERS IN RAW DATA	NUMBER OF TREATED CUSTOMERS IN MODEL	PER CUSTOMER SHED EVENT SAVINGS (KW)	MODELING PRECISION
Summer	ecobee Heat Pump	3,502	2,900	0.81	7%
Summer	Sensi AC	496	395	0.86	14%
Summer	Sensi Heat Pump	460	372	0.83	15%
Winter	ecobee Heat Pump	4,755	1,352	1.17	5%
Winter	Sensi AC	496	261	0.79	19%
Winter	Sensi Heat Pump	460	224	1.18	12%

Tariff

The evaluation team found similar shed savings between customers with different tariffs. Table 36 shows the number of enrolled customers, the number of customers modeled, the per customer shed savings, and modeling precision across tariffs. Given the high proportion of customers on the Residential Tariff (over 90%), the evaluation team does not expect that program savings were greatly impacted by customers' billing tariff. While there are somewhat different shed savings for each tariff, the differences are minor compared to the precision and could reflect other customer characteristics that correlate with their tariff, such as the number of thermostats per customer and customers' daily routines during events.

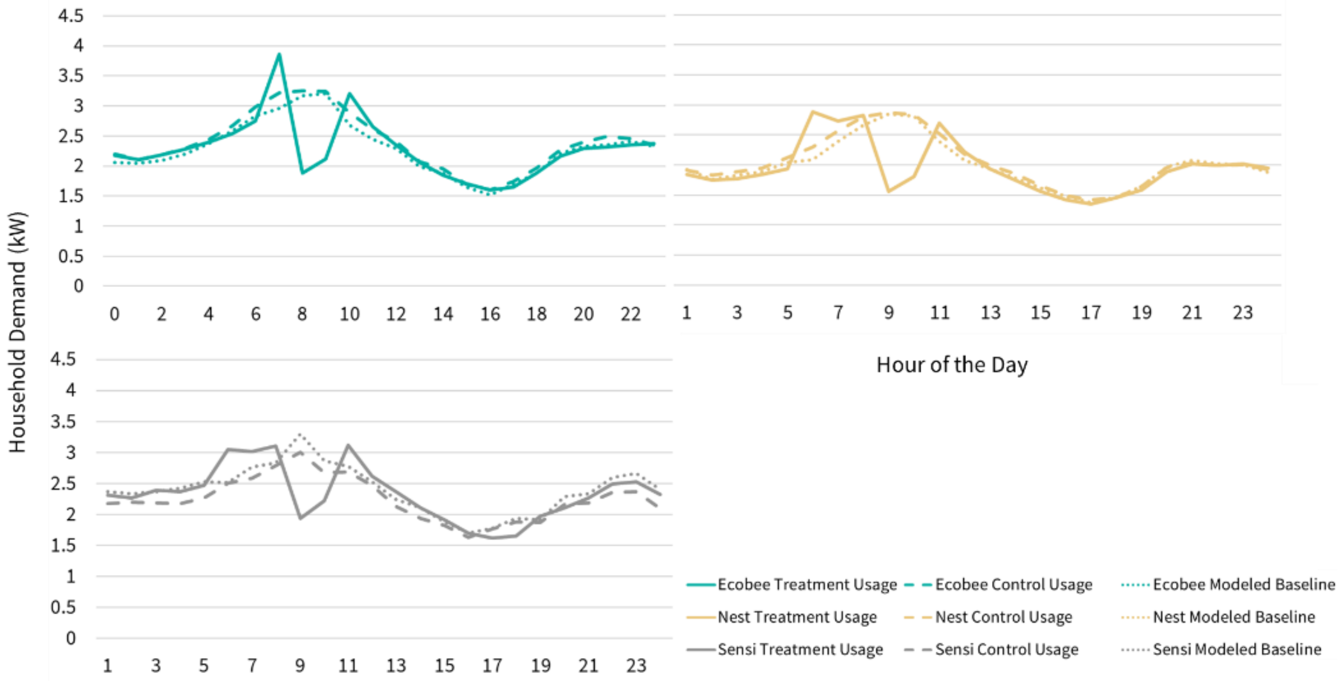
Table 36. Savings by Tariff

TARIFF	NUMBER OF CUSTOMERS IN RAW DATA	NUMBER OF CUSTOMERS IN MODEL	PER CUSTOMER SHED EVENT SAVINGS (KW)	MODELING PRECISION
Residential	12,667	10,956	0.98	2%
FlatBill Residential	634	498	1.08	10%
Pre-Pay	123	97	0.80	30%

Technology Functionality

The evaluation team visualized usage data by event and thermostat brand to assess whether the technology was operating as expected. Based on this high-level investigation, the evaluation team estimated that the thermostats operated as expected during the shed hours of the events, but they operated somewhat unexpectedly during preconditioning. Figure 22 shows average treatment usage, average control group usage, and the modeled baseline by thermostat brand during the event on January 29, 2021. Each thermostat brand clearly shows two hours of demand reduction or shed, as expected. However, ecobee appears to operate preconditioning differently than expected and different from the other two brands. While the other two brands operated preconditioning over three hours, ecobee appears to operate preconditioning over one hour only, which led to a larger preconditioning increase in demand usage immediately preceding the event.

Figure 22. Treatment Group, Control Group, and Modeled Baseline Usage on January 29, 2021



Cost-Effectiveness

There are many nuances to estimating cost-effectiveness for DR programs, and many states are actively updating their established methodologies. In this section, the evaluation team provides a brief discussion of potential nuances to consider for any future updates to Georgia Power's cost-effectiveness methodologies.

Demand Response Cost-Effectiveness Considerations

While many components of DR programs fit well within established energy efficiency practices, there are notable differences. In the bullets below, the evaluation team identifies factors that Georgia Power and their stakeholders may want to consider should they choose to update their demand-side-management cost-effectiveness methodologies.[24]

- Cost Estimates: determining the appropriate incremental cost for demand response, especially for a societal cost test. Because many DR participating customers already own their smart thermostat, the societal cost for DR might only reflect the program administrative costs and no or limited incremental cost for the customer. For example, some states are considering the incremental cost to be 75% of the incentive amount.

- Control Group Benefits: determining the financial benefit of the control group. In the current Temp✓ program design, control group customers are enrolled and active in the program, yet do not contribute to overall program savings nor benefits. However, if warranted, Georgia Power and the implementer have access and ability to include these customers in the treatment group and achieve higher program savings. As such, control customers provide additional capacity reserve in the current program design, which Georgia Power could choose to include as program benefits. Similarly, should Georgia Power choose not to include the control group in the program benefits, Georgia Power and the implementer could adjust the program design to forego the control group and deliver the DR event algorithms to all eligible enrolled customers, which would lead to higher program savings and benefits.

- Hourly Impacts: determining the hourly benefit and penalties from DR events. There are two reasons to consider estimating DR impacts by hour: (1) the financial benefit of demand savings varies by hour, and (2) this approach can also capture the penalties associated with preconditioning and snapback.

- Day Type Considerations: determining benefits based on certain day type conditions, such as summer peak and winter peak days. Georgia Power may want to consider estimating impacts and benefits separately by season, as the avoided costs and other cost-effectiveness components may vary between day types. This approach could enable Georgia Power to balance the frequency of events appropriately across seasons.

- Sensitivity of Impacts: determining benefits more in line with other Resource Adequacy rules and requirements, which may include high and low estimates of resource availability.

- Availability Adjustment: determining benefits from DR, while accounting for limitations in frequency and duration of events. While energy efficiency programs deliver recurring or permanent coincident

[24] Many of these factors are described in greater detail in California's "2010 Demand Response Cost Effectiveness Protocols" and "Load Impact Estimation for Demand Response: Protocols and Regulatory Guidance" https://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/128596.PDF, https://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/81979.PDF, or in Pennsylvania's documentation in section G.3 at https://www.puc.pa.gov/pcdocs/1636986.docx

demand savings, demand response programs provide savings for shorter durations and less often. As such, this adjustment factor would give credit to DR resources that can be called more frequently for longer durations and de-rate DR resources that are more constrained.

- Notification Time Adjustment: determining benefits from DR, while accounting for limitations in the expediency in calling an event. For example, this adjustment factor accounts for the extent to which DR program managers would have called events differently if day-ahead notifications were not required. To some extent, this factor accounts for how well the DR savings align with system peaks. This adjustment factor gives credit to DR resources that can be called more immediately and de-rates DR resources that require longer notification times.

- Trigger Adjustment: determining benefits from DR, while accounting for limitations in the criteria needed to call an event. For example, this adjustment factor accounts for the extent to which DR program managers must refrain from calling an event, when an event may be worthwhile. This adjustment factor gives credit to DR resources that have a high level of flexibility for calling events and de-rates DR resources that have strict criteria for triggering/calling an event.

- Distribution Adjustment: determining benefits from DR programs that delay the need for infrastructure improvement, such as when DR programs serve as a non-wired alternative. In California, this factor is defaulted to 0% unless programs can document the benefits otherwise.

- Energy Adjustment: determining energy savings benefits from DR programs that reflect the higher-than-average energy costs that utilities typically experience on event days. Because DR events typically save energy and typically occur on days with higher demand and higher energy prices, the energy saved on these days is more valuable. Georgia Power could capture this adjustment by using time-differentiated avoided energy costs to claim energy savings from Temp✓ events.

- DR Specific Line Losses: determining benefits based on the higher-than-average line losses that may be experienced on an event day. Because events are typically called during periods of high demand, the line losses associated with demand savings from DR events may be higher than normal. This adjustment factor gives that added value of DR savings to the program.

- Generation Capacity Adjustments: determining benefits in reference to baseline generation operations. DR programs provide two benefits compared to comparable generators. They can be considered as reducing reserve margin for operating generators that provide reserve generation to respond to system contingencies. Similarly, DR savings are not affected by the Peak Performance Penalty of CT generators during peak heat conditions.

Realization Rates

Table 37 shows the program's reported savings, verified savings, and overall retrospective realization rate.

Table 37. Retrospective Realization Rate Summary

SAVINGS TYPE	DEMAND SAVINGS (KW)
Reported Savings	10,031
Verified Savings	8,137
Retrospective Realization Rate	81%

Verified Net Savings

Evaluators typically consider impact results for DR programs to be net. Freeridership and nonparticipant spillover are assumed to be non-existent because customers do not have access to demand response events outside of the program.

Participant spillover is more complex because it is partially captured in the study design. This evaluation used an experimental study design with a rotating control group, which provided the counterfactual baseline for each event. As such, the analysis included participant spillover savings for any shedding actions employed by the treatment customers on the event day, because only the treatment customers would be aware of the event. However, because of the control group, this analysis may ignore demand savings from recurring or lifestyle changes resulting from participation in the program. For example, if customers decide to modify their setpoint schedule to reduce usage at peak times daily after joining the program, the control group would reflect a slightly reduced baseline and the estimate of savings would be falsely low. In alignment with standard practices, the evaluation team assumes this additional participant spillover is minimal to nonexistent and does not measure it.

Process Evaluation

To understand the customer experience, the evaluation team conducted online surveys following a summer DR event in 2020 and a winter DR event in 2021. The survey assessed motivations, enrollment experience, customer satisfaction, and demographics. The evaluation team fielded the surveys within one day of each DR event. Each survey sample was representative of the program population, considering home type (single versus multifamily) and geography. To avoid overburdening participating customers, summer event participants who completed the summer event survey did not receive the winter event survey. Pilot participants were also excluded from the surveys.

The evaluation team fielded web-based surveys to 10,247 summer event enrollees and 12,196 winter event enrollees. This included all customers, including those who received the event and those who did not (including both control group customers and customers who opted out or experienced connectivity issues). Due to timing challenges in receiving data, the evaluation team was unable to identify which group customers were in prior to the survey but was able to match these data during analysis. After data cleaning, a total of 3,281 survey responses were included in the analysis, yielding a 15% response rate across both surveys.[25] Figure 23 reports the total cleaned survey disposition of winter and summer events.

Figure 23. Process Evaluation Survey Disposition

Summer Event
September 3, 2020

- Fielded September 4, 2020
- Fielded to 10,247 summer event participants
- 1,790 responses analyzed (after data cleaning)
- 17% response rate
- 85% of respondents were treatment participants

Winter Event
January 29, 2021

- Fielded January 30, 2021
- Fielded to 12,196 winter event participants
- 1,491 responses analyzed (after data cleaning)
- 12% response rate
- 69% of respondents were treatment participants

The following sections detail the results related to source of awareness, reasons for participation, experience during the DR events, satisfaction with the program, and program impacts on customers. We report on differences between the groups when they are statistically significant. Statistically significant differences reported in this section are significant at the 90% confidence level; we specify in all cases where there is a statistically significant difference.

Program Awareness and Marketing

Overall, respondents reported that Georgia Power's outreach and communication efforts for their Temp✓ program worked well. Respondents reported that they became aware of the program through Georgia Power emails (62%) and the website (13%) most frequently. Ten percent of respondents reported learning about the program from their thermostat company and 7% learned about the program through the Georgia Power

[25] About 11% of respondents were removed from analysis because they said they were not enrolled or were unsure if they were enrolled in the Temp✓ Program. Nearly 5% of respondents were removed due to incomplete responses. Two summer events occurred in September (September 3, 2020, and September 10, 2020). To ensure summer event responses pertained to the September 3, 2020, event those who took the survey after September 9, 2021, were removed from analysis (less than 2%).

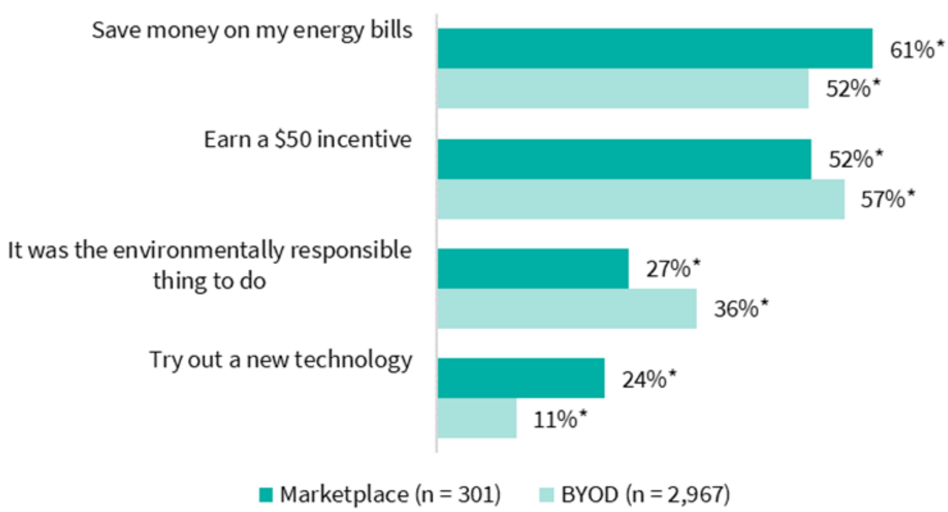
Marketplace. Over half of respondents (59%) reported having just one thermostat in their home and 32% had two thermostats. Most respondents owned Google Nest thermostats (76%), followed by ecobee (17%), and Sensi (8%).

Participation Drivers

Financial benefits were the primary drivers of participation. Over half of respondents (57%) said they enrolled for the $50 incentive. There was a perception among respondents that participation would decrease their energy bill; 53% of respondents said they enrolled to save money on their energy bills. However, program marketing materials *do not* suggest that customers will save money on their energy bills, and yet this is still a primary motivator for participation.

Motivations were similar between the BYOD and Marketplace respondents (Figure 24). While financial incentives were the primary drivers for BYOD respondents, they were significantly more likely than Marketplace respondents to report that they were enrolling in the program because it was environmentally responsible and less likely than Marketplace respondents to report that they were enrolling because they wanted to try a new technology.

Figure 24. Marketplace versus BYOD Primary Drivers for Enrollment



Source: Temp✓ customer survey. B6. Why did you enroll in this program? Please select up to three.

Respondents who purchased their smart thermostat on the Georgia Power Marketplace were asked how influential the instant rebate and the additional Temp✓ program rebate were in their decision to purchase a device. Nearly all respondents (98%) said the instant rebate was either very or somewhat influential. Similarly, almost all respondents (98%) said the extra Temp✓ program rebate was very or somewhat influential in their decision to purchase the smart thermostat.

The evaluation team asked participants who confirmed they enrolled in the Temp✓ program whether the program worked as they originally expected it would. Nearly a quarter of participants (24%) said the program did not work as they originally expected, or they were unsure whether the program worked as they originally expected, indicating that participants may need more information on how the program works during the enrollment process.

Demand Response Event Experience (Treatment Customers Only)

The evaluation team asked respondents if they recalled any DR events in the last two weeks. For both the summer and winter survey respondents, only one event had occurred in the previous two weeks. Most of the treatment group recalled at least one event (87% for both summer and winter events) while most of the control group did not recall any events (59% for summer events and 57% for winter events). One-quarter of the treatment group recalled more than one event and 43% of the control group recalled at least one event. This indicates that participants are not always aware whether an event was happening. Of treatment respondents who recalled the DR event, nearly all (88%) learned about it through an email. The second most common response was learning about the event from their thermostat (7%). Most treatment respondents who recalled the event (85%) were also home for all or part of the event.

We asked respondents what actions they took during the DR event that could affect energy usage. The top three actions respondents took during the event were turning off lights (29%), avoiding running the dishwasher (28%), avoiding doing laundry (27%). In the summer event, 46% of respondents reported using a fan.

Perceived Effect on Home Comfort and Routines

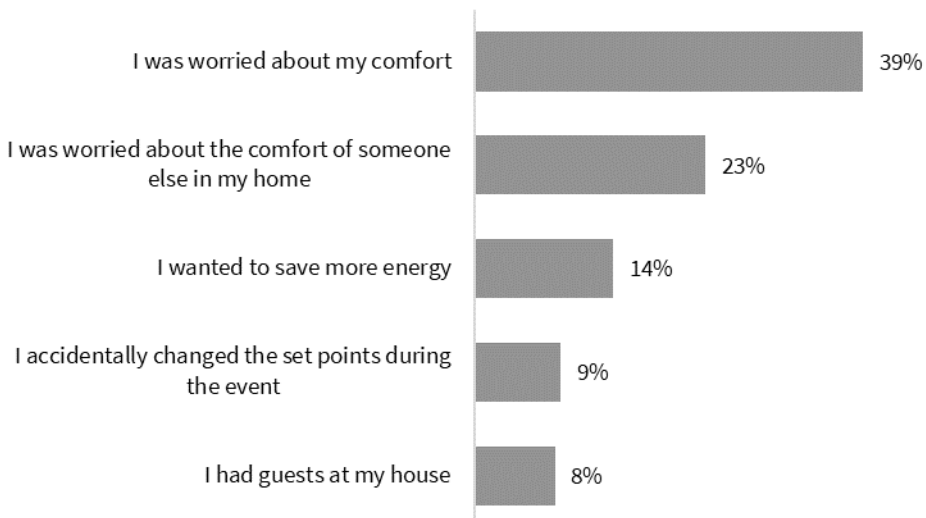
While some respondents indicated that the events affected their comfort, few respondents indicated that the event affected their routines. When asked about their comfort during the event, 30% of treatment respondents indicated their home was uncomfortable compared to the days before and after the event. Nearly one-quarter (22%) said they experienced some sort of negative impact because of the event such as being too hot or cold (94% for both summer and winter events) or experiencing too much humidity (17% in the summer event and 2% in the winter event). Despite this, only 5% said that the event affected their daily routine.

Opt-Outs

Few respondents reported opting out of the events, but some respondents may have opted out accidentally. About 15% of treatment respondents reported taking actions that would have opted them out of the event, including opting out explicitly or simply adjusting thermostat setpoints during the event (15% in the summer event and 14% in the winter event). This opt-out rate is like what the implementer reported average opt-out rate of 13% (17% in the summer events and 11% in the winter events). However, when asked in the survey whether they chose to opt out of the event, only about 3% of respondents reported that they had done so (2% of summer event respondents and 3% of winter event respondents), indicating respondents may not fully understand how event opt-outs work. There was no meaningful difference in reported opt-outs by thermostat brand based on survey data; however, according to the implementer data, there was a higher opt-out rate for Emerson thermostats in the winter than Nest or ecobee thermostats.

Of respondents who opted out of the event, the most common reason for opting out was that they were concerned about their own comfort or the comfort of someone in their home (n = 39, Figure 25). Others said that during preconditioning they adjusted their temperature up during the summer or down during the winter. These respondents explained that pre-heating or pre-cooling made their home uncomfortable, or they changed to a more efficient temperature because they wanted to save more energy. This indicates additional education is needed so customers understand the purpose of the preconditioning periods, and so they are aware that changing their thermostat temperature, even during the preconditioning period, will result in them opting out of the event.[26]

Figure 25. Reasons for Opting Out (n = 366)



Source: Temp✓ customer survey. C12. Why did you change the temperature or opt out of the optimization event?

Satisfaction with Program and Georgia Power

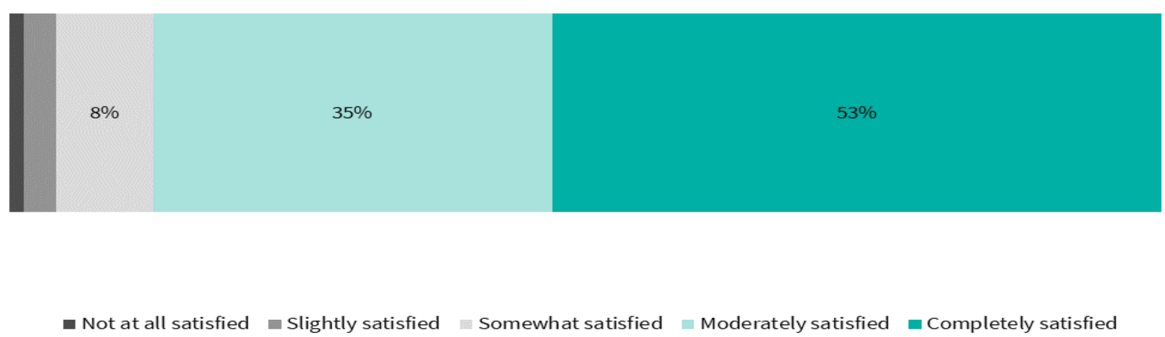
Overall, respondents reported high satisfaction with the Temp✓ program, with 85% of respondents reporting being moderately or completely satisfied with the program. Respondents were most satisfied with their smart thermostat (94%), the amount of notice given before an event (92%), and the enrollment process (86%).

[26] Note that ecobee devices may re-enter the event period if a customer opts out during preconditioning.

Respondents were less satisfied with the report they were given after the event (67%). Of the respondents who reported why they were less satisfied with the post-event report two said they wanted more information and four said they did not receive a report at all.

In addition to being satisfied with the Temp✓ program, respondents reported high satisfaction with Georgia Power overall. Most respondents (88%) were moderately or completely satisfied with Georgia Power (Figure 26). This did not vary by enrollment channel, device type, or event recall.

Figure 26. Satisfaction with Georgia Power (n = 3,238)



Source: Temp✓ customer survey. D3. Taking into consideration all aspects of your utility service experience, please rate your current satisfaction with Georgia Power overall?

Participant Survey Demographics

Survey respondents were wealthier, had higher educational attainment, tended to be younger, and most identified as White. Compared to the average citizen in Georgia, survey respondents were wealthier and younger. In addition, most respondents (77%) lived in homes that were built after 1980. Over one-half of respondents (61%) have lived in their homes for three years or less. Most survey respondents (89%) lived in single family homes. Nearly three-quarters (59%) of respondents earned a household income of $75,000 or more, higher than the median household income in Georgia ($58,700).

Nearly three-quarters of survey respondents (73%) were younger than 50 years old. Two-thirds of survey respondents (67%) were White, 16% were Black, and 11% were Asian. The general population of Georgia is slightly more diverse: 60% of the population is White, 33% is Black, 10% is Latino, and 4% is Asian. Table 38 displays the survey respondents' age, income, and ethnicity compared to the average or median resident of Georgia.[27] The average age of survey respondents was higher than the median age of Georgia residents.

Table 38. Respondent Demographics Compared to State of Georgia

CATEGORY	SURVEY	GEORGIA
Age	12% are 60 and older	14% are 65 and older
Income	69% make at least $75k	Median income is $59k
Ethnicity	67% are White	60% of population is White

Conclusions and Recommendations

Conclusion 1: The Temp✓ program achieved 81% of claimed program savings, and 84% of the claimed savings per treated participant device.

The evaluation team estimated the Temp✓ program savings by combining savings per participating customer with the verified number of participating customers. The team estimated savings per participating customer using interval usage data and verified program participation by cross referencing the program enrollment data with the implementer's event-specific participation data. These results in combination reflect 81% of the implementer's estimated program savings on average, and the evaluation team's estimated savings per participating customer reflects 84% of the implementer's estimate on average.

Recommendations:

- **Georgia Power should plan to achieve 84% of the savings provided in the implementer's post-event summaries.** While the evaluation team estimates a retrospective program level realization rate of 81%, most of the difference in participant counts occurred during the September 10, 2020, event and

[27] United States Census Bureau. (2019). Quick Facts Georgia. Retrieved from United States Census Bureau Quick Facts: https://www.census.gov/quickfacts/GA

did not reappear throughout the winter. As such, the evaluation team recommends the program managers plan to rely on the implementer's future participant counts, and to expect to achieve 84% of the savings per participant device. Georgia Power should revisit this value in future planning cycles, especially if the implementer uses a different methodology to estimate reported savings.

Conclusion 2: The evaluation team identified some considerations that could improve program cost-effectiveness for future program planning.

While many factors influence DR program cost-effectiveness, the evaluation team identified certain changes that could improve cost-effectiveness: the approach for incorporating control customers into the cost-effectiveness screening, the appropriate cost estimate, and the approach for incorporating energy savings into the program. More generally, many states are actively updating their DR cost-effectiveness tests, and as such, the evaluation team gathered a summary of factors being considered in DR cost -effectiveness protocols in other states. Depending on the role Georgia Power and their stakeholders envision for DR moving forward, they can reference this list should they choose to update their DR cost-effectiveness methodologies.

Recommendations:

- Georgia Power should discuss with stakeholders whether to include control customers in calculating program benefits, and if Georgia Power is unable to include control customers in calculating program benefits, refrain from using a control group for future evaluations. To provide the most accurate estimate of savings, the implementation team withholds some eligible enrolled customers to serve as a control group. The implementers and evaluators use the control group to estimate the baseline for treatment participants (i.e., the hourly demand the treated participants would have used in absence of the program). However, evaluators often use alternative methods to estimate savings. For example, evaluators can estimate savings without a control group by creating a quasi-experimental control group from nonparticipants or simply using non-event days with similar weather conditions to estimate baseline usage.

- Georgia Power should discuss with stakeholders how best to estimate DR costs. Because many DR participants already own their smart thermostat, the societal cost for DR might only reflect the program administrative and implementation costs and no or limited incremental cost for the customer. For example, some states are considering the incremental cost to be 75% of the incentive amount. Georgia Power should discuss what costs are most appropriate to use for Georgia Power's DR cost-effectiveness tests.

- Georgia Power should consider including energy savings benefits in their cost-effectiveness tests. While the DR program energy savings per participant are relatively low (e.g., 0.53 kWh/event per participant in winter and 0.98 kWh/event per participant in summer), Georgia Power could consider including these savings in the Temp✓ program's benefits to improve the program's cost-effectiveness. Similarly, because the Home Energy Improvement Program evaluation excluded these event days in their analysis, it would not double count savings.

- Georgia Power should discuss with stakeholders how best to account for participation over time for DR programs. The Temp✓ program enrolled additional customers throughout the five events included in this evaluation, and in this report, the evaluation team presents the delivered savings during those events based on the level of participation at the time of those events. However, in an avoided capacity framework, Georgia Power may want to consider the program benefits relative to the total capacity the program has accrued at the end of a planning cycle (including additional enrollment throughout the program period) rather than the program's savings during past events with past enrollment levels.

- More generally, should Georgia Power and their stakeholders update the DR cost-effectiveness methods in Georgia, they can reference factors being considered in other states. The primary benefit of improving the accuracy of DR cost-effectiveness methods is to improve DR portfolio planning and decision making. Georgia Power should use DR cost-effectiveness methods that best meet the needs of Georgia ratepayers. Should they update their DR cost-effectiveness methods, they can reference the list of factors identified in this report as being considered in other states and identify updates that represent the appropriate balance of effort and value for Georgia ratepayers.

Conclusion 3: The demand response events do not drastically affect treatment participating customers' comfort or routines.

While most treatment participating customers (~60%) recall the event, they reported that there is little to no effect on their comfort or routine. In addition, we would expect that a larger proportion of treatment participants would recall the event if there were extreme adverse effects. When respondents report negative effects of the event it often revolves around health issues.

Recommendations:

- When recruiting new participating customers in this program, consider including participant testimonials to highlight the fact that the program is relatively low impact and that when issues arise, it is easy to override an event. This type of information might alleviate stress for potential customers. In addition, consider highlighting the number of events a season they may experience. While there could be a certain number of events called, given the RCT structure of the program, not all enrolled customers will participate in every event.

Conclusion 4: Customers may be unaware of the program details like how to opt out of the program or the benefits to them.

Survey respondents who adjusted the temperature of their thermostat during the event did not know that that they were opting out of the event. We have found similar responses in other Georgia Power DR programs. In addition, we found that respondents were motivated by potential energy savings on their bill, even though Georgia Power does not advertise energy savings from this program. Finally, nearly a quarter of participants said the program did not work as they originally expected, or they were unsure whether the program worked as they originally expected, indicating that participants may need more information on how the program works during the enrollment process.

Recommendations:

- **Ensure that program details about customer benefits are clear in the marketing and enrollment materials.** Language on the Georgia Power program page describes grid-level savings, but potential customers may not understand that the savings will not be reflected on their bill. Consider conducting research surrounding the program language about savings and benefits. Research could include interviews, focus groups, or A/B testing to understand how to best communicate the purpose of the program and how it will individually benefit participants. Per program staff, they have reviewed and changed the messaging to clarify expectations for customers.
- **Ensure that program instructions are clear in event notifications.** Participants may need a bit more help understanding how to opt out of the event and a clearer definition of what it means to opt out. Consider conducting research surrounding this language and the timing of providing these definitions and instructions. For example, it may be helpful to provide an opt-out refresher in the email notifying people of the events. Per program staff, this language was updated prior to the summer 2021 season to provide customers with more information regarding the events, maximize their comfort, and minimize any questions or concerns.

Conclusion 5: The evaluation team found that savings per treated participating customer were relatively stable across several customer characteristics.

The evaluation team investigated the impact of thermostat brand, customer bill tariff, and HVAC type (where available) on savings, and found relatively stable results – the savings did not vary greatly across these characteristics.

Recommendations:

- **Georgia Power program managers could expect similar savings per treated participating customer in future years if they choose to maintain the current design.** The savings per treated participating customer are relatively high and stable. Furthermore, the evaluation team did not find groups of low or high savers in our research. As such, it seems likely Georgia Power would achieve similar results in future years under this current design.

Conclusion 6: About half of enrolled Temp✓ program participating customers and devices completed the event algorithms.

The nature of participation is somewhat unique for DR programs. While over 14,000 Georgia Power customers enrolled in the Temp✓ program with almost 19,000 devices by the event January 29, 2021, only about 6,800 customers completed the event algorithms. Adding complexity, some customers who did not complete the event algorithms still achieved demand savings. Customers commonly do not complete the event algorithms in demand response programs, where they may be excluded during the implementer’s processes as well as due to customers' actions and device settings. However, there are opportunities for program managers and implementers to improve the percent of enrolled devices that complete the event algorithms moving forward.

Recommendations:

- Georgia Power should consider working with stakeholders to allow Georgia Power to claim benefits from the control group, or if not, requesting the implementers forego withholding the control group to enable a higher proportion of enrolled devices to contribute to the program savings. While the control group enables the implementer and evaluators to estimate savings more accurately, the added level of accuracy is most valuable while the program launches and foregoing the control group moving forward could enable Georgia Power to claim greater program savings in future years with the same number of enrolled customers and devices.
- Georgia Power should consider requesting the implementers identify enrolled customers or devices that are routinely unable to participate in events. Some DR enrolled devices may routinely be unable to contribute to program savings, for example, due to ongoing connectivity issues. Program managers and implementers could consider contacting these customers and requesting the customers reconcile the issues. To motivate customers to act, program managers could consider providing seasonal incentives to customers who are actively participating in events.

Conclusion 7: Ecobee may be implementing preconditioning algorithms outside of the program's expectations.

Ecobee customers' usage data indicates that their thermostats are implementing preconditioning in one hour immediately preceding the shed portion of the event, while Sensi and Nest thermostats are implementing preconditioning over multiple hours, as documented in the implementers' program data.

Recommendations:

- Georgia Power and the Temp✓ program implementers should consider discussing whether the ecobee preconditioning algorithms warrant updates. Ecobee thermostats appear to be implementing preconditioning unexpectedly, which is leading to high demand increases in the hour preceding the shed portion of the event. However, Georgia Power and the implementer should determine the priority for addressing this. Georgia Power claims savings for this program based on demand reduction during the shed portion of the event, which is not heavily affected by ecobee's preconditioning algorithms.

3. RESIDENTIAL SPECIALTY LIGHTING

Program Design and Delivery

The goal of the Residential Specialty Lighting program is to reduce overall energy use of Georgia Power customers, as well as their peak demand contributions, by promoting the adoption of LED lighting. The program relies on a network of participating retailers, food bank distributions, and the Georgia Power Online Marketplace. In addition to discounting the purchase price of lamps, the program includes a marketing campaign designed to increase awareness and acceptance of efficient lighting products.

The Residential Specialty Lighting program incentivizes several types of bulbs, used in different fixtures and applications. For the purposes of this report, we report differences across bulb types where notable, and define them as such:

- Standard Lamps: This refers to standard, pear-shaped lightbulbs used in general lighting applications (such as a table lamp) and account for around 70% of the installed lighting in the residential sector. This report will refer to them as “standard” lamps, but they are often also referred to as A-lamps, A-shape or A-line bulbs, and general service lamps (GSLs).
- Specialty Lamps: This refers to more specialized bulb shapes (such as globes and candelabras) which are used in specific fixtures or applications (such as bathroom vanity lighting, or dining room candelabras). These lamps account for approximately 15% of residential lighting in the residential sector.
- Reflector Lamps: This refers to common cone-shaped lightbulbs most typically used in track lighting and "recessed can" light fixtures. The bulb is lined with reflective coating to direct the light. These lamps account for approximately 15% of residential lighting in the residential sector.

In 2020, the Residential Specialty Lighting program provided incentives on nearly 700,000 LED lamps in retail stores and distributed another 169,200 LED lamps through select Georgia food bank partners. Additionally, the program supported approximately 67,400 LED lamps through the Georgia Power Marketplace. In total, the Residential Specialty Lighting program claimed 935,822 LED lamps during the 2020 program year. Figure 27 shows the geographic distribution of these bulbs by zip code.[28]

[28] For retail lighting, Figure 27 shows the zip code of the retail storefront. The service zip code of the purchaser is not collected.

The In-Store Retail Component of the Specialty Lighting program was not active for the first quarter of 2020 due to delays selecting an implementation contractor and negotiating memoranda of understanding with retailers; however, the Marketplace component was active as of the beginning of 2020. The COVID-19 pandemic unfolded around the same time the retail program launched in spring 2020 and led to several design changes. The intent of the program was initially to focus on specialty bulbs, but program strategy was intentionally adjusted to incentivize more standard lamps and achieve a larger volume of energy savings. These adjustments helped to offset reduced activity in other residential programs due to COVID-19 safety considerations and to minimize the shortfall in 2020 residential class energy goals.

Table 39 shows the distribution of program lamps by retailer and lamp type. Notably, Table 39 shows that most of the bulbs claimed by the Residential Specialty Lighting program were standard bulbs (66%) rather than specialty (20%) or reflector bulbs (14%). The intent of the program was to focus on specialty bulbs. This was in response to the planned Energy Independence and Security Act (EISA) 2020 backstop, which was scheduled to impose a federal minimum energy efficiency standard of 45 lumens per watt for all general service lamps (GSLs), a category that includes standard lamps. In September 2019, however, the US Department of Energy (DOE) issued a Notice of Proposed Determination stating that the backstop provision would not be enacted. There are legal challenges to the reversal, as well as recent developments (in summer 2021) by the DOE that indicate the backstop will likely be reinstated, but resolution will undoubtedly take time (see Appendix 3B: Recent Developments Regarding EISA Under the Biden Administration for more information). Therefore, for the 2020 – 2022 cycle, Georgia Power's residential lighting efforts included markdowns of standard lamps as well as non-standard LED products (i.e., specialty bulbs and reflectors).

Reported gross energy and summer peak demand savings for the Residential Specialty Lighting program total 34,566 MWh and 3,979 kW respectively.

Figure 27. Distribution of Program Lamps by Zip Code

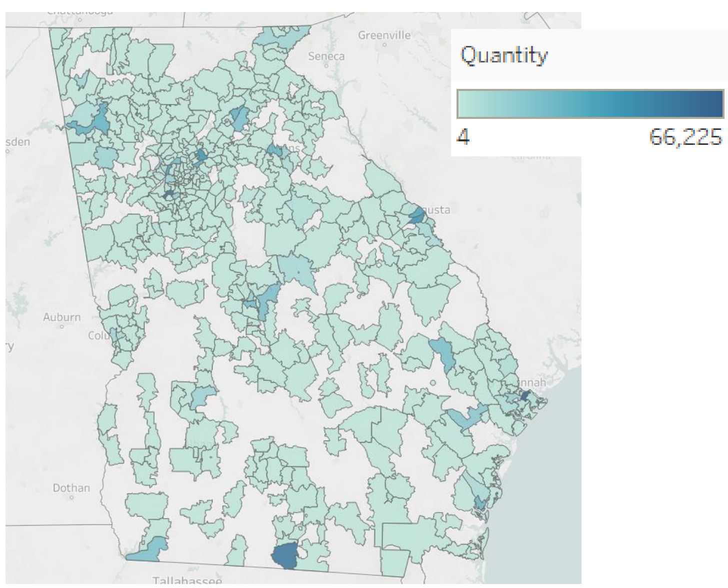


Table 39. Distribution of Program LEDs by Retailer and Lamp Type

RETAILER	REFLECTOR	SPECIALTY	STANDARD	TOTAL	SHARE
The Home Depot	52,233	60,240	93,656	206,129	22.0%
Food Banks	--	--	169,200	169,200	18.1%
Costco	24,438	37,644	56,724	118,806	12.7%
Walmart	8,050	35,672	60,364	104,086	11.1%
Habitat Restore	11,240	6,273	72,552	90,065	9.6%
Online Marketplace	8,060	7,737	51,594	67,391	7.2%
Target	6,053	8,212	37,158	51,423	5.5%
Sam's Club	5,596	2,496	28,516	36,608	3.9%
Ace Hardware	3,095	9,843	20,639	33,577	3.6%
Dollar Tree	4,708	3,366	17,270	25,344	2.7%
Lowe's	8,762	8,162	--	16,924	1.8%
Independents	570	1,897	6,456	8,923	1.0%
True Value	407	1,374	4,345	6,126	0.7%
Dollar General	--	--	1,220	1,220	0.1%
Total	**133,212**	**182,916**	**619,694**	**935,822**	**100.0%**

Implications of the COVID-19 Pandemic

The evaluation team recognizes that this evaluation occurred during a timeframe in which the COVID-19 pandemic impacted daily life for residential customers in Georgia. The Specialty Lighting program was able to operate relatively normally during the pandemic in 2020 and 2021, with LEDs distributed through food banks and discounted LED lighting offered through both the in-store upstream retail and Online Marketplace channels throughout the pandemic. As shown below, the Specialty Lighting program overachieved its original goals in 2020. This was largely due to intentional program strategy adjustments that were put in place to mitigate disruptions caused by COVID-19 to the residential class and other residential programs in the portfolio. Georgia Power adjusted the original 2020 target of 18,031,408 kWh to 33,591,498 kWh following discussions with PSC staff early in the pandemic.

Evaluation, research, and analysis nearly always have the potential for introduced and inherent biases and exogenous factors that may influence results. Ideally, evaluators attempt to control for these factors in analyses, such as through sample design. Where controlling for them is not possible, evaluators will attempt to identify and characterize the factors that may have influenced evaluation results. For all program evaluations conducted this cycle, the evaluation team has carefully considered possible ways the unprecedented events of the COVID-19 pandemic and related factors may have impacted our results. There is much that is still unknown about how the COVID-19 pandemic has influenced household energy use and behavior in the US, and it is likely that the pandemic has affected households differently depending on household size, location, employment status, and other demographic factors (such as income, race, age, etc.). Additionally, whether and at what speed these factors return to pre-2020 conditions are occurring at varying degrees and speeds across different demographics and populations.

The evaluation team identifies two primary ways the COVID-19 pandemic may have impacted, and continues to impact, program evaluations for the Specialty Lighting program. First, the pandemic likely impacted customer energy consumption and end-use behavior, as people across the country adjusted to new routines such as remote work and virtual schooling. Some of the assumptions used by the evaluation team – such as lighting hours-of-use – were developed prior to the pandemic and are used as our current best-estimate. It is not yet known if or how these factors may have changed meaningfully for Georgia Power customers, especially for evaluation and future planning purposes. Given the longer-term effects of the pandemic across the US, Georgia Power may want to consider reassessing key customer operating characteristics and impact factors for future evaluations, where feasible and cost-effective given future measure contributions to the portfolio. This reassessment will allow Georgia Power to understand if current estimates remain accurate, especially if new economic realities such as remote work continue to persist.

Secondly, the pandemic may have impacted customer purchasing behavior, with fewer customers shopping in-person especially during the early days of the pandemic. The Specialty Lighting program includes both online and in-person channels to participate, and in-person retail channels such as hardware, home improvement, big box, and grocery stores have all remained open as essential services. The evaluation team conducted interviews with retail managers in late 2020 as part of the shelf-stocking research, and in general retail managers indicated that aside from the spring of 2020, shopping patterns and sales remained relatively similar (if not slightly increased) compared to past years. However, given the unprecedented nature of the pandemic, there may be factors or considerations (such as shipping timelines) that are not measurable or quantifiable by the bounds of this evaluation, and therefore, all results of evaluations completed during this timeframe should be interpreted with this in mind.

Program Performance

Table 40 summarizes energy and summer peak demand savings delivered by the Residential Lighting program, including program savings goals, and Table 41 shows the distribution of savings by program component (retail, Marketplace, and food bank distributions).

Table 40. Residential Lighting Program Savings, PY2020

METRIC	TIME PERIOD	GROSS SAVINGS GOAL	REPORTED SAVINGS	VERIFIED GROSS SAVINGS	VERIFIED NET SAVINGS	REALIZATION RATE
Electric Energy Savings (MWh/yr.)	2020	18,031	34,566	32,821	11,784	95%
Summer Peak Demand Reduction (kW)	2020	92	3,979	4,728	1,664	119%

Table 41. Residential Lighting Program Savings by Component, PY2020

PROGRAM COMPONENT	REPORTED GROSS		VERIFIED GROSS		VERIFIED NET	
	ENERGY SAVINGS (MWH/YR.)	SUMMER PEAK DEMAND SAVINGS (KW)	ENERGY SAVINGS (MWH/YR.)	SUMMER PEAK DEMAND SAVINGS (KW)	ENERGY SAVINGS (MWH/YR.)	SUMMER PEAK DEMAND SAVINGS (KW)
Retail Lighting	26,579	3,000	26,208	3,840	6,674	978
Marketplace	2,415	284	2,017	271	514	69
Food Banks	5,572	695	4,597	617	4,597	617
Total	**34,566**	**3,979**	**32,821**	**4,728**	**11,784**	**1,664**

Table 42 outlines the verified gross and NTG adjustment factors, and Table 43 shows these factors by program component. Realization rates and NTG ratios are a function of verified gross and net savings, the derivation of which is discussed later in this chapter.

Table *42*. Residential Lighting Program Adjustment Factors, PY2020

METRIC	REALIZATION RATE (%) [a]	NTG (%) [b]
Electric Energy Savings	95%	36%
Summer Peak Demand Reduction	119%	35%

*[a] Realization Rate is defined as **verified** gross savings divided by **reported** savings.*

*[b] NTG is defined as **verified** net savings divided by **verified** gross savings.*

Table *43*. Residential Lighting Program Adjustment Factors by Program Component, PY2020

COMPONENT	METRIC	REALIZATION RATE (%) [a]	NTG (%) [b]
Retail Lighting	Electric Energy Savings	99%	25%
	Summer Peak Demand	128%	25%
Marketplace	Electric Energy Savings	84%	25%
	Summer Peak Demand	96%	25%
Food Banks	Electric Energy Savings	83%	100%
	Summer Peak Demand	89%	100%

[a] *Realization Rate is defined as* ***verified*** *gross savings divided by* ***reported*** *gross savings.*

[b] *NTG is defined as* ***verified*** *net savings divided by* ***verified*** *gross savings.*

Research Questions

This section provides the research questions for the evaluation of the Residential Specialty Lighting program. These research questions guided the direction of this program's evaluation activities, including the focus of the data collection activities.

Impact Questions

- Are the per-unit savings assumptions (as shown in Table 44) accurate? If not, how, or why should they be adjusted?
- How did the program perform against participation and savings goals (as shown in Table 44)?
- How many efficient LED bulbs would have been sold in Georgia absent Georgia Power's Specialty Lighting program? How effectively is the program influencing customer decision-making around efficient lighting?
- Are there other high efficiency lighting products or delivery mechanisms that should be added to this program to get deeper savings?

Process Questions

- Does the shift in program focus to specialty lighting have any implications on the delivery of the program from the perspective of program staff and implementers?
- How have other program changes (new program implementer, adjusted retailer focus, etc.) affected program delivery?
- Are customers who use the Online Marketplace satisfied with their experience? How did they learn about the program and what influenced their decisions to purchase lighting on the Marketplace?
- Given the uncertainty surrounding the EISA backstop, what is the current and future role of GSLs? Is the logic behind the Specialty Lighting program appropriate and effective?

Impact Evaluation

Verified Gross Impacts

This section details each step of the impact evaluation and its associated electric energy savings, summer peak demand reduction, and winter peak demand reduction.

Approach

The verified gross savings analysis for the Residential Specialty Lighting program relied largely on a desk review of savings calculations and the underlying parameters that fed into the calculations. Savings algorithms and key impact factors are discussed below with additional detail located in Table 44.

The high-level energy savings calculation for calculating savings from efficient lighting is as follows:

$$Savings = (Baseline\ Wattage - Efficient\ Wattage) * Annual\ Hours\ of\ Use$$

For LED lightbulbs that moved through Georgia Power's Specialty Lighting program, the efficient wattages were known with certainty. However, due to the nature of the program, baseline wattages were not known, nor were annual hours of use. Thus, estimating savings required making assumptions about baseline wattages and hours of use. Additionally, the savings calculation should also account for:

- Cross-sector sales. Some program-supported bulbs are installed in commercial sockets rather than residential sockets. This is important because hours of use tend to be higher in commercial sockets.
- In-service rates. Some program-supported bulbs end up in storage rather than in a light socket. Bulbs in storage do not produce any energy savings. In this context, an in-service rate (ISR) represents the percentage of bulbs that end up in sockets within a given timeframe.
- Interactive effects. LEDs produce less waste heat than inefficient bulbs. This reduces air conditioning loads in the summer (less heat to reject) and increases heating loads in the winter.

Table 44 shows the specific savings calculations used for verified gross energy and peak demand savings. Notably, there are separate formulas for residential sockets and commercial sockets. We assumed that all bulbs distributed through food banks and LEDs sold through the Online Marketplace were installed in residential sockets. For all other bulbs, we calculated savings under both residential and commercial operating parameters, and then took a weighted average of the resulting savings values using the cross-sector sales rate. The cross-sector sales rate, as well as all other key impact factors, is discussed briefly in Table 45 and in more detail in Appendix 3. – Residential Specialty Lighting.

Table 44. Savings Algorithms

METRIC	SOCKET	ALGORITHM
Energy Savings	Residential	$kWh = Qty * \frac{Watts_{Baseline} - Watts_{Efficient}}{1{,}000} * HOU_R * 365.25 * ISR * HVAC_E$
	Commercial	$kWh = Qty * \frac{Watts_{Baseline} - Watts_{Efficient}}{1{,}000} * HOU_C * 365.25 * ISR * HVAC_E$
Summer Peak Demand Savings	Residential	$kW = kWh * ETDF_S * HVAC_{D\_S}$
	Commercial	$kW = Qty * \frac{Watts_{Baseline} - Watts_{Efficient}}{1{,}000} * ISR * HVAC_{D\_S} * CF_S$
Winter Peak Demand Savings	Residential	$kW = kWh * ETDF_W * HVAC_{D\_W}$
	Commercial	$kW = Qty * \frac{Watts_{Baseline} - Watts_{Efficient}}{1{,}000} * ISR * HVAC_{D\_W} * CF_W$

Table 45. Key Impact Factors

IMPACT FACTOR	EVALUATION APPROACH	VALUE
$Watts_{Baseline}$	Conducted a review of the census of program-supported LEDs on the ENERGY STAR® Qualified Products List. Mapped LED products to appropriate baseline wattage using style, application, base, and lumen output.	Variable
$Watts_{Efficient}$	Pulled efficient wattages from the ENERGY STAR® Qualified Products List for all program-supported LEDs.	Variable
Cross-Sector Sales	Conducted a literature review of national cross-sector sales research. Calculated the average cross-sector sales rate across the reviewed studies. Assumed LEDs purchased through the Online Marketplace or distributed through food banks stay in the Residential sector.	6.2%
Daily Hours of Use (HOU)	Used research from 2013 Georgia Power Light Meter Study and 2017 DSM Program Evaluation.	HOU_R: 2.62 HOU_C: 9.57
Summer and Winter Energy to Demand Factors (ETDF)	For residential, employed the ETDF values used in the 2017 evaluation, which were drawn from the load shape of a large southeastern state utility.[29] For commercial, used coincidence	$ETDF_S$: 0.0114% $ETDF_W$: 0.0172% CF_S: 57.4% CF_W: 43.1%

[29] The winter ETDF referenced in the 2017 evaluation indicates higher winter coincidence than summer. This is a driver for higher winter peak demand savings reported in this report.

IMPACT FACTOR	EVALUATION APPROACH	VALUE
and Coincidence Factors (CF)	factors from recommendations Nexant provided Georgia Power as part of the 2017 evaluation.	
Interactive Effects (HVAC)	Our team performed interactive effects modeling. These efforts are discussed in detail in Appendix 3A: Detailed Methodology We estimate separate factors for energy ($HVAC_E$) and summer/winter peak demand ($HVAC_{D\_S}$ and $HVAC_{D\_W}$).	$HVAC_E$: 0.98 $HVAC_{D\_S}$: 1.175 $HVAC_{D\_W}$: 0.849
In-Service Rate (ISR)	Conducted online surveys with participants who purchased LEDs through the Online Marketplace.	GSL: 85.2% Specialty: 86.3%
Where: R=Residential, C=Commercial, S=Summer, W=Winter, D=Demand, and E=Electric Energy		

Realization Rates

Table 46 and Table 47 compare the reported gross savings and verified gross savings for energy savings and summer peak demand savings respectively.[30]

Table *46*. Residential Specialty Lighting Program Reported & Verified Gross Electric Energy Savings, PY2020

COMPONENT	REPORTED ELECTRIC ENERGY SAVINGS (MWH/YR.)	VERIFIED GROSS ELECTRIC ENERGY SAVINGS (MWH/YR.)
Retail Lighting	26,579	26,208
Marketplace	2,415	2,017
Food Banks	5,572	4,597
Total Savings	34,566	32,821
Realization Rate		95%

[30] The summer peak period is defined as 4-5pm during July weekdays.

Table *47*. Residential Specialty Lighting Program Reported & Verified Gross Peak Demand Reduction, PY2020

MEASURE	REPORTED PEAK DEMAND REDUCTION (KW)	VERIFIED GROSS PEAK DEMAND REDUCTION (KW)
Retail Lighting	3,000	3,840
Marketplace	284	271
Food Banks	695	617
Total Savings	3,979	4,728
Realization Rate		119%

Table 48 shows the reported gross deemed savings and verified gross per-unit savings for standard, specialty, and reflector LEDs. The verified gross per-unit values reflect residential installations only (i.e., these values do not reflect cross-sector sales).[31]

Table *48*. Residential Specialty Lighting Program Reported & Verified Gross per-unit Savings Values, PY2020

MEASURE	UNIT OF MEASURE	REPORTED DEEMED SAVINGS			VERIFIED GROSS PER-UNIT SAVINGS		
		KWH	SUMMER KW	WINTER KW	KWH	SUMMER KW	WINTER KW
Standard LED	One lamp	32.9	0.0041	n/a	28.0	0.0038	0.0041
Specialty LED	One lamp	42.2	0.0045	n/a	31.1	0.0042	0.0045
Reflector LED	One lamp	48.3	0.0046	n/a	45.3	0.0061	0.0066

[31] For standard LEDs, per-unit assumptions that do reflect cross-sector sales are 33.1 kWh, 0.0048 kW in summer, and 0.0046 kW in winter. For specialty LEDs, these values are 36.4 kWh, 0.0053 kW, and 0.0050 kW. For reflector LEDs, these values are 52.9 kW h, 0.0077 kW, and 0.0073 kW.

Table 49 summarizes key realization rate drivers and their directional effect on the verified gross savings estimates.

Table 49. Realization Rate Drivers

TERM	VALUE	DIRECTIONAL EFFECT ON VERIFIED GROSS SAVINGS	REASONING
In-Service Rate	GSL: 85.2% Specialty: 86.3%	↓	A percentage of LEDs purchased end up in storage. Bulbs in storage do not produce savings.
Cross-Sector Sales	6.2%	↑	Some LEDs purchased at retail stores end up in commercial sockets rather than residential sockets. Commercial sockets tend to have greater hours of use, allowing for more annual savings.
Interactive Effects	Energy: 0.98	↓	See below.
	Summer Demand: 1.175	↑	LEDs produce less waste heat than inefficient bulbs. In the summer, air conditioning load is reduced because there is less waste heat to reject.
	Winter Demand: 0.849	↓	LEDs produce less waste heat than inefficient bulbs. In the winter, the heating system must make up for the heat not supplied by lightbulbs.

Net Impacts

In estimating net impacts, our goal is to understand the extent to which program marketing and incentives increased the adoption of efficient lighting among the Georgia Power customer base. Would program participants purchase LED lighting absent the program? Or did the program influence purchasing decisions?

To estimate a net-to-gross ratio, we used state-level lighting sales data purchased from the Consortium for Retail Energy Efficiency Data (CREED) LightTracker initiative to model the effect of state-level program efforts on shares of LED lighting technologies across the US. The sales data included all retail distribution channels. Bulbs distributed in conjunction with food bank partners are an income-qualified offering and received a net-to-gross ratio of one. This modeling leverages the fact that states have varying levels of program intensity, and the shares of the efficient bulbs purchased are higher in states with aggressive programs. Once the national regression model was estimated, we zeroed out program expenditures in Georgia to estimate the counterfactual—or what the share of LED bulbs would have been in the state absent program expenditures. The difference between this value and our estimate of LED share based on actual program expenditures is the program “lift.”

Data Sources

The evaluation team leveraged various data sources for the analysis, though it relied primarily on sales data prepared by CREED.[32] CREED LightTracker is a service that allows utilities and M&V contractors to share the cost of national lighting market research. LightTracker is CREED's first initiative, focused on acquiring full-category lighting data including incandescent, halogen, CFL, and LED bulb types, for all US distribution channels. CREED speaks as one voice for program administrators nationwide as they request, collect, and report on the lighting sales data needed by the energy efficiency community. Evaluation team member Demand Side Analytics has provided paid analysis and reporting services to the CREED LightTracker initiative since 2015.

The sales data come from two primary sources: point-of-sale (POS) state sales data (representing grocery, drug, dollar, discount, mass merchandiser, and selected club stores) and National Consumer Panel (NCP) state sales data (representing home improvement, hardware, online, and selected club stores). The CREED LightTracker initiative purchased raw datasets from third-party vendors and then cleaned and processed all data for analysis.[33, 34] Table 50 maps program retailers to the LightTracker data source.

Table 50. Map of Program Retailers to Data Source

RETAILER	DATA SOURCE
The Home Depot	Panel
Costco	Panel
Walmart	POS
Habitat Restore	Panel
Online Marketplace	Panel
Target	POS
Sam's Club	POS
Ace Hardware	Panel
Dollar Tree	POS
Lowe's	Panel
True Value	Panel
Dollar General	POS

[32] See https://www.creedlighttracker.com

[33] The information contained herein is based in part on data reported by IRI, Inc. through its Advantage service for, and as interpreted solely by LightTracker, Inc. Any opinions expressed herein reflect the judgment of LightTracker Inc. and are subject to change. IRI disclaims liability of any kind arising from the use of this information.

[34] Data presented include LightTracker calculations based in part on data reported by Nielsen through its Strategic Planner and Homescan Services for the lighting category for the 52-week period ending approximately on December 31, 2020, for the available state level markets and Expanded All Outlets Combined (xAOC) and Total Market Channels. Copyright © 2020, Nielsen.

Besides the sales data made available through LightTracker, the model inputs were a combination of program data collected by the evaluation team, as well as household and demographic data collected through various publicly available websites. A list of data sources for the primary model input data follows:

- National bulb sales
    - POS data (grocery, drug, dollar, discount, mass merchandiser, and selected club stores)
    - NCP data (home improvement, hardware, online, and selected club stores)[35]
- US Census Bureau import data (CFL and LED imports)
- DSM Insights, an E Source database of utility program data
- ENERGY STAR lighting program data (utility lighting program budgets)
- ENERGY STAR shipment data (released by the US Environmental Protection Agency)
- North American Electrical Manufacturers Association shipment data
- American Community Survey (ACS) data (household characteristics and demographic data)
- Retailer square footage per state (based on Internet searches)
- General population surveys, lighting saturation studies, and other secondary data collection made publicly available through evaluation reports

We describe the data sources in detail in Appendix 3A: Detailed Methodology (see the following sections: Lighting Sales, Program Activity, Presence and Absence of Retailers (Channel Variables), State-Level Household and Demographic Characteristics).

LED Lighting Market Shares in Georgia

As noted above, some of the key attributes the team developed include:

- Market share distribution: LED market share distribution for the US, Georgia versus the US, as well as across each state and across retail channels
- Program intensity: LED lighting market share relative to overall program expenditures per household
- Program incentives: Average LED lighting program incentives per bulb

Below we provide additional detail on each of these attributes of the lighting market.

Figure 28 shows the national market share of the four bulb types (incandescent, halogen, CFL, and LED) across the past six years. LEDs gained substantial market share, rising from 19% in 2015 to 70% in 2020. From 2015 to 2017, LEDs largely displaced sales of CFLs only. In 2018, LEDs began to displace inefficient bulbs. Even so,

[35] Also referred to as non-POS data.

inefficient lighting (incandescent bulbs and halogens) still represents almost a third of the lighting market.

Figure 28. Year-Over-Year Total US Market Share by Type

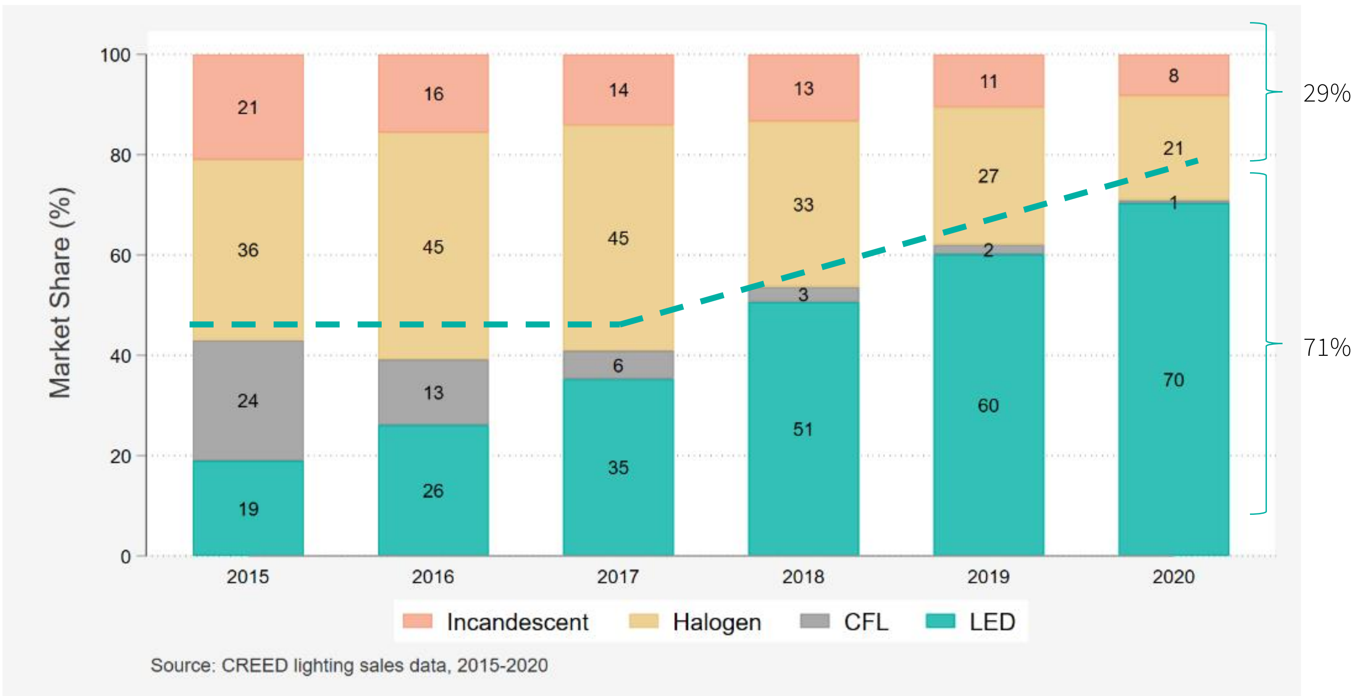


Figure 29 compares the data in Figure 28to Georgia market shares. LED market shares in Georgia have trailed national market shares by several percentage points each year. The trajectory in Georgia aligns with the trajectory observed in non-program states. As noted further below, upstream lighting program activity in Georgia is limited compared to most other program states.

Figure 29. Georgia, No Program, and Total US Year-Over-Year LED Market Share

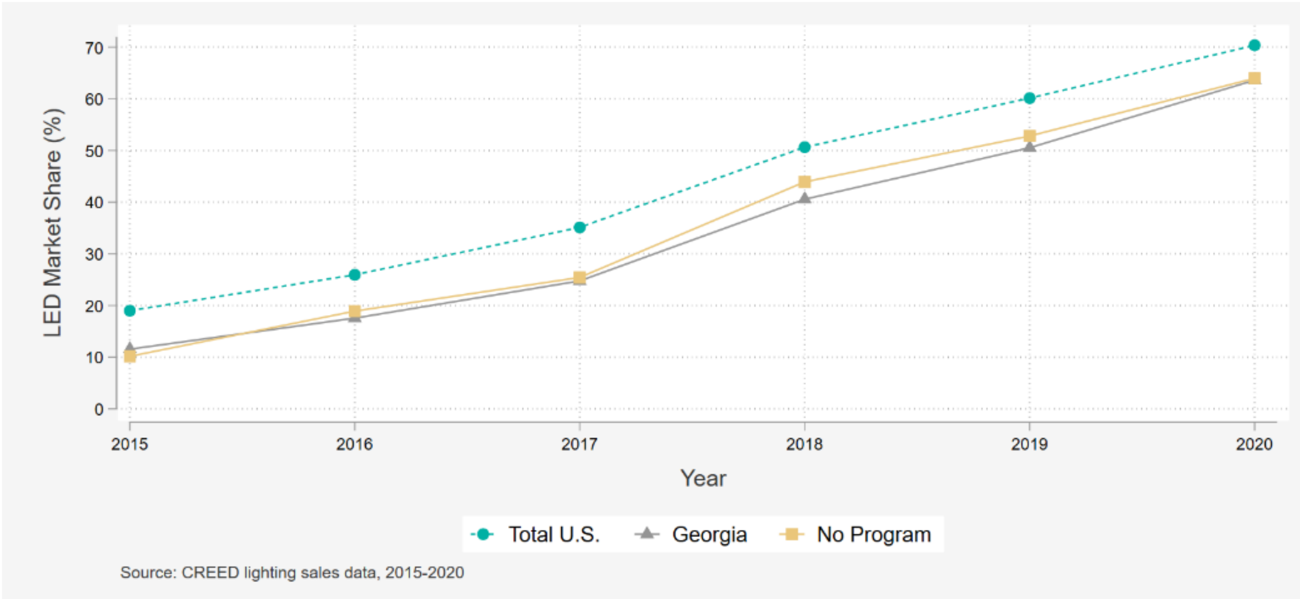


Figure 30 shows the LED market share by lamp style. Breakouts are shown for Georgia, no program states, and program states across 2019 and 2020.[36] The market shares differed substantially by style, with LEDs representing most of all bulb styles in 2020, even in states without programs, and most reflector lamps (92% in no program states). Georgia outpaced non-program states in only one lamp style – standard lamps.

[36] The "no program" states in 2020 are Alabama, Kansas, Kentucky, Mississippi, Nebraska, Tennessee, and Wyoming. Two prior non-program states—Virginia and Delaware—offered programs in 2020.

Figure 30. LED Market Share by Lamp Style (2019 – 2020)

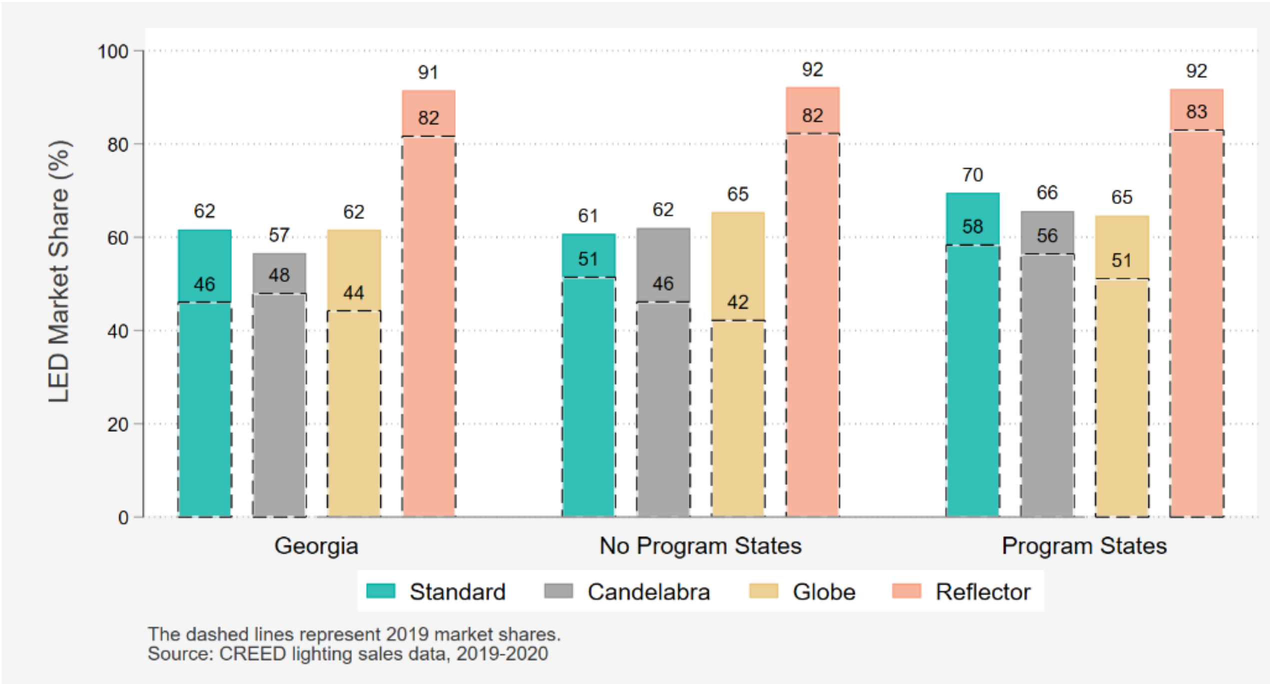
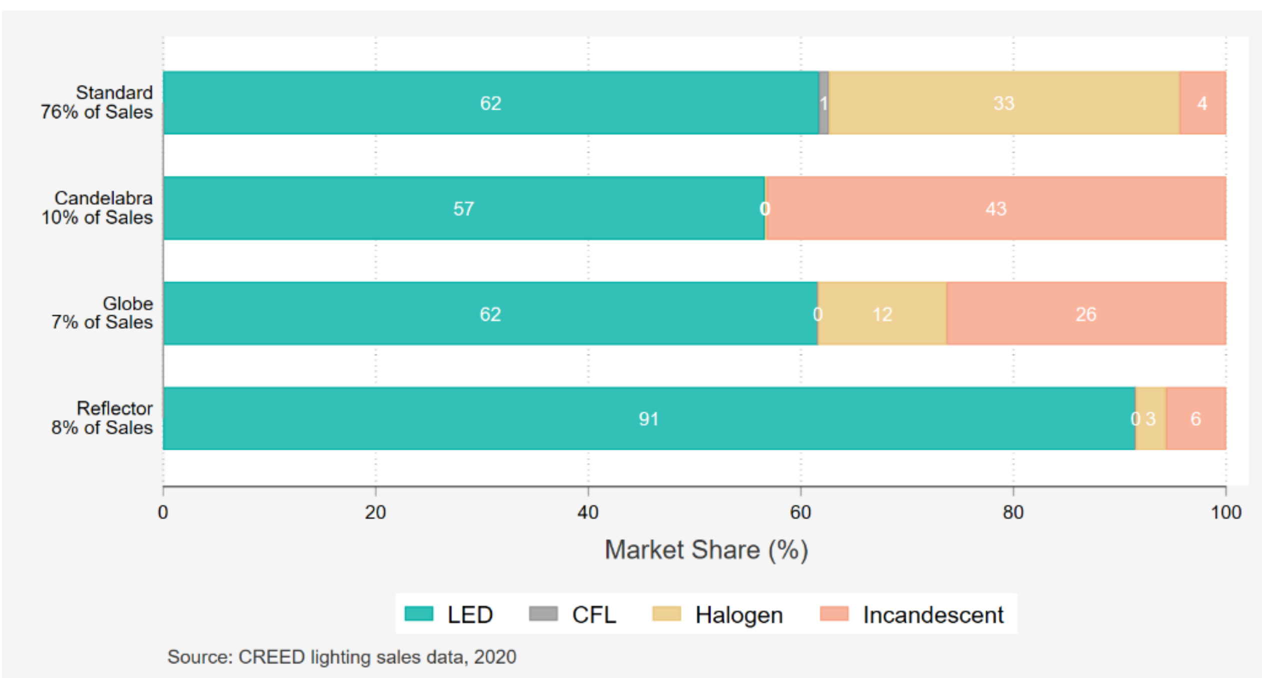


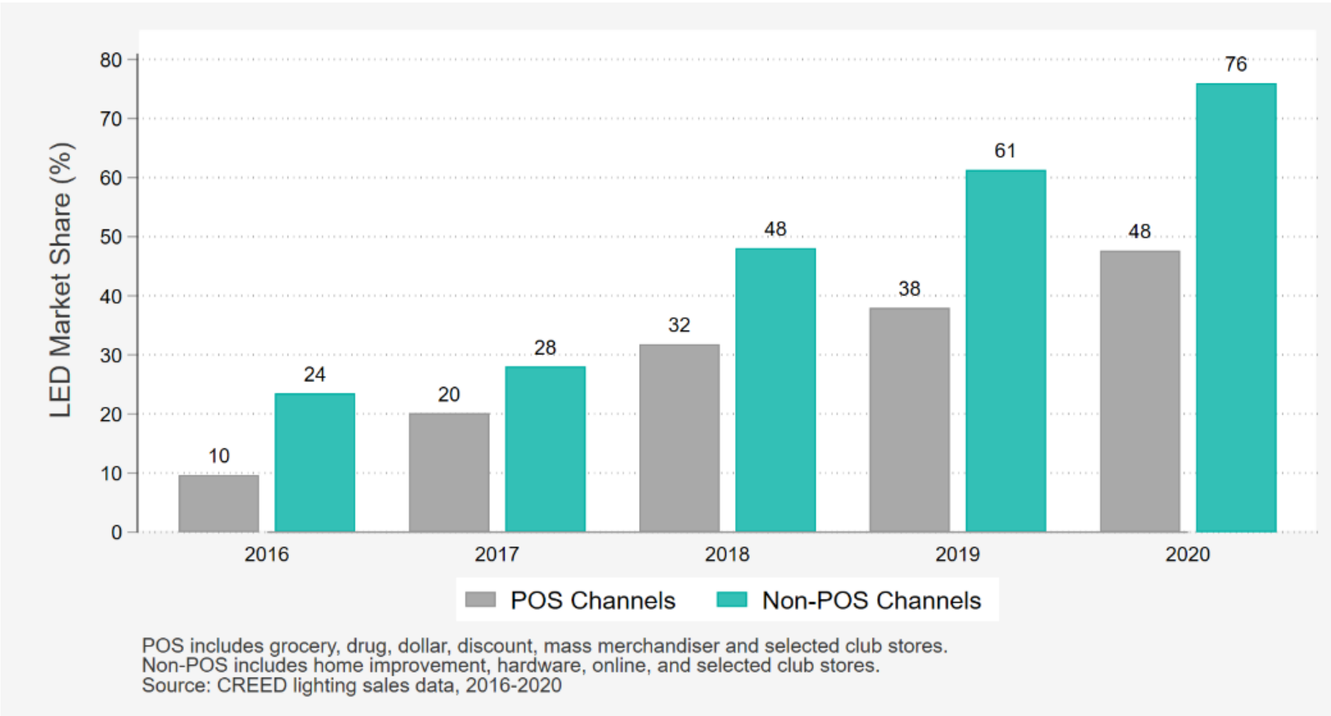
Figure 31 shows the distribution of bulb type by bulb style within Georgia. The overwhelming majority of standard non-LEDs sold were halogen lamps. For specialty and reflector bulbs, most non-LEDs sold were incandescent lamps.

Figure 31. Distribution of Bulb Type by Bulb Style (Georgia)



Analysis of the sales data model shows that market share for LEDs was greater in the non-POS retail channels than the POS retail channels.[37] As shown in Figure 32, LED market share increased in both retail channels since 2016 (10% to 48% in POS channels and 24% to 76% in non-POS channels).

Figure 32. Georgia LED Market Share by Retail Channel Year-Over-Year



Program Activity

Figure 33 shows the state-level LED share as a function of program activity (program state or non-program state). In 2020, there were seven states in the non-program bin. This figure shows that LED share was higher in program states, although the relative percent difference decreased considerably over the years (the relative difference was (29%-20%)/20% = 45% in 2016 and 13% in 2020). Additionally, LED share in non-program states typically lagged LED share in program states by about one year (e.g., in 2018 the average LED market share in program states was 52%, and in 2019 the non-program states had an LED market share of about 54%).

[37] In total, approximately 56% of Georgia bulbs are purchased in the non-POS channels.

Figure 33. Relationship between Program Spending and LED Sales

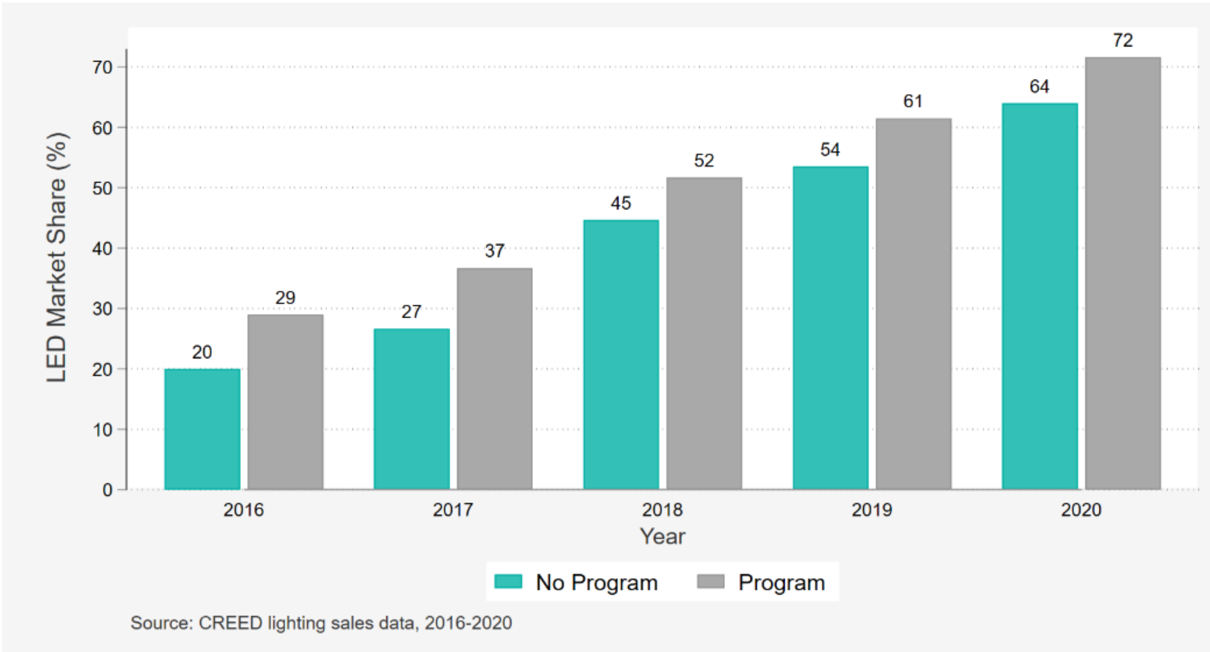
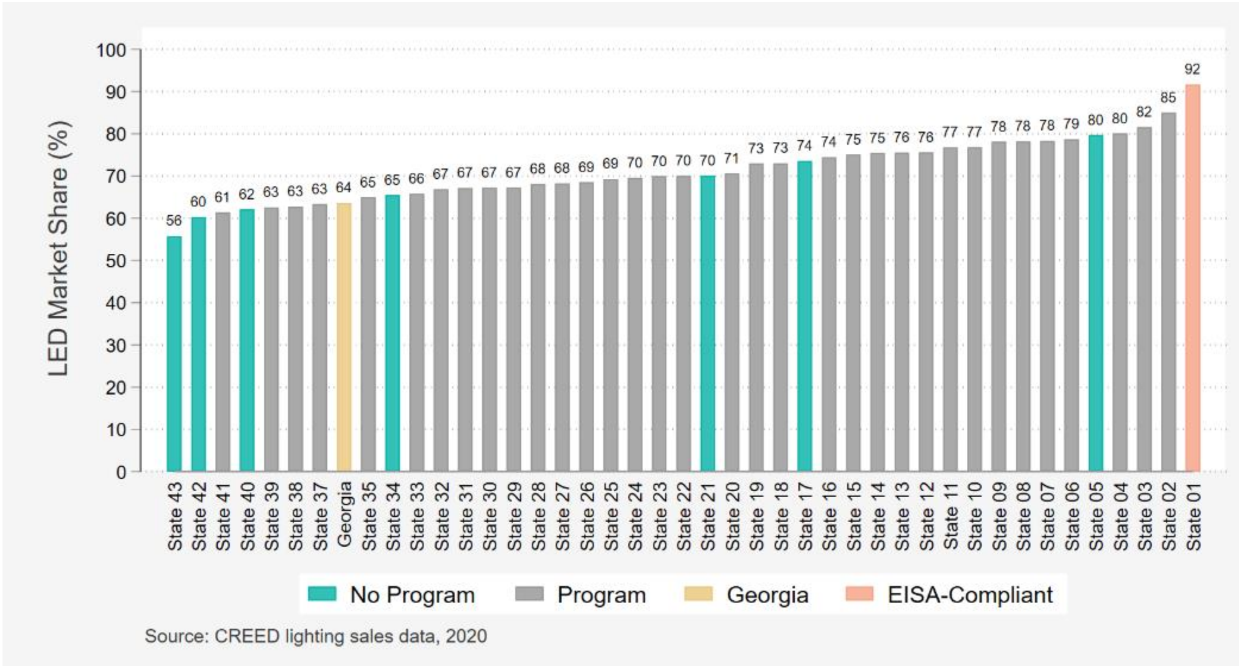


Figure 34 shows where Georgia was positioned in comparison to the modeled states when looking at LED sales. There are a handful of program states with low LED market shares, but the overall trend is clear: states with programs generally have higher LED market shares than states without lighting programs. Most of the non-program states had LED market share below 70% (the national market share).

Figure 34. LED Sales Distribution Across States (2020)



Program Intensity

Figure 35 shows the distribution of program-supported lamps per household for states in which the evaluation team had sufficient data. Georgia Power's Upstream Lighting program incented less than one LED lamp per household. This ranks well below the average (1.5 LEDs per household) and median (1.3 LEDs per household) values for the included states.

Figure 35. Average Number of Program Lamps per Household (2020)

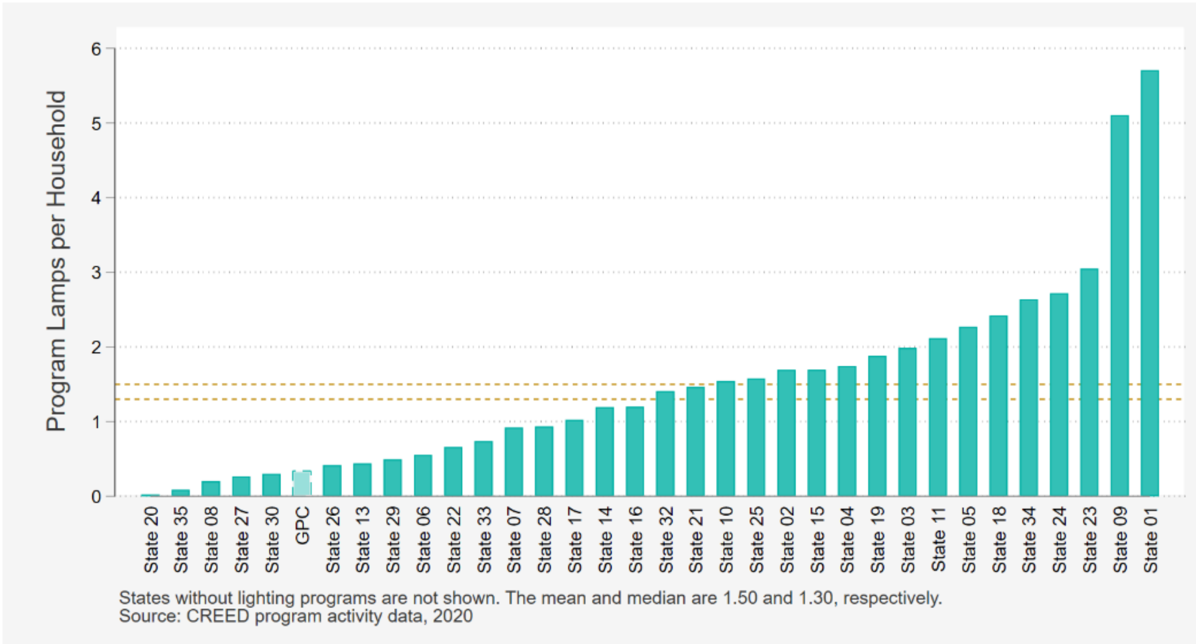
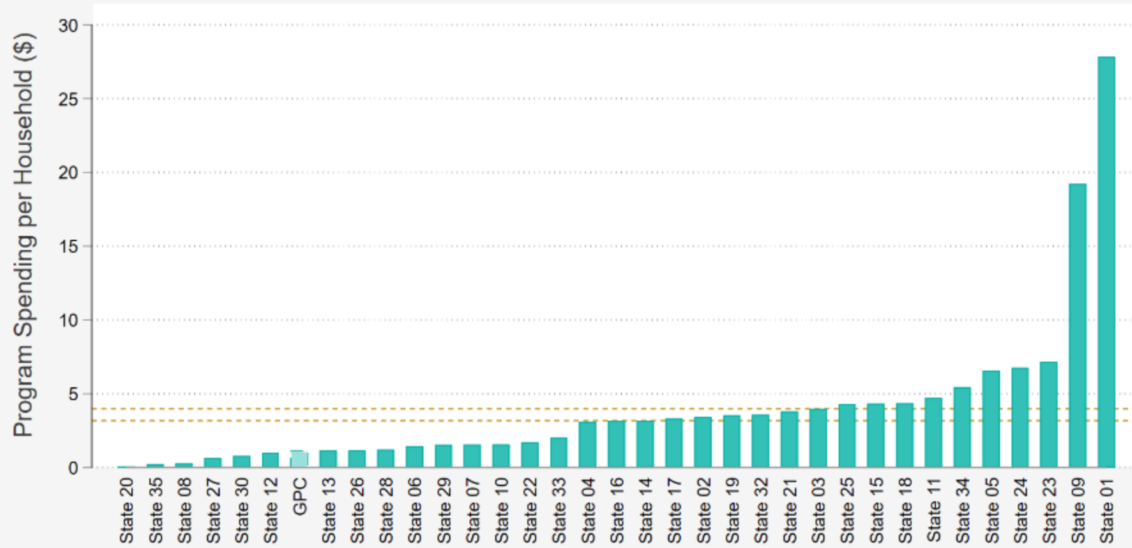


Figure 36 shows the distribution of program spending per household for states in which the evaluation team had sufficient data. In most states, upstream lighting programs spend fewer than $5 per household. Across states, the average and median values were $3.99 and $3.17 per household. Georgia Power's Residential Specialty Lighting program spent about $1 per household in 2020.

Figure 36. Average Program Spending per Household



States without lighting programs are not shown. The mean and median are $3.99 and $3.17, respectively.
Source: CREED program activity data, 2020

As shown in Figure 37, the evaluation team also compared the average incentive offered per LED across states in which LED incentive information was collected. A simple calculation of incentive dollars divided by bulb units yielded average incentives per state. In the states with sufficient data, LED incentives ranged from approximately $0.75 to $4.50 per LED bulb, with most of these states offering between $1 and $2 per LED. The mean and median LED incentives were $1.83 and $1.78, respectively. At around $1.00 per LED, Georgia Power falls on the lower end of the distribution.

Figure 37. Average Upstream Lighting Incentive Per LED (2020)

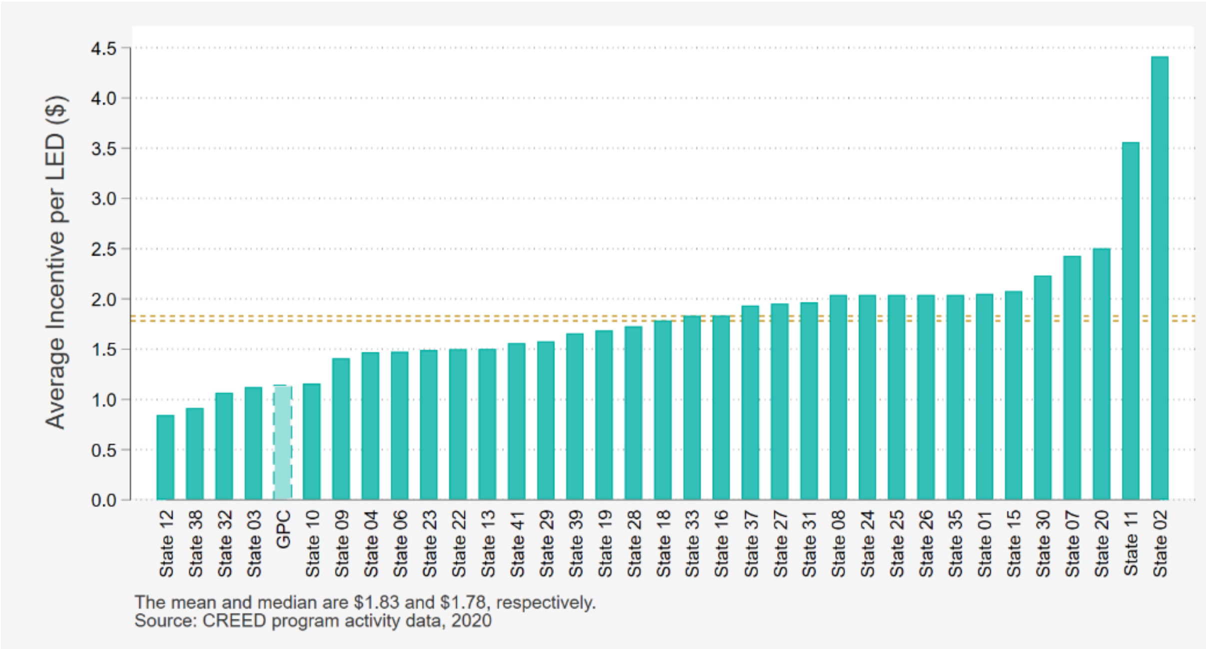
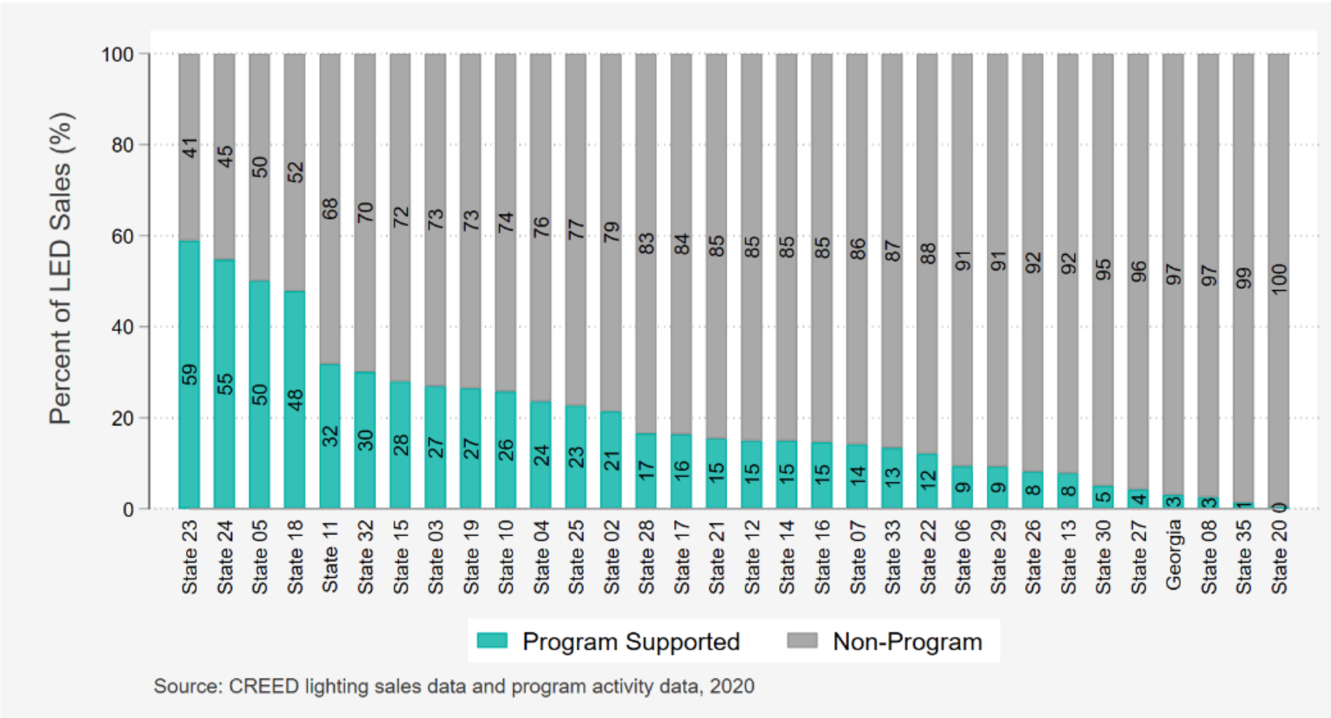


Figure 38 shows the percentage of LED sales, by state, incented by a retail or online marketplace lighting program (where this percentage is calculated by dividing the number of incented LED bulbs by the total LED bulbs sold in the state). Georgia falls on the low end of the distribution at 3%.

Figure 38. Percentage of LED Sales Supported by Upstream Lighting Program



It is clear from the data used for the national sales model that program spending was at least partially responsible for an increased market share of LED sales. Although these figures help illustrate program activity in relation to LED sales, the regression analysis provided information about what other factors could be influencing the market and provided a better understanding of the programmatic impacts.

Modeling Methods

This section serves as a high-level summary of the methods (see Appendix 3A: Detailed Methodology for greater detail on modeling methods). The primary objective of the national sales model was to quantify the impact of state-level retail lighting program activity on the sales of LEDs, while controlling for demographic, household characteristics, and retail channel variables that could affect consumers' uptake of efficient lighting products. In doing so, our team had several important decisions to make, namely:

- Which independent variables should be tested for inclusion in the model? The evaluation team considered the comprehensive set of variables listed in Table 51. In total, 36 different models were tested. We ultimately selected variables for inclusion in the model based on their statistical significance and ability to improve the model specification.
- For the program intensity variables, should we use a square root transformation? One of the key independent variables in this analysis is upstream lighting program spending per household. Figure 39 shows that the square root model tapers LED market share as the square root of

spending increases. This reflects diminishing returns in terms of market share as program spending increases and graphically provides a good fit for the data. Our final model used a square root transformation on the program age term but not the program spending term.

- **How should states be weighted in the model?** Weighting states equally ignores the fact that some states have greater populations and more bulb sales. Weighting states based on bulb sales may bias the results towards states with lower LED penetration, as higher LED penetrations lead to less socket turnover and therefore fewer bulb sales. Ultimately, our model used the number of households per state as the weight.

- **What should the functional form of the model be?** The dependent variable in this analysis – LED market share – is bounded above and below by 100% and 0% (i.e., a state cannot have greater than 100% LED market share or less than 0% market share). Due to this constraint, we could opt to use a beta regression model, or a similar model type built for such a constraint. Since the LED market share values only range from 56% to 85%, and program intensity and program age explain so much of that variation, the evaluation team elected to estimate the model using ordinary least squares (OLS) regression.

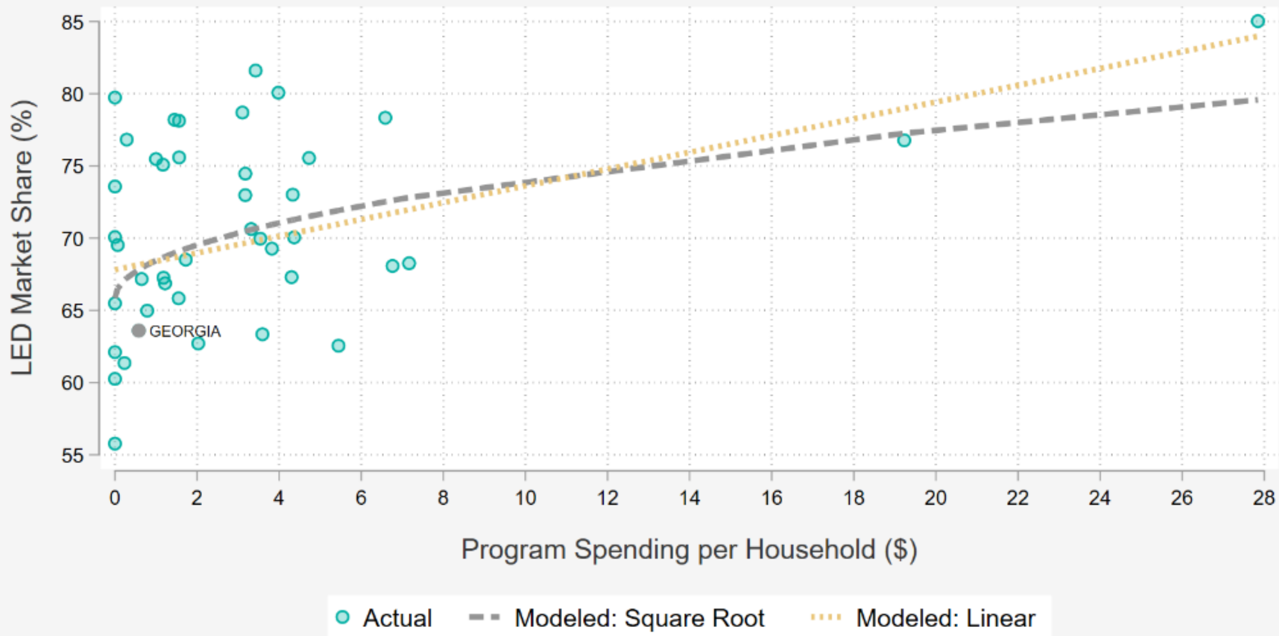
Table 51. Program Intensity, Channel, and Demographic Variable Descriptions

TYPE OF VARIABLE	DESCRIPTION
Program Intensity Variables	
Program Spending per Household$_i$	Total upstream program budget in state 'i' divided by the number of households in state 'i'.
SQRT (Program Spending per Household)$_i$	Square root of the program spending per household.
Program Age$_i$	Number of years program administrators in state 'i' have operated upstream lighting programs (CFL or LED).
SQRT (Program Age)$_i$	Square root of the program age.
Channel Variables	
Sq ft NonPOS per HH$_i$	The average non-POS retail square footage per household in state 'i.' Equal to non-POS square footage divided by the number of households in state 'i'.
Percent Sq ft NonPOS$_i$	The percentage of total retail square footage belonging to non-POS retailers in state 'i.' Equal to non-POS square footage divided by (POS sq ft + non-POS sq ft).
Sq ft POS per HH$_i$	The average POS retail square footage per household in state 'i.' Equal to POS square footage divided by the number of households in state 'i'.
EISA$_i$	An EISA indicator variable. Equal to 1 for states that have adopted EISA standards (California) and 0

TYPE OF VARIABLE	DESCRIPTION
	otherwise.
Demographic Variables	
Political Index$_i$	A state-level partisan voter index developed by Gallup [a] using presidential election voting results as a state-level partisan proxy. A higher than 1.0 value represents greater democratic influence and a value less than 1.0 indicates greater republican influence.
Average Electricity Cost$_i$	The state-level average residential retail rate of electricity sourced directly from the Energy Information Agency.[b]
Cost of Living$_i$	State-level cost of living indices developed by the Missouri Economic Research and Information Center.[c]
Percentage of Renters Paying Utilities$_i$	All these state-level demographic and household variables were derived from the most current US Census ACS.[d]
Median Income$_i$	
Percentage Owner Occupied$_i$	
Percentage of Population with College Degree$_i$	

a. http://news.gallup.com/poll/125066/state-states.aspx
b. https://www.eia.gov/electricity/data/state/
c. https://www.missourieconomy.org/indicators/cost_of_living/
d. http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t

Figure 39. Linear versus Non-Linear Modeling



Source: CREED lighting sales data and program activity data, 2020

Results

The following section presents the findings from applying the multivariate regression model.

Multivariate Regression Model

Because of the complexity of the relationships and numerous combinations of these channel, demographic, and household characteristic variables, the evaluation team tested several different model options. Across the models tested, program spending and program age were the two most significant predictors of LED market share. The regression coefficients for the program intensity variables, and subsequent estimates of the NTG ratio, proved relatively stable across many model specifications. Table 52 displays the relevant statistics for the 2020 model, which leveraged five explanatory variables: the square root of program age, program spending per household, the non-POS retail square footage per household, political index, and an EISA implementation indicator variable (equal to 1 for California and 0 otherwise).

Table 52. Model Summary Statistics (n = 43 States)

TERM	MODEL COEFFICIENT	P-VALUE OF COEFFICIENT
Model Intercept[38]	0.6700	0.000
Program Spending per Household	0.0063	0.015
Program Age (Square root)	0.0166	0.026
Non-POS Square Feet per Household	0.0252	0.071
Political Index	-0.1397	0.066
EISA Indicator Variable	0.2224	0.000
Model Adjusted R-squared	0.751	

There are a few potential limitations to the model that are worth noting. While the R-squared value of 0.751 is considered a reasonable fit, it is possible that the model omitted variables that might better explain LED market share. Also, the use of comparison states in the baseline does not reflect any potential interstate influence on non-program states. In other words, the efforts of Georgia Power, combined with the millions of dollars spent on lighting in other program states, may have impacted the retailer sales of lamps in non-program (or even moderate program) states (e.g., by creating improved economies of scale and reduced prices, improved supply chains, etc.). This would increase the baseline/comparison area sales and mean that the program spending coefficient was underestimated (and the resulting NTG would be a conservative estimate).

The positive and significant coefficient for program age indicates that prior program activity positively influenced current-year efficient market share. This may reflect several factors, including "momentum" in terms of customer awareness, education, and preference for efficient lighting, as well as retailer knowledge and promotion of efficient lighting. Program age might also be thought of as an indicator for market effects, meaning the portion of efficient lighting sales from potentially permanent changes in the market resulted from ongoing program activity.

NTG Estimates

The evaluation team's NTG calculations relied on comparing modeled LED market share with counterfactual LED market share. We estimated the counterfactual scenario using the model discussed in the previous section but with the program spending variable set to zero and the program age variable decremented by one year.

[38] The table also includes the model intercept, which describes the point at which the model intercepts the y-axis and does not have a meaningful interpretation.

The difference between modeled market share and counterfactual market share represents the program lift, or net increase in efficient bulb sales resulting from program activity. To convert the market share (percentage) lift into the lift in actual LED sales that were attributed to the program, we multiplied the market share lift by the total number of bulbs — for all bulb types — sold in 2020, as determined by the sales data analysis described above. This value represents the net impact of the program (i.e., the total lift in the number of LEDs sold), which the evaluation team then divided by the total number of program bulbs sold (the gross number of bulbs) to determine the NTGR:

$$NTGR = \frac{Lift\ in\ the\ number\ of\ LEDs\ sold\ in\ 2020}{\#\ of\ program\ incented\ LED\ bulbs\ sold\ in\ 2020}$$

Table 53 shows the NTG calculations. The counterfactual LED market share is 69.8% (row F). Converted to bulbs, the counterfactual scenario is 14,042,777 LED bulbs. With the program, the modeled LED market share is 70.7% (row G), or 14,238,000 LED bulbs. The lift resulting from the program is the difference of these two figures, or 195,223 LEDs (row J). Since the program claimed 766,622 LEDs in 2020, the NTG is 25.5% (the net lift in LED sales divided by the gross number of bulbs claimed). Note that food bank distributions are not included in the 766,622 program bulbs. LEDs distributed through food banks receive a NTGR of 100%.

Table 53. NTG Calculations

PROGRAM COMPONENT	GEORGIA POWER TERRITORY
Total Bulbs, All Technologies (A)	20,131,830
Program $ per HH Actual (B)	$1.12
Program $ per FF Counterfactual (C)	$0.00
Program Age Actual (D)	10
Program Age Counterfactual (E)	9
LED Market Share Counterfactual (F)	69.8%
LED Market Share Modeled (G)	70.7%
LED Quantity Counterfactual (H = A * F)	14,042,777 [a]
LED Quantity Modeled (I = A * G)	14,238,000 [a]
Net LEDs Modeled (J = I – H)	195,223
Program Bulbs 2020 (K)	766,622
NTGR Modeled (L = J / K)	25.5%

a. Values in this table may not sum or multiply exactly due to rounding.

Table 54 shows reported gross savings, verified gross savings, and verified net savings for Georgia Power's Residential Specialty Lighting program. The NTGR shown in Table 53 (25.5%) was applied to two of the three program components (Retail Lighting and the Online Marketplace). LEDs distributed through food banks received a NTGR of 100%. The program NTGRs for energy and summer peak demand are 35.9% and 35.2%, respectively. The following equation illustrates the calculation of the weighted average NTGR for energy across the Retail, Marketplace, and Food Bank components.

$$NTGR_{Energy} = \frac{6{,}674 + 514 + 4{,}597}{26{,}208 + 2{,}017 + 4{,}497} = 35.9\%$$

Table 54. Residential Lighting Program Savings by Component, PY2020

PROGRAM COMPONENT	REPORTED GROSS		VERIFIED GROSS		VERIFIED NET	
	ENERGY SAVINGS (MWH/YR.)	SUMMER PEAK DEMAND SAVINGS (KW)	ENERGY SAVINGS (MWH/YR.)	SUMMER PEAK DEMAND SAVINGS (KW)	ENERGY SAVINGS (MWH/YR.)	SUMMER PEAK DEMAND SAVINGS (KW)
Retail Lighting	26,579	3,000	26,208	3,840	6,674	978
Marketplace	2,415	284	2,017	271	514	69
Food Banks	5,572	695	4,597	617	4,597	617
Total	**34,566**	**3,979**	**32,821**	**4,728**	**11,784**	**1,664**
Total Combined Net-to-Gross (All Components)					**36%**	**35%**

Comparison to Prior Years

Using the model specification identified in Table 52, the evaluation team estimated NTGRs for Georgia Power's Upstream Lighting programs for 2017 to 2019. The results were as follows:

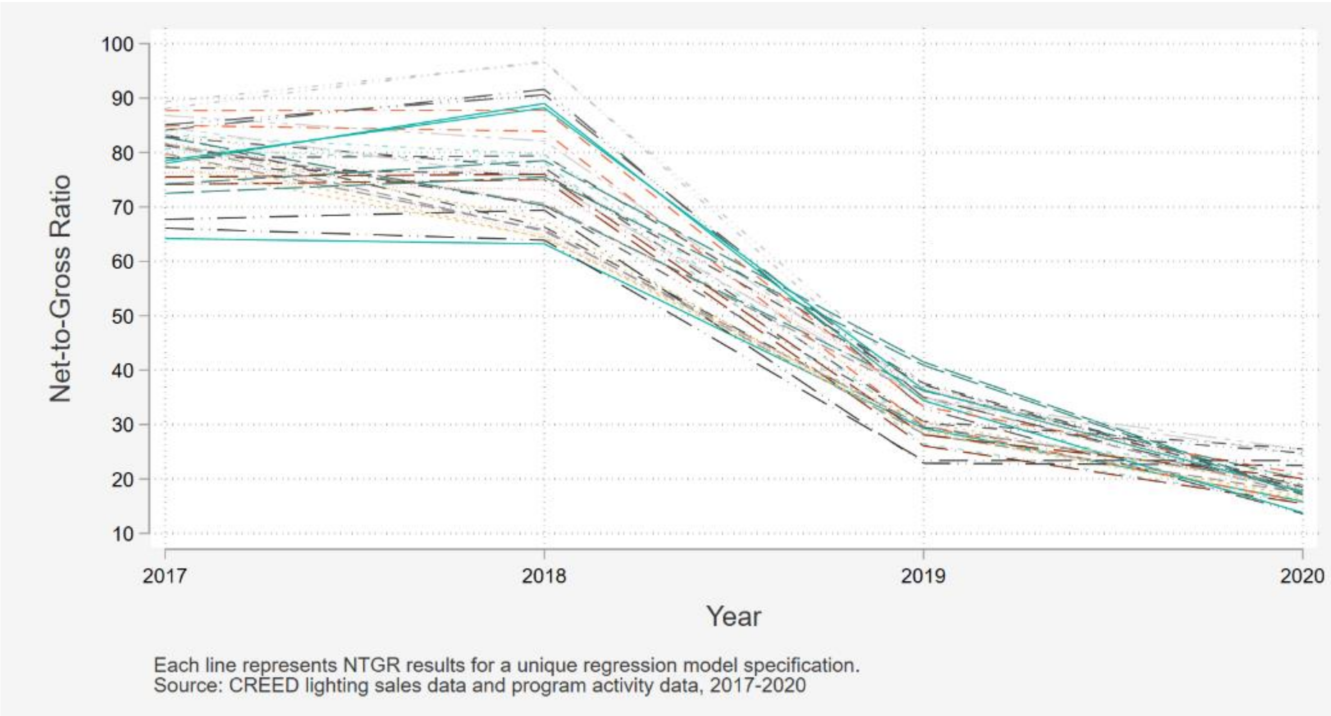
- 2017: 81.3%
- 2018: 70.3%
- 2019: 30.6%
- 2020: 25.5%

The drop from 2018 to 2019 is partially explained by the evolving lighting landscape and decline in LED prices, but it is important to note that Georgia Power claimed nearly twice as many bulbs in 2019 as they did in 2018, with only a modest increase in program spending. The number of claimed program bulbs is the denominator in the NTGR calculation, thus it makes sense to see a large drop from 2018 to 2019. As markets transform and technologies move along the adoption curve, programs may no longer need high incentives to motivate participants, which can indicate that consumers may be choosing those products more often on their own without rebate influence. When rebates are no longer needed to motivate consumers to choose a product, this often correlates with higher freeridership levels.

We also estimated NTGRs for each year using each of the 36 regression model specifications we tested for 2020. The results of this exercise, presented in Figure 40, tell a compelling story – as the national LED market share has increased and LED prices have dropped, the rate of freeridership in upstream lighting programs has also increased.

Given that we see LED market shares in the 70% range for some states without upstream lighting programs, this finding makes sense.

Figure 40. NTGR Time Series



Process Evaluation

Marketplace Customer Survey

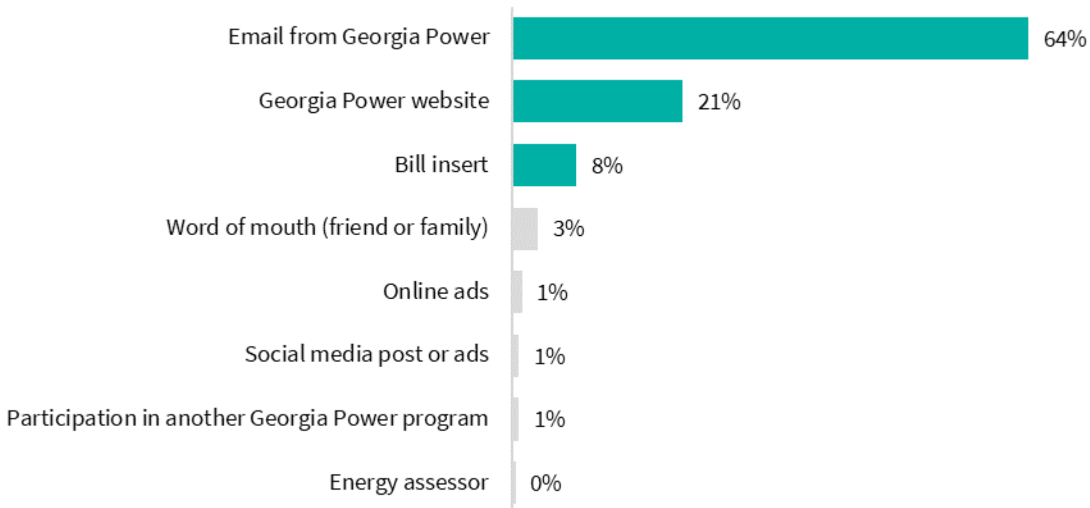
The process evaluation for the Residential Specialty Lighting program focused on the Georgia Power Online Lighting Marketplace. The evaluation team surveyed 254 customers who purchased lighting from the Online Marketplace between January and September 2020. Eighty-four customers purchased standard lighting, 84 purchased specialty lighting, and 86 purchased both standard and specialty lighting.[39] The following sections describe the results related to source of awareness, reasons for participation, experience and satisfaction with the program, and program impacts on customers.

[39] Purchases of either reflector or specialty bulbs on the Marketplace are combined and referred to as "specialty" lighting thro ughout this section.

Online Marketplace Awareness

The largest drivers of participation in the Online Marketplace were email marketing campaigns promoting the Online Marketplace and its sales. Almost two-thirds of customers heard about the Online Marketplace through an email they received from Georgia Power (64%). Other common sources of program awareness were the Georgia Power website (21%) and a bill insert (8%).

Figure 41. Sources of Program Awareness (n=253)

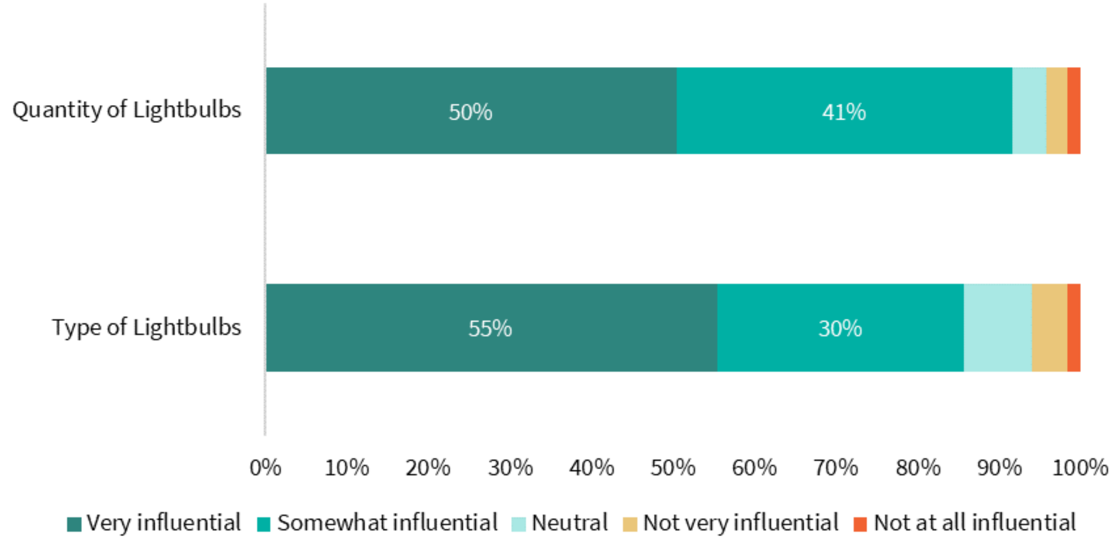


Source: Online Lighting Marketplace customer survey. B1. How did you first learn about the Georgia Power Marketplace?

The marketing of flash sales also proved to be effective to drive sales through the Online Marketplace. Of those who were identified as having purchased lighting during a flash sale, a vast majority were aware of the sale (85%).[40] Of those, most indicated that the flash sale impacted their decision to purchase the type and quantity of lightbulbs that they did.

[40] We identified flash sale purchases based on the date of purchase falling within the timeframe of the flash sale.

Figure 42. Influence of Flash Sale on Lightbulbs Purchased (n=119)



Source: Online Lighting Marketplace customer survey. D5, D6. How influential was the flash sale on your decision to purchase the type/number of lightbulbs that you did?

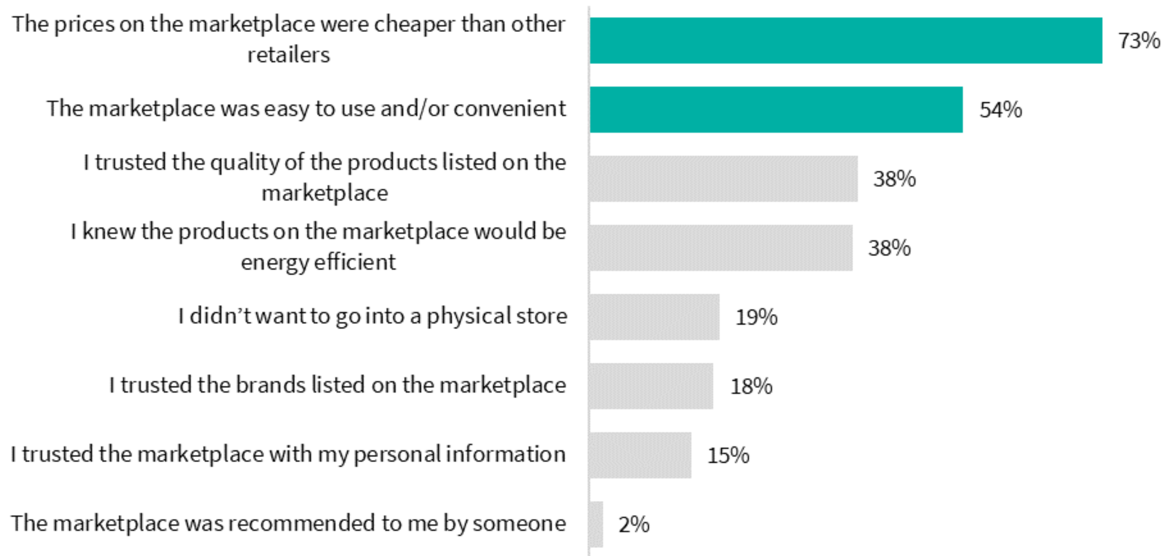
Just over half of lighting purchasers said that they were aware of other Georgia Power energy efficiency programs (55%). Of those, most were aware of the Specialty Lighting program (66%), Home Energy Improvement Program (57%), and the Temp✓ program (53%).

Motivations to Use the Online Marketplace

The primary motivators for customers to purchase energy efficient lighting at the time they did were to save energy and to save money on their utility bills (70% each). Respondents also indicated that they wanted to replace old equipment, help the environment, and take advantage of the flash sale through the Online Marketplace. When asked specifically why they purchased lighting through the Online Marketplace instead of another retailer, almost three-quarters said that the prices on the Online Marketplace were cheaper than other retailers (73%), and another half said that the Online Marketplace was easy to use and/or convenient (54%).[41]

[41] There were no significant differences between the proportion of flash sale versus non-flash sale purchasers who said they used the Marketplace because the prices were cheaper.

Figure 43. Reasons for Purchasing from Online Marketplace Instead of Another Retailer (n=252)



Source: Online Lighting Marketplace customer survey. D2. D2. Why did you decide to buy lighting products from the Georgia Pow er Marketplace instead of another retailer?

Overall, all but three customers said that the prices on the Online Marketplace were either cheaper or a similar price to what they would pay elsewhere. Almost all customers said they would use the Online Marketplace if they were to purchase lighting products again in the future (95%).

Using the Online Marketplace

Almost all customers said it was very or somewhat easy to use the Online Marketplace to buy lighting products. Of the six customers who said the Online Marketplace was difficult to use, four indicated that the Online Marketplace was unable to validate their address or account number. Per program staff, account validation has been improved recently and address validation success rates have increased.

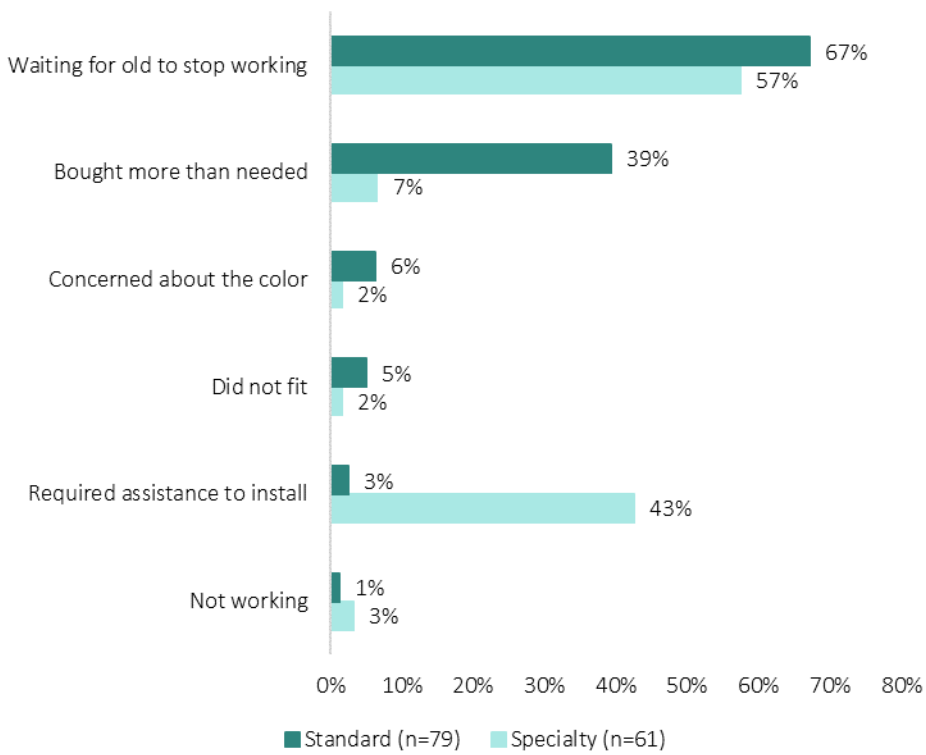
Most customers found that the product descriptions on the website were useful with 91% indicating that they were either very or somewhat useful.

Lighting Installations

As stated previously in our discussion of ISRs, approximately 85% of standard lightbulbs and 86% of specialty lightbulbs purchased through the Online Marketplace were reported as either currently installed in a customer's home or intended to be installed in the next 12 months. When a customer purchased more than ten lightbulbs through the Online Marketplace, we asked if they purchased more lighting than they needed to qualify for free shipping; about one-third of customers indicated that they had (29% for standard and 33% for specialty). The evaluation team explored whether this impacted in-service rates to understand if some of the additional bulbs purchased went into storage. Most customers who purchased extra bulbs still installed them in their home or planned to install them in the next year, at equal proportions to those who did not purchase extra bulbs. Therefore, there was no impact on ISRs.

The most common reason that lighting was not installed in a customer's home was that the customer was waiting for the existing lightbulbs to stop working. Other common reasons were that customers bought more than they needed, and that the lighting required assistance to install. Customers who purchased specialty lighting were significantly more likely to have not installed their lighting because it required assistance compared to those who purchased standard lighting. However, participants who purchased GSLs were much more likely to say that they purchased more than they needed.

Figure 44. Reasons Lighting was not Installed



Source: Online Lighting Marketplace customer survey. C7, C16. Why isn't the standard/specialty lighting currently installed in your business/home?

Most of the lighting that was not installed was reported as having been put into storage (92% for standard lighting and 90% for specialty). All but one customer who had not installed the lighting they purchased said they planned to install it in the future.

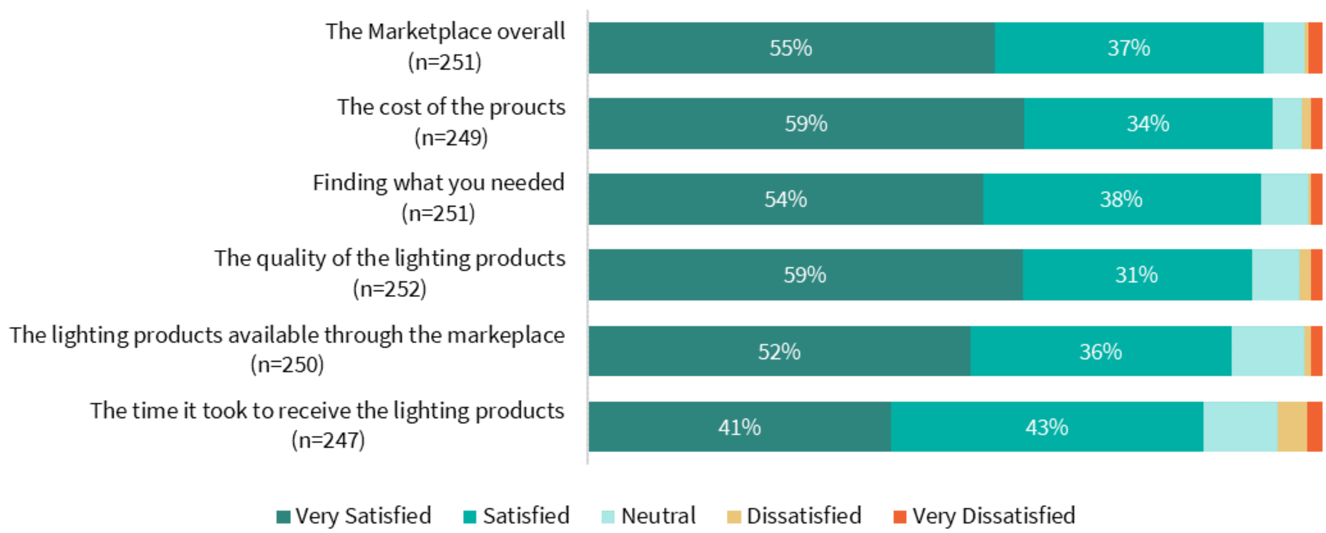
Satisfaction with the Online Marketplace

Overall, customers were very satisfied with all aspects of the Online Marketplace. Almost all customers were either very satisfied or satisfied with the Online Marketplace overall (92%). All aspects of the Online Marketplace were also rated very highly; over 90% were very satisfied or satisfied with the cost of the products, finding what they needed on the Online Marketplace, and the quality of the lighting products.

The time it took to receive the lighting products received the lowest satisfaction ratings, with 84% either very satisfied or satisfied. It should be acknowledged that the advent of many online retailers offering two-day shipping (such as Amazon and Target) may have skewed the general public's perception of acceptable shipping times, and the COVID-19 pandemic impacted shipping time for all carriers in 2020. Below are the reported shipping times for the 12 customers (5% of the total) who said they were very dissatisfied or dissatisfied with the time it took to receive their lighting:

- Within one to less than two weeks (n=8)
- Within three to less than four weeks (n=2)
- Longer than four weeks (n=2)

Figure 45. Satisfaction with the Online Marketplace



Source: Online Lighting Marketplace customer survey. F1. F1. Please rate your satisfaction with each of the following aspects of the Georgia Power Marketplace.

The 20 customers who said they were neutral, dissatisfied, or very dissatisfied with the Online Marketplace overall were asked to explain why they gave the satisfaction rating they did. Three customers mentioned that the life of the product was short. Other comments mentioned receiving an incorrect order, difficulty finding product descriptions, needing to enter a lot of information to complete the purchase, and the shipping policy.

When asked how likely they would be to recommend the Online Marketplace to a friend or colleague, almost two-thirds (64%) rated their likelihood as a 9 or 10 on a scale of 1 to 10 where 1 was "not at all likely" and 10 was "extremely likely".

Participant Suggestions for Improvement

Most surveyed customers did not have any suggestions for improving the Online Marketplace. Of those that did (n=36), the most common suggestions were to remove the limit on the number of bulbs that could be purchased (n=7), and to include more lighting products (n=7). Customers also mentioned wanting lower prices and faster shipping times (n=4).

> *"Please offer more styles of bulbs. The GU with the Frankenstein base, I have some of those. Also, the daylight option would be nice on the general bulbs too."*
>
> \- Georgia Power Online Lighting Marketplace customer

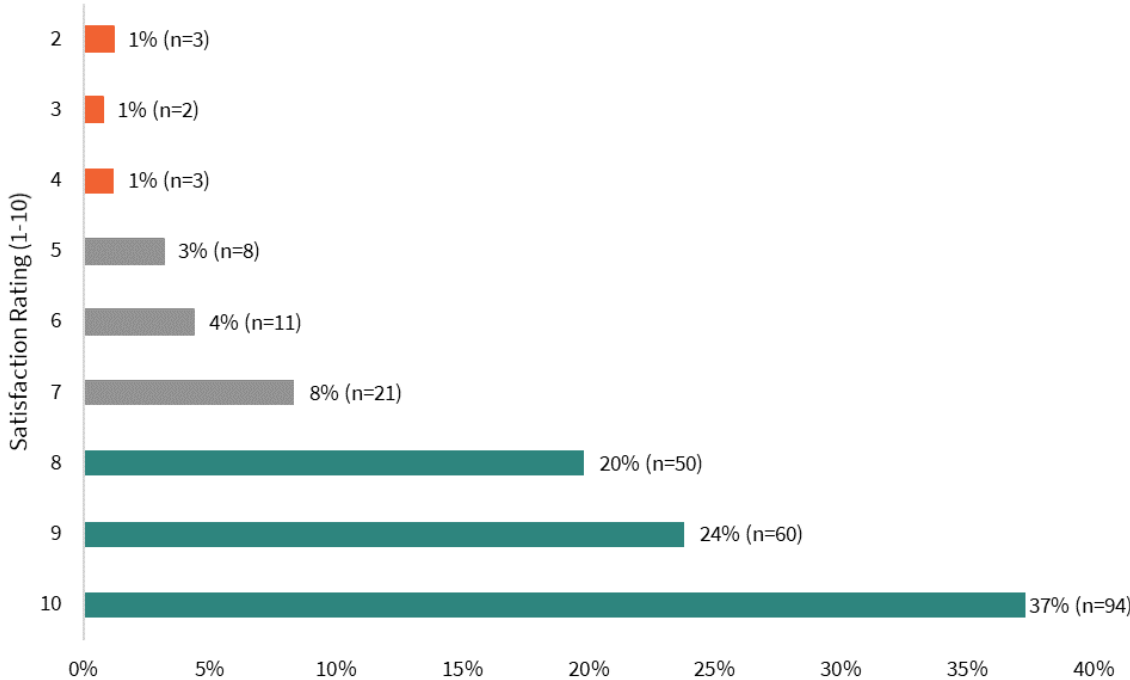
> *"I wanted to replace all my bulbs but was limited on the number of bulbs that I could buy during the Flash Sale and for the year. I understand why you have a limit, but it was frustrating not to be able to replace all the bulbs at the same time which would give me a better feel for how long they last and how much they were saving on utilities. But I do appreciate the opportunity to buy at a discount."*
>
> \- Georgia Power Online Lighting Marketplace customer

> *"Make the pricing more competitive and faster shipping. Allow for people to cancel the order if need to be."*
>
> \- Georgia Power Online Lighting Marketplace customer

Satisfaction with Georgia Power

Overall, Online Lighting Marketplace customers were satisfied with Georgia Power. Over three-fourths of customers rated their satisfaction as an 8, 9, or 10 on a scale of 1 to 10 where 1 was "not at all satisfied" and 10 was "extremely satisfied".

Figure 46. Satisfaction with Georgia Power

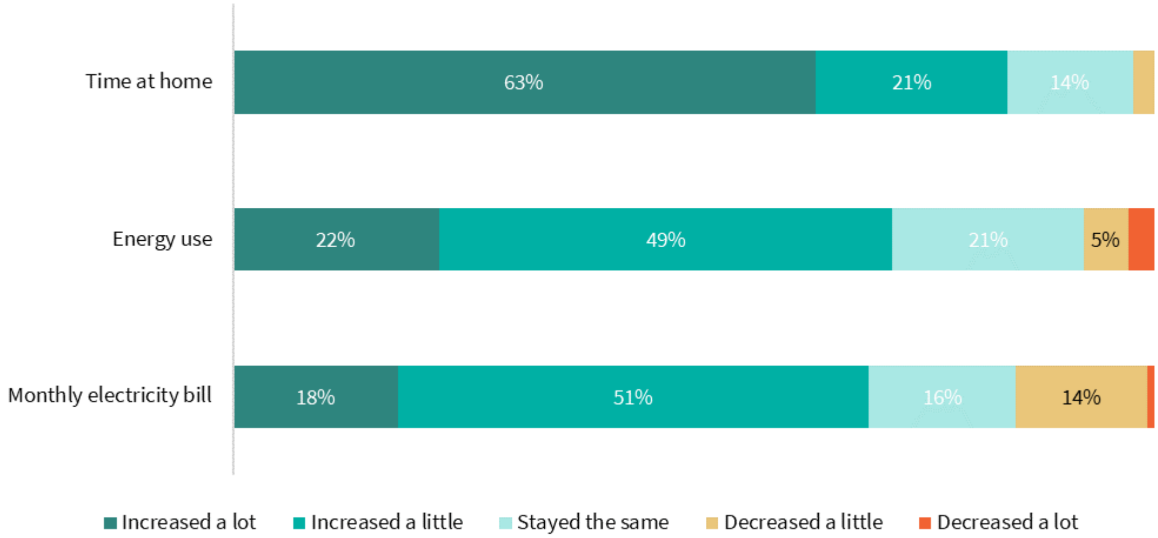


Source: Online Lighting Marketplace customer survey. F4. F4. Taking into consideration all aspects of your utility service experience, please rate your current satisfaction with Georgia Power overall.

Participants and COVID-19

Given the timing of the Online Marketplace customer survey, we included questions to assess customer perceptions of the effects of the COVID-19 pandemic on energy-related behavior in their home. Most surveyed customers indicated that the amount of time they spent at home in 2020 compared to 2019 had increased at least a little (84%), and almost three-fourths reported that their energy use had increased in 2020 (72%). Two-thirds of customers reported an increase in their energy bill compared to 2019 (69%), while about 15% said their energy bill had decreased in 2020.

Figure 47. Effects of COVID-19 on Energy-Related Behavior



Source: Online Lighting Marketplace customer survey. G1-G3. Compared to this time in 2019, would you say the time your household spends at home/amount of energy your household uses in each week/your monthly electric bill has….

Less than one-half of customers reported making improvements to their home since the beginning of 2020 (41%). Of those who made improvements, most reported the cost to be at least $1,000 (80%). The most common improvements made were installing new lighting (n=19), painting the interior or exterior (n=15), installing new HVAC equipment, and installing insulation (n=11).

Participant Survey Demographics

Most surveyed customers reported owning their home (90%) and living in single family homes (91%). Most had lived in their homes for at least four years (70%) and most homes were less than 60 years old, with 85% built in 1960 or later. Most customers reported one to three people living in their household (80%) and that their household size stayed the same between 2019 and 2020 (80%).

Surveyed customers were older, with most being 45 years old or older (71%). One-fourth of customers declined to report their annual household income, but of those who did, over one-half reported a total annual household income of $75,000 or more (59%). Almost three-fourths of surveyed customers reported achieving at least a four-year college degree (71%) and almost one-third were retired (32%). Most surveyed customers did not indicate that their employment situation changed since 2019 (83%); however, of those that did, the most common changes to employment situations were a loss of job (n=9), change of job (n=6) , working from home (n=6), and retirement (n=6). Most customers identified themselves as White (69%), followed by Black or African American (15%), and reported speaking English in their home (90%).

See Appendix 3C: Survey Demographics for additional details on survey respondent demographics.

Conclusions and Recommendations

Conclusion 1: As the lighting market continues to shift toward LEDs, freeridership rates continue to increase for upstream lighting programs.

Georgia Power's residential lighting NTG value dropped significantly from the 2017 evaluated value. In 2020, more than 70% of screw-based lighting sales in the US were LEDs. Even in states without upstream lighting programs, LED market shares were in the 60% to 70% range. The national LED market share, which doubled since 2017, will continue to climb as LEDs approach price parity and consumers recognize LEDs as the superior technology. This means future upstream lighting programs will carry a considerable amount of freeriders – consumers who benefit from program incentives even though they would have purchased LEDs absent program discounts.

Recommendations:

- Remove reflectors from the Retail and Marketplace components of the program, which should increase NTG estimates. More than 90% of reflectors sold in the US are LEDs. Program efforts should focus on bulb types with lower LED shares, such as globes and candelabras. The program team conducted a sensitivity analysis within the NTG analysis, and if reflectors are removed from the program, the overall weighted NTG increases from 36% to 43% for energy savings. If Georgia Power removes reflectors from future program designs, they could reference this value (43%) for a NTG estimate.
- Focus on store types where LED market shares are lower. Home improvement stores like Home Depot have higher LED market shares than grocery, dollar, and discount stores. Costco does not sell inefficient lighting. By moving program dollars out of Home Depot, Costco, and other home improvement or club stores, the program could expect a lower freeridership rate. To limit freeridership and potentially serve an increased proportion of low to moderate income (LMI) customers, program dollars should be focused on stores such as Dollar Tree, Dollar General, and True Value.
- Continue distributing LEDs through food banks. The freeridership rate for this program component is 0%. Shifting more program dollars into this component will help Georgia Power further engage LMI customers (while also serving to boost the overall NTGR of the program).
- Research in other jurisdictions indicates that increased incentives are one way to reduce freeridership. Aggressive discounts can increase program volume without increasing the number of freeriders (meaning a lower rate of freeridership).

Conclusion 2: Monitor developments regarding the EISA backstop under the Biden administration.

It appears likely that the Biden administration will act before the end of 2021 to restore EISA lighting standards at the federal level, including both the expanded GSL definition (which now includes globes, candelabras, and reflectors) as well as the 45 lumen/Watt efficacy standard. There is uncertainty, however, as to the length of time DOE will allow between adoption of the standards and the time it begins enforcing compliance. Lightbulb manufacturers will likely argue a period of years is necessary, while efficiency advocates believe six months would be generous. A 12-month sell-through period would represent a compromise between the *months* that efficiency advocates support and the *years* lightbulb manufacturers will likely seek, recognizing that the Biden administration appears motivated to restore these standards. The standards could also take years to take effect, however, if the DOE pursues new rulemaking and the National Electrical Manufacturer Association (NEMA) trade group pursues litigation and wins an injunction against the DOE.

Recommendations:

- Plan for retail lighting programs to continue through at least the end of 2022 but be prepared to terminate the program should the EISA backstop be reinstated. Though uncertainty remains, it appears reasonable to assume that the expanded GSL definition and 45 lumens/Watt efficiency standard will be in effect by sometime in 2023 or 2024. This means there is possibly only one to two additional years remaining for upstream lighting programs to impact the retail market for LEDs. Direct install or kit delivery mechanisms could still be offered once the backstop is in place.
- Monitor the baseline. The realization rates for 2020 were close to 100% because Georgia Power's per-unit assumptions were well aligned with current federal standards. If or when federal lighting standards change, the baseline wattage in the savings algorithm will decrease and the per-unit savings assumptions will need to be adjusted accordingly.

Conclusion 3: Customers were satisfied with the Online Marketplace and would use it to buy lighting products again.

Almost all customers were either very satisfied or satisfied with the Online Marketplace overall (92%) and all other aspects of the Online Marketplace were also rated very highly. Customers reported that the Online Marketplace was easy to use and that the product descriptions were useful. Almost all customers said they would use the Online Marketplace if they were to purchase lighting products again in the future (95%).

Conclusion 4: A percentage of program-supported LED bulbs sold in retail stores are installed in commercial sockets rather than residential sockets.

The nature of upstream lighting programs is that participants are typically not known, nor is the destination of the program-supported lamps. Though most lamps are installed in residential sockets, some lamps end up in commercial sockets. Savings assumptions and algorithms should reflect this.

Recommendations:

- Adjust per-unit savings values to account for cross-sector sales. Assuming 100% residential operating parameters will undersell the savings for bulbs that may cross sectors, as commercial hours of use and coincidence factors are higher than residential hours of use and coincidence factors. For LED bulbs sold through the Online Marketplace or distributed through food banks, savings assumptions should reflect purely residential operating parameters. For LED bulbs sold through retail stores, savings assumptions should reflect cross-sector sales. We use a 6.2% cross-sector sales rate for this evaluation.

- If program partners fundamentally change (per our recommendation to move program dollars out of home improvement stores like Home Depot), this cross-sector sales rate may need to be reassessed. Businesses likely do not buy LED lightbulbs at the same rate at Dollar General as they do Home Depot, for example.

Conclusion 5: The long-term impacts of the COVID-19 pandemic on home energy use are not currently well-understood and should be monitored.

Most surveyed customers indicated that the amount of time they spent at home in 2020 compared to 2019 increased at least a little (84%), and almost three-fourths reported that their energy use increased in 2020 (72%). If the ongoing pandemic results in customers spending increased time in their home, this may result in long-term shifts in energy use and load shapes and increase the savings from efficient lighting.

Recommendations:

- Consider reassessing annual hours of use and coincidence factors for residential lighting if cost-effective given program and market considerations described above. Given the effects of the pandemic, Georgia Power could consider reestablishing important customer characteristics and metrics for lighting as well as other measures for future program cycles.

Conclusion 6: Installation rates were relatively high for both standard and specialty bulbs.

Most survey respondents indicated they had already installed the lightbulbs they purchased through the Online Marketplace, with most of the remaining customers indicating they planned to install their bulbs in the next 12 months. Relatively few customers – less than 15% - indicated that the lightbulbs they purchased were placed in longer-term storage. Notably, these findings were consistent across both standard and specialty bulb types (85% and 86% installation rates, respectively).

Conclusion 7: Customers used the Online Marketplace because of the low prices.

Almost three-quarters of customers said they used the Online Marketplace to buy lighting products because the prices were cheaper than other retailers (73%), and all but three customers said they thought the prices on the Online Marketplace were either cheaper or a similar price to what they would pay elsewhere. The cost of the products on the Online Marketplace was the item with the highest satisfaction, with 93% of respondents either very satisfied or satisfied.

4. HOME ENERGY IMPROVEMENT PROGRAM – INDIVIDUAL IMPROVEMENTS AND WHOLE HOUSE

Program Design and Delivery

The Home Energy Improvement Program (HEIP) is composed of multiple distinct subcomponents designed to serve different households in the residential customer class.

- Whole House Single Family: Qualified customers who complete a home energy assessment and recommended improvements to achieve a 25% electric energy reduction receive a rebate for 50% of the cost of the improvements, up to $1,150 per year.
- Whole House Multifamily: Encourages residential property owners to have a home energy assessment conducted, and to implement energy efficiency measures with the goal of lowering tenant bills, improving renter comfort, and increasing renter retention. Qualified projects can receive rebates for 50% of the cost, up to $575 per housing unit.
- Individual Improvements: Offers incentives for energy efficiency upgrades in single family homes on an a la cart basis. Some measures require participants use an approved program contractor, while other measures can be self-installed or installed by a licensed professional not affiliated with the program. Customers can receive a rebate for 50% of the cost of the improvements, up to $600 per year.
    - Marketplace Thermostats: Allows residential customers to shop for and purchase smart, Wi-Fi enabled thermostats at up to 50% off the retail price. Thermostat rebates are offered at 50% of the eligible thermostat cost, up to $75 for single family homes and $38 for multifamily home. Findings for this program component are presented separately, in Home Energy Improvement Program - Thermostat Marketplace, as they are delivered separately from most measures in the Individual Improvements and Whole House paths.

Both Whole House tracks utilize the Beacon HEA software tool to model the energy performance of the residence, identify upgrades, and estimate the energy and peak demand savings from the identified upgrades.

Changes from Previous Cycle Design

The measures offered through HEIP largely carried over from the 2017 - 2019 cycle except for the changes listed below.

- Only single family homes are eligible for the Individual Improvements path.
- Rebates on high efficiency central HVAC systems are not part of the Individual Improvements measure catalog for 2020 - 2022.

In some respects, HEIP 2020 – 2022 is like the 2017 – 2019 cycle. Smart Wi-Fi enabled thermostats sold through the Georgia Power Marketplace (results presented in Home Energy Improvement Program - Thermostat Marketplace) continue to be the largest measure in terms of contribution to program savings (as planned), and the program includes separate paths for Whole House and Individual Improvements. However, there were several important operational changes.

- The transition to in-house implementation: In prior cycles HEIP was delivered by a third-party implementation contractor. For the 2020 – 2022 cycle, Georgia Power staff manage the network of contractors, process and approve incentive payments, conduct QA/QC, and are responsible for other program delivery functions internally.

- Dual participation across the Whole House and Individual Improvements tracks: In prior cycles, residential customers typically participated in either the Whole House or Individual Improvements path. During the first 15 months of the 2020 - 2022 cycle, participants commonly received measures and rebates through both the Whole House and Individual Improvements paths.

- The COVID-19 pandemic: HEIP, like much of the residential DSM portfolio, was impacted in 2020 due to the pandemic. Participation was lower in part because marketing for the program was generally paused for much of 2020 due to the pandemic. Safety protocols also limited the ability of contractors to visit homes and perform upgrades for much of 2020. When marketing resumed, it was focused on do-it-yourself Individual Improvements measures to avoid having a contractor enter customers' homes. In addition, the pandemic limited Georgia Power staff's ability to perform in-person QA/QC, and instead relied on photo QA/QC.

Implications of the COVID-19 Pandemic

The evaluation team recognizes that this evaluation occurred during a timeframe in which the COVID-19 pandemic impacted daily life for residential customers in Georgia. As described above, HEIP has several channels with different design and delivery mechanisms, and the pandemic impacted each of these differently. While the smart thermostat measure offering through Georgia Power's Online Marketplace operated relatively normally during 2020, participation was reduced in the Individual Improvements (excluding the smart thermostat measure) and Whole House channels until late 2020. The lower participation was due to a pause in program marketing and additional safety protocols given the COVID-19 pandemic. During 2020 and 2021, HEIP was not able to conduct in-person QA/QC per usual, and instead relied on documentation and photos for quality control. Only one contractor had high levels of participation in the program through the majority of 2020 into early 2021. Notably, this single contractor was responsible for 77% of the reported energy and peak demand savings within Whole House Single Family. This contractor worked primary in a small geographic area in Northwest Georgia and primarily treated single family rental properties. These projects usually also included an additional Individual Improvements rebate for air sealing. The implications of this combination of factors on the evaluation team's ability to evaluate these pathways in HEIP are described in detail throughout this report.

Evaluation, research, and analysis nearly always have the potential for introduced and inherent biases and exogenous factors that may influence results. Ideally, evaluators attempt to control for these factors in analyses, such as through sample design. Where controlling for them is not possible, evaluators will attempt to identify and characterize the factors that may have influenced evaluation results. For all program evaluations conducted this cycle, the evaluation team has carefully considered possible ways the unprecedented events of the COVID-19 pandemic and related factors may have impacted our results. There is much that is still unknown about how the COVID-19 pandemic has influenced household energy use and behavior in the US, and it is likely that the pandemic has affected households differently depending on household size, location, employment status, and other demographic factors (such as income, race, age, etc.). Additionally, whether and at what speed these factors return to pre-2020 conditions are occurring at varying degrees and speeds across different demographics and populations.

Of all Georgia Power programs, the COVID-19 pandemic affected program design and delivery for HEIP most significantly (specifically for the Individual Improvements and Whole House tracks). Below, our team lays out the COVID-19 implications separately for each program track. The implications of the pandemic on the thermostat measures rebated through the Online Marketplace are discussed in that chapter.

Whole House – Single Family

While the team completed a variety of data collection and analysis activities, we ultimately did not feel confident estimating realization rates or net-to-gross ratios for the 2020 – 2022 cycle for Whole House. This program tracks experienced significant disruption and deviation from normal program operations, in addition to separate challenges the team faced in accurately measuring and verifying savings generated by the program.

Key challenges that impacted our ability to verify and estimate both gross and net energy savings for Whole House are highlighted below. These are discussed in more detail throughout this report.

- One contractor dominated program participation.
- The customer demographics differed from typical program participation.
- There were challenges with contractor data input and quality of work.[42]
- There were tracking data issues.

The evaluation team informed the Georgia Power team of these issues as soon as possible, and Georgia Power took corrective action with the contractor to address QA/QC and data input quality concerns. Evaluation results are applied prospectively in Georgia and our team expects the Whole House Single Family track to look and operate differently in the 2023 – 2025 cycle than it did during the first 15 months of 2020 – 2022. In the following sections, the evaluation team provides findings from this year's activities to inform program design and delivery but recommends applying the realization rates and net-to-gross results from the 2017 evaluation for future planning.

Whole House – Multifamily

Most of the multifamily projects claimed during the evaluation study period were legacy or rollover projects that began in the prior cycle, for which final project completion and test out did not occur until 2020. Georgia Power program staff typically perform a verification site visit after the completion of upgrades, but prior to project payment for large complexes. Due to the safety restrictions imposed by COVID-19, program staff were unable to perform in-person visits for much of 2020 into 2021. Some of the verification issues identified by the evaluation would have likely been identified and corrected as part of implementation under typical operating conditions. While the implications to overall verified savings for this cycle would be the same, this should be kept in mind when interpreting and applying realization rates applied prospectively should on-site verification return to pre-pandemic levels.

Individual Improvements[43]

The COVID-19 pandemic generally limited the ability of contractors to visit homes, identify upgrades, and ultimately sell jobs. However, some residential customers continued to make improvements and apply for rebates during the pandemic, and the program continued to operate in a limited fashion until late 2020. Ultimately, the composition of the Individual Improvements track was most influenced by the program design decision to allow dual participation in Whole House and Individual Improvements, as 40% of Individual Improvements participants (primarily air sealing participants) also completed a Whole House upgrade in this evaluation cycle. These projects were driven primarily by one Whole House contractor. The evaluation team

[42] As of Q3 2021, the Georgia Power program team reports that they have conducted additional QA/QC and taken corrective action with this contractor to ensure that data will be collected accurately and completely going forward.

[43] See Home Energy Improvement Program - Thermostat Marketplace for information about the implications of the COVID-19 pandemic on the smart thermostat Individual Improvements measure available through Georgia Power's Online Marketplace.

was able to evaluate Individual Improvements gross savings via an engineering review to provide input for future planning and make some recommendations for ways to adjust some measures should program participation look different in future years. Due to overlapping issues as described for the Whole House pathway, the evaluation team recommends carrying forward 2017 freeridership and spillover results for future planning.

Program Performance

Table 55 summarizes savings for the program, across the various pathways evaluated. As this only presents the Individual Improvements and Whole House paths, overall program goals are not presented here.

Table 55. HEIP Individual Improvements and Whole House Savings Summary

PROGRAM PATHWAY	METRIC	TIME PERIOD	REPORTED SAVINGS	VERIFIED GROSS SAVINGS	VERIFIED NET SAVINGS	REALIZATION RATES
Individual Improvements	Electric Energy Savings (kWh/yr.)	2020 – Q1 2021	2,419,509	1,115,689	731,892	46%
	Summer Peak Demand Reduction (kW)	2020 – Q1 2021	1,172	358	235	31%
Whole House – Single family [a]	Electric Energy Savings (kWh/yr.)	2020 – Q1 2021	2,615,898	973,114	721,077	37%
	Summer Peak Demand Reduction (kW)	2020 – Q1 2021	827	330	245	40%
Whole House - Multifamily	Electric Energy Savings (kWh/yr.)	2020 – Q1 2021	1,067,096	788,558	583,533	74%
	Summer Peak Demand Reduction (kW)	2020 – Q1 2021	250	305	226	122%

[a.] *For the Whole House Single Family pathway, these realization rates and verified savings reference the 2017 evaluation.*

As described in the next section, HEIP is a complex program design that includes multiple components.

Figure 48 shows the distribution of energy savings across program components for the first 15 months of the 2020 – 2022 cycle. The “Legacy” distinction at the bottom of the figure deals with projects initiated during the 2017 – 2019 cycle but completed, paid, and claimed during the 2020 – 2022 cycle. Legacy savings come primarily from a small number of large multifamily complexes. Whole House multifamily projects tend to have long project timelines, much like a custom project in the commercial sector; while these projects were potentially scoped or begun in a prior year, the program required them to be re-approved for this cycle.

Figure 48. Distribution of Reported Energy Savings (kWh) By Program Component – 2020 + Q1 2021

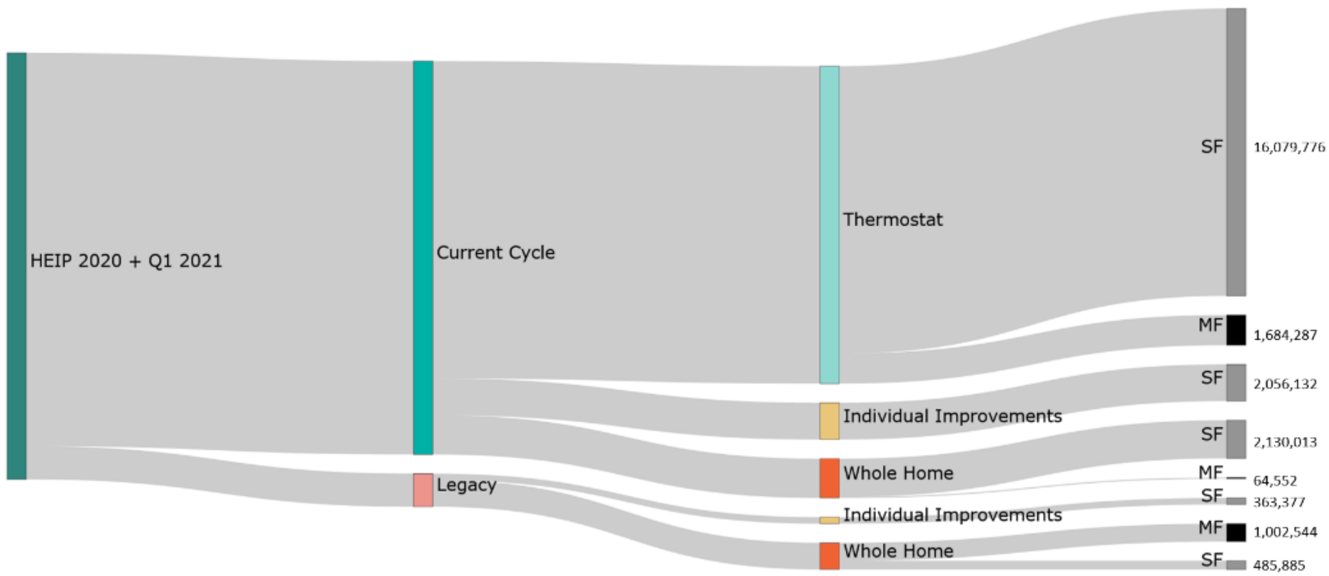


Table 56 outlines the *verified* gross and NTG adjustment factors.

Table 56. HEIP Individual Improvements and Whole House Adjustment Factors

PROGRAM PATHWAY	METRIC	REALIZATION RATE (%) [a]	FREERIDERSHIP	SPILLOVER	NTG (%) [b]
Individual Improvements	Electric Energy Savings (kWh/yr.)	46%	38%	4%	66%
	Peak Demand Reduction (kW)	31%	38%	4%	66%
Whole House – Single Family	Electric Energy Savings (kWh/yr.)	37%	27%	1%	74%
	Peak Demand Reduction (kW)	40%	27%	1%	74%
Whole House - Multifamily	Electric Energy Savings (kWh/yr.)	74%	27%	1%	74%
	Peak Demand Reduction (kW)	122%	27%	1%	74%

[a.] *Realization Rate is defined as* ***verified*** *Gross savings divided by* ***reported*** *savings. For the Whole House Single Family pathway, these realization rates reference the 2017 evaluation.*

[b.] *NTG is defined as* ***verified*** *net savings divided by* ***verified*** *gross savings. For all pathways in this chapter, the freeridership, participant spillover, and net-to-gross results reference the 2017 evaluation.*

Research Questions

The evaluation team conducted qualitative and quantitative research activities to answer the following key research questions for the program:

- What was the customer experience with the program, from sign-up through completion?
- How did customers become aware of the program?
- What were customer motivations for participation?
- How satisfied were customers with the program, including the participation process, interactions with the program delivery team, and satisfaction with each piece of equipment received?
- How useful were the written reports that customers received after the assessment?
- Are customer homes more comfortable after the improvements?
- Are utility bills lower after the improvements?
- What do participants recommend for program improvement?
- During the assessment, were customers given additional energy savings tips that they have put into practice? If yes, what have they done?
- As a result of their participation, did customers install any other measures for which they did not receive a utility rebate? If so, what were they?
- What are the program's verified measure installations?
- To what extent did freeridership affect the program?

Impact Evaluation

This section details each step of the impact evaluation and its associated electric energy savings and peak demand reduction. As discussed previously, HEIP has several program tracks customers can participate in. These include:

- Individual Improvements, an a la carte rebate offering for envelope improvement and HVAC measures in single family homes, including the ability to purchase rebated smart thermostats through the Georgia Power Online Marketplace. As noted above, the evaluation of thermostats rebated through the Online Marketplace are included in Home Energy Improvement Program - Thermostat Marketplace.

- Whole House Single Family, a performance-based program that focuses on Whole House improvements

- Whole House Multifamily, a performance-based program targeted at property owners

The evaluation team's approach and findings for each track are discussed separately in the following sections. The remainder of this impact section details the results by each track. Additional information on impact analyses and methodologies are included in Appendix 4A. Algorithms and AssumptionsAppendix 4. – Home Energy Improvement Program – Individual Improvements and Whole House

Impact Evaluation: Individual Improvements

Description and Performance

Georgia Power offers rebates for a variety of individual energy efficiency upgrades through HEIP for residential customers who do not wish to pursue a whole home suite of measures. Findings for the smart thermostat program component are presented separately, in Home Energy Improvement Program - Thermostat Marketplace, as they are offered separately from most measures in the Individual Improvements and Whole House paths. Individual Improvements (excluding smart thermostats) in single family homes account for just over 10% of the reported energy savings in HEIP for 2020 and the first quarter of 2021. Table 57 lists the measures claimed during the first 15 months of the 2020 – 2022 program cycle and provides the number of participants, claimed savings, and associated rebate payments. Georgia Power tracks the envelope improvement measures separately by heating fuel and claims larger per-unit energy savings for upgrades in electrically heated homes.

Table 57. Participation and Reported Savings by Measure – Individual Improvements 2020 + Q1 2021

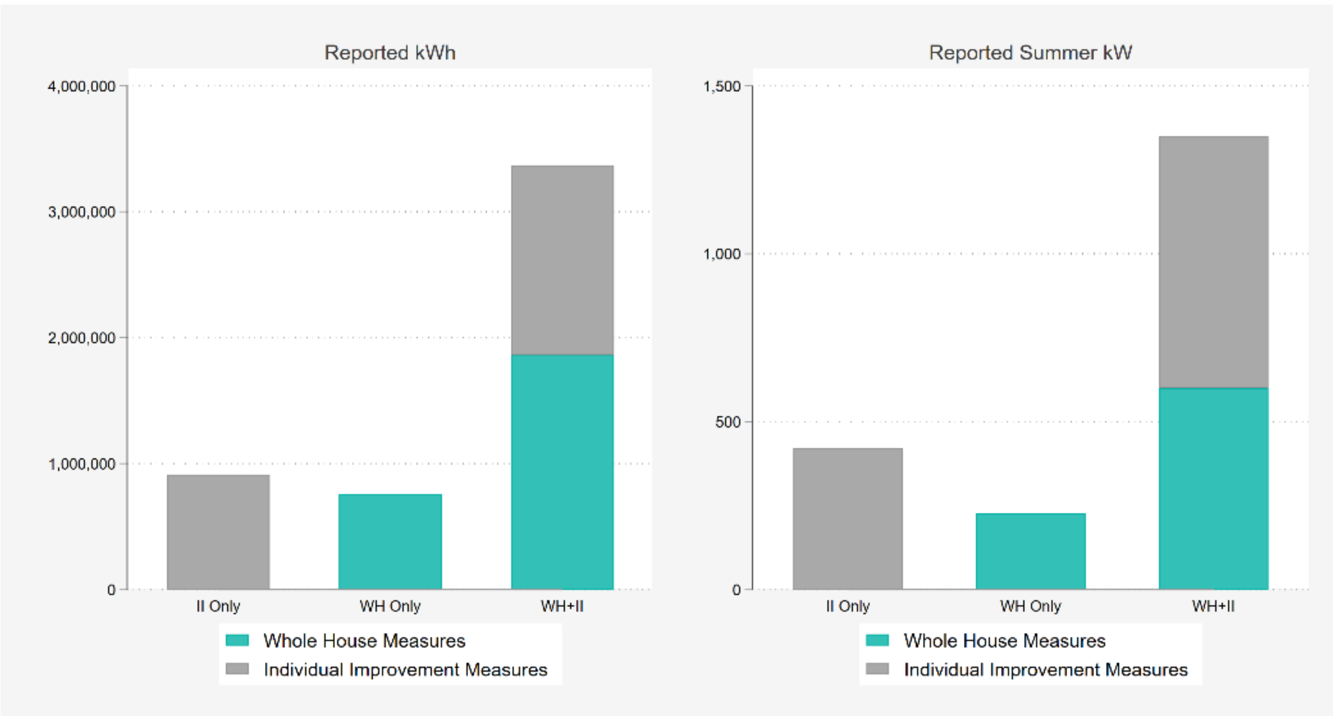
MEASURE	MEASURE COUNT (2020 AND Q1 2021)	KWH SAVINGS	SUMMER KW SAVINGS	TOTAL INCENTIVE
Home Energy Assessment	259	0	0.0	$34,188
Attic Insulation – Gas	475	105,491	90.2	$117,944
Attic Insulation – Elec	226	151,858	50.6	$55,732
Duct Sealing – Gas	52	52,558	46.1	$15,346
Duct Sealing – Elec	33	63,363	16.3	$9,900
Air Sealing – Gas	519	748,584	695.9	$155,900
Air Sealing – Elec	376	1,138,875	268.9	$113,025
Heat Pump Water Heater	107	158,253	3.6	$26,650
Central AC	1	526	0.1	$50
TOTAL	**2,048**	**2,419,509**	**1,171.7**	**$528,735**

Many of the residential customers who participated in the Individual Improvements path also participated in the Whole House path of HEIP in 2020 and Q1 2021. This “dual participation” approach is allowed if the home can still achieve a 25% whole home energy reduction as estimated by the Beacon HEA tool after completing the Individual Improvements measure. Table 58 shows the number of distinct residential accounts with claimed savings exclusively from the Individual Improvements, accounts that only participated in the Whole House path, and number of accounts that participated in both paths during our 15-month period of investigation. Figure 49 shows how the reported energy and peak demand savings were distributed across the participant types. [44]

Table 58. Frequency Table of HEIP Participation 2020 and Q1 - 2021

PARTICIPATION TYPE	DISTINCT PARTICIPANTS (UNIQUE ACCOUNT NUMBER)
Individual Improvements Only	931
Whole House Only	243
Whole House and Individual Improvements	679
TOTAL	1,853

Figure 49. Distribution of Claimed Savings by Participant Type and Path



Verified Gross Savings Approach

The evaluation team's calculation of verified gross savings for HEIP Individual Improvements measures relied on a combination of algorithms from technical reference manuals (TRMs) from various jurisdictions. These

[44] This analysis excludes smart thermostats purchased through the Georgia Power Marketplace.

TRMs included, but were not limited to, Georgia Power's 2019 TRM. This approach was used, in part, because the reported gross per-unit savings come from various sources, including results from prior cycle evaluations, building simulation models, and algorithms. Where appropriate, the same algorithms used to determine reported savings were used to calculate verified savings with updates to parameters based on primary data collection. However, in cases where reported savings was determined through prior evaluations or building simulations, or when the algorithmic approach in the Georgia Power TRM did not line up well with the available data, the evaluation team utilized algorithms and approaches from alternative sources. Georgia Power did not claim winter peak demand savings for HEIP Individual Improvements but requested that the evaluation team estimate winter peak demand savings for each measure.

Table 59 provides the type of approach and the source for the reported deemed savings for each HEIP Individual Improvements measure, showing which measures rely on prior evaluations, which rely on simulation modeling, and which were based on algorithms outlined in the Georgia Power 2019 TRM. Table 60 and Table 61, presented later in this section, provide additional details on the approaches used to calculate verified savings.

Table 59. HEIP Reported Deemed Savings Approach

MEASURE	REPORTED DEEMED SAVINGS TYPE	REPORTED DEEMED SAVINGS SOURCE	REPORTED SAVINGS APPROACH USED FOR VERIFIED SAVINGS
Attic Insulation	Evaluation result	Results from Evaluation of Georgia Power Company's 2014 DSM Programs. Nexant, July 2015.	
Duct Sealing	Evaluation result	Results from Evaluation of Georgia Power Company's 2010 Residential DSM Programs. Nexant, July 2011.	
Air Sealing	Evaluation result	Results from Evaluation of Georgia Power Company's 2010 Residential DSM Programs. Nexant, July 2011.	
Heat Pump Water Heater	Algorithm	Savings algorithm with deemed inputs for baseline and new efficiencies, delta water temperature, and daily hot water usage.	X

Figure 50 shows an example of the source for one of the applicable measures in the Georgia Power TRM. The figure shows that the energy savings for the air sealing measure is characterized solely based on the results of a prior evaluation, and not on a specified savings algorithm. While the Georgia Power TRM does not document the algorithm or assumptions, the 2010 evaluation report does provide the energy savings algorithms and most inputs. The evaluation team's approach to the air sealing measure for both HEEAP and HEIP Individual Improvements in this evaluation uses the same underlying equations.

Figure 50. Georgia Power TRM Infiltration Reduction Air Sealing Measure Modeling Details

Measure Modeling Details

Savings Algorithm
kWh = Kwh_eval

Value		Description	Value	Units	Reference
kWh_eval	=	Verified energy savings for air sealing treatment	3,037.00	kWh	1

References	
1	Evaluation of Georgia Power Company's 2010 Residential DSM Programs. Nexant, July 2011.

A primary focus of verified gross savings estimation was to utilize as much site-specific data as possible. More detail on the estimation of savings is described below and in Appendix 4A. Algorithms and Assumptions

Database Review

A total of 2,048-line items were identified in the set of 2020 and Q1 2021 Individual Improvements projects. Two-hundred fifty-nine of those line items were Home Energy Assessments, while the remaining 1,789 were Individual Improvements measures including air sealing, duct sealing, attic insulation, heat pump water heaters, and one central air conditioner. The evaluation team reviewed the program tracking database for completeness and performed checks on the accuracy of entered information against project documentation from a sample set of 173 measures across 140 projects.

The evaluation team used site-specific program tracking database information to perform calculations used to identify verified savings. The calculation methodologies are described in the next section and in Appendix 4. – Home Energy Improvement Program – Individual Improvements and Whole House Information taken from the database for use in those calculations includes:

- Heat pump water heater uniform energy factor
- Home square footage
- Inches of attic insulation and the associated R-value
- Pre-improvement blower door test CFM
- Post-improvement blower door test CFM
- Pre-improvement duct leakage CFM
- Post-improvement duct leakage CFM

Engineering Desk Reviews

The evaluation team performed engineering reviews of project documentation for each Individual Improvements HEIP measure type. As noted in Table 59, the same methodology that was used to determine reported savings was used to calculate verified savings for the heat pump water heater measure. The other measures used alternate approaches.

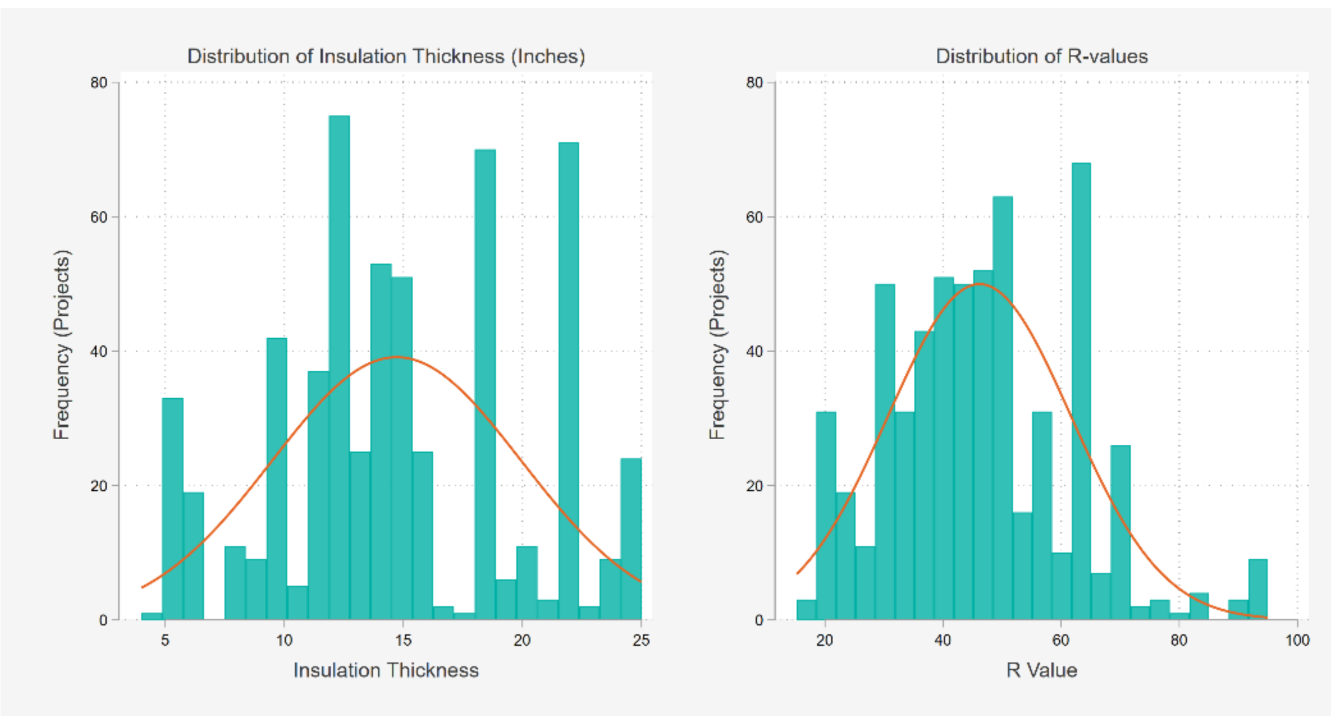
In this section we provide descriptions of the engineering analysis that we ran for each measure category. A detailed description of the engineering analysis methodology is in Appendix 4A. Algorithms and Assumptions

Attic Insulation

The program tracking data contained a total of 701 attic insulation measures, 475 of which were for homes with gas heating and 226 of which were for homes with electric heating. The program tracking data assigned per-unit annual savings for attic insulation projects of 222 kWh for homes with gas heat and 672 kWh for homes with electric heat. The reported savings for this measure were assigned based on results of the evaluation of Georgia Power's 2014 Residential DSM programs.

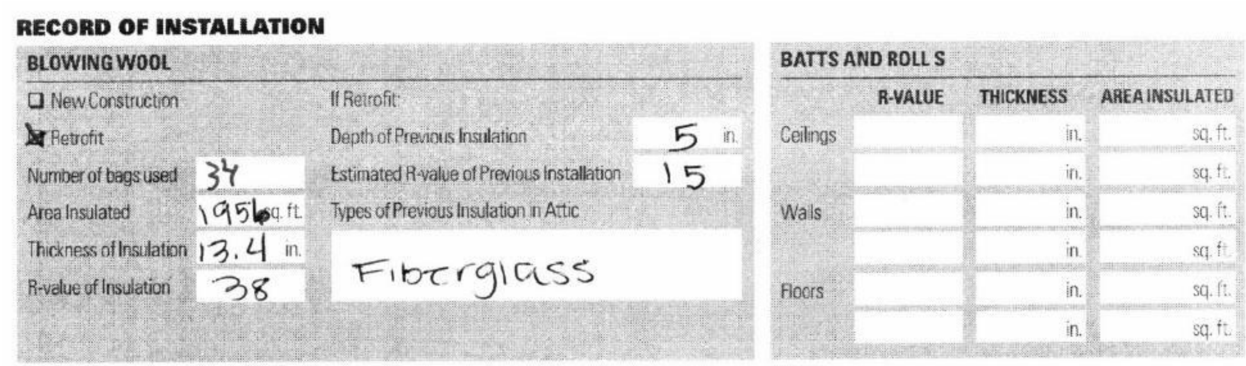
The evaluation team calculated verified savings for all attic insulation measures in the program tracking database, using pre- and post-improvement R-values for each project. The program tracking data captures insulation thickness and R-value for each project. Figure 51 shows the distribution of insulation thickness and R-values stored in the program tracking data for the period of evaluation.

Figure 51. Histogram of Attic Insulation Inches and R-values



The design of the application workflow is for participants or contractors to enter the type of insulation added and the number of inches added. The program tracking system then computes the R-value using assumed R-values per inch by insulation type (fiberglass, spray foam, cellulose etc.). The evaluation team found that actual data entry practices varied. Through a review of project documentation, we determined that the values in the tracking data most commonly represent the total thickness and R-value of the attic insulation after the upgrade. To estimate energy savings, a baseline R-value is also required. Seventeen projects in the HEIP evaluation sample included supporting documentation providing either the baseline condition or quantity of insulation added in combination with a final insulation level, which allows the baseline level to be calculated. Figure 52 shows an example of a contractor invoice with detail on the baseline condition. We use such data available in the project documentation to estimate an average baseline R-value of approximately R-13. This is noteworthy because program rules require existing attic insulation levels be less than R-11.[45] Participating homes with high starting R-values will deliver less energy savings, all else equal.

Figure 52. Example of Contractor Invoice with R-Value Documentation



RECORD OF INSTALLATION

BLOWING WOOL

☐ New Construction		If Retrofit:	
☒ Retrofit		Depth of Previous Insulation	5 in.
Number of bags used	34	Estimated R-value of Previous Installation	15
Area Insulated	1956 sq. ft.	Types of Previous Insulation in Attic	Fibcrglass
Thickness of Insulation	13.4 in.		
R-value of Insulation	38		

BATTS AND ROLL S

	R-VALUE	THICKNESS	AREA INSULATED
Ceilings		in.	sq. ft.
		in.	sq. ft.
Walls		in.	sq. ft.
		in.	sq. ft.
Floors		in.	sq. ft.
		in.	sq. ft.

Another input that affects the energy savings from attic insulation is the efficiency of the HVAC system. The evaluation team used the average efficiencies documented in project files for the sampled projects in the evaluation of the Whole House program path. That program included average in-situ central air conditioner and air source heat pump efficiencies of 13 SEER and 8.2 HSPF, respectively.

Duct Sealing

The program tracking data contained a total of 85 duct sealing measures, 52 of which were for homes with gas heating and 33 of which were for homes with electric heating. The reported data assigned savings for duct sealing projects of 1,011 kWh for homes with gas heat and 1,920 kWh for homes with electric heat. These

[45] https://www.georgiapower.com/content/dam/georgia-power/pdfs/residential-pdfs/Single-Family-HEIP-Preconditions_v020121.pdf

reported savings values come from the results of the evaluation of Georgia Power's 2010 Residential DSM programs.

The evaluation team calculated verified savings for each duct sealing measure in the program tracking database using the site-specific pre- and post-improvement leakage rates measured in cubic feet per minute at 25 pascals (CFM25). The average reduction in duct leakage for all Individual Improvements projects was 207 CFM25. As with the attic insulation measure, the evaluation team used average SEER and HSPF efficiency values from the Whole House evaluation sample.

Air Sealing

The program tracking data contained a total of 885 air sealing measures, 519 of which were for homes with gas heating and 376 of which were for homes with electric heating. Many of these homes also completed a HEIP Whole House project at the same time as the air sealing measure. The program tracking data assigned savings for air sealing projects of 1,443 kWh for homes with gas heat and 3,037 kWh for homes with electric heat. These reported savings values come from the results of the evaluation of Georgia Power's 2010 Residential DSM programs.

Each air sealing project captured in the program tracking database included site-specific pre- and post-improvement blower door test results measured in cubic feet per minute at a negative pressurization of 50 pascals (CFM50). The evaluation team calculated verified energy and demand savings using the pre- and post-improvement values for each project in the database. The average reduction in infiltration was slightly greater than 1,000 CFM50. The average size of homes that received air sealing through the Individual Improvements path was 1,450 square feet. This is notable as home size is an important predictor of the magnitude of infiltration reduction achieved through air sealing.

Heat Pump Water Heater

The program tracking data contained a total of 107 heat pump water heater measures. The reported data assigned savings for heat pump water heater projects of 1,479 kWh. The measure characterization that led to the reported unit savings of 1,479 kWh assumes the heat pump water heater meets the ENERGY STAR Product Specification for Residential Water Heaters' Eligibility Criteria Version 3.0 which specifies an energy factor (EF) of 2.00 for electric water heaters less than or equal to 55 gallons. The heat pump water heaters rebated through HEIP had energy factors that far exceeded that criteria value, averaging an EF of 3.66. Verified gross savings was calculated using the site-specific energy factors recorded in the program tracking database.

Site Inspections

The evaluation team completed eight in-person and four virtual site visits with participants who received both an Individual Improvements and Whole House project at their home. Three additional virtual inspections were completed with participants who completed a Whole House project without an Individual Improvement. Whether completed in-person or virtually, the objective of a site inspection is to independently verify the installation of all claimed measures and the accuracy of the home characteristics that can affect savings such as heating fuel and water heating fuel. Where observable, field staff collected information on both existing conditions and improved conditions.

The findings from site inspections, both in-person and virtual, served to validate the information provided in project documentation and confirm comprehensive measure installation.

Verified Gross Results

Table 60 shows the *reported* deemed savings and *verified* gross per-unit savings for HEIP Individual Improvements measures. For attic insulation, duct sealing, and air sealing, the evaluation team estimated winter peak demand savings for homes with electric heating only.

Table 60. HEIP Individual Improvements Reported & Verified Gross Per-Unit Savings Values

MEASURE	UNIT OF MEASURE	REPORTED DEEMED SAVINGS			*EX POST* GROSS PER-UNIT SAVINGS		
		KWH	SUMMER KW	WINTER KW	KWH	SUMMER KW	WINTER KW
Attic Insulation – Gas	Home	222	0.19	n/a	58	0.04	0.00
Attic Insulation – Electric	Home	672	0.22	n/a	463	0.03	0.26
Duct Sealing – Gas	Home	1,011	0.89	n/a	515	0.22	0.00
Duct Sealing – Electric	Home	1,920	0.49	n/a	791	0.18	0.25
Air Sealing – Gas	Home	1,431	1.33	n/a	726	0.33	0.00
Air Sealing – Electric	Home	3,013	0.71	n/a	823	0.32	0.11
Heat Pump Water Heater	Water Heater	1,479	0.03	n/a	2,233	0.17	0.48

Table 61 highlights notable differences between reported and verified gross estimates.

Table 61. HEIP Individual Improvements Notable Differences between Reported & Verified Gross

MEASURE	REPORTED SOURCES AND ASSUMPTIONS	VERIFIED GROSS SOURCES AND ASSUMPTIONS	PRIMARY REASONS FOR DIFFERENCES
Attic Insulation	Results from Evaluation of Georgia Power Company's 2014 DSM Programs. Nexant, July 2015.	Mid-Atlantic TRM v9.0 drives primary calculation; Site-specific R-values from program tracking data and average baseline when site-specific was not available.	Baseline R-value averaged approximately R-13, based on available data from sampled sites; Verified savings cooling and heating system efficiencies of 13 SEER and 8.2 HSPF.
Duct Sealing	Georgia Power TRM v2.0; deemed from July 2011 evaluation results.	Algorithms based on Minnesota TRM v3.2; duct leakage reduction based on site-specific pre- and post-leakage reduction CFM from contractor duct blaster tests.	Site-specific duct leakage testing results. Square footage of participating homes was small.
Air Sealing	Georgia Power TRM v2.0; deemed from 2010-2011 evaluation results.	Algorithm based on 2011 Georgia Power evaluation. Site-specific pre- and post-improvement blower door test results used as inputs.	Average CFM50 reduction of approximately 1,000 CFM50; average home size of approximately 1,500 sq. ft.
Heat Pump Water Heater	Georgia Power TRM v2.0; Baseline energy factor 0.90, Installed unit energy factor 2.00.	Georgia Power TRM v2.0; Baseline energy factor 0.90, Site-specific energy factor of installed equipment, averaging 3.66.	Energy factor of equipment installed averaged 3.66, indicating a substantial increase over TRM assumption.

Realization Rates

Table 62 and Table 63 show the Individual Improvements *reported* savings and *verified* gross savings as well as realization rates.

Table 62. HEIP Individual Improvements Reported & Verified Gross Electric Energy Savings

MEASURE	REPORTED ELECTRIC ENERGY SAVINGS (KWH/YR.)	VERIFIED GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)
Attic Insulation	257,349	132,488
Duct Sealing	115,921	52,884
Air Sealing	1,887,459	690,839
Heat Pump Water Heater	158,253	238,952

MEASURE	REPORTED ELECTRIC ENERGY SAVINGS (KWH/YR.)	VERIFIED GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)
Central Air Conditioner	526	526
Total Savings	2,419,509	1,115,689
Individual Improvements Energy Realization Rate		46%

Table 63. HEIP Individual Improvements Reported & Verified Gross Summer and Winter Peak Demand Reduction

MEASURE	REPORTED SUMMER PEAK DEMAND REDUCTION (KW)	VERIFIED GROSS SUMMER PEAK DEMAND REDUCTION (KW)	VERIFIED GROSS WINTER PEAK DEMAND REDUCTION (KW)
Attic Insulation	141	25	50
Duct Sealing	62	17	8.3
Air Sealing	965	297	43
Heat Pump Water Heater	3.6	19	51
Central Air Conditioner	0.1	0.1	0.0
Total Savings	1,172	358	160
Individual Improvements Demand Realization Rate		31%	N/A

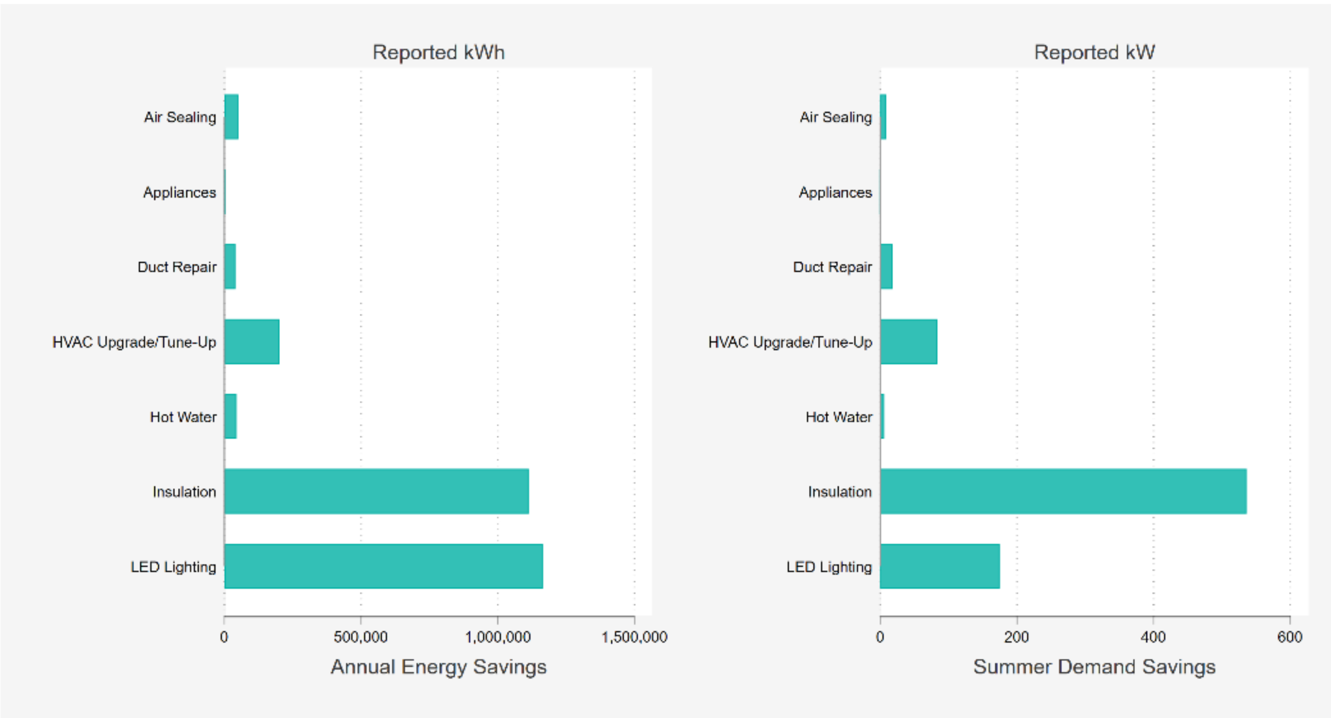
Impact Evaluation: Whole House – Single Family

Description and Performance

Bundled Whole House improvements in single family homes accounted for under 11% of the reported energy savings in HEIP for 2020 and Q1 2021. This longstanding Georgia Power program offers customers a holistic approach to home energy improvements and is driven largely by a network of program contractors. Program eligibility depends on the results of a home energy assessment, which are completed using the Beacon HEA software. A participating program contractor conducts an on-site home energy assessment to determine if a 25% electric energy reduction is possible and what upgrades are needed to achieve the required reductions. The installed upgrades must deliver at least a 25% reduction in annual electric energy use (according to Beacon HEA) to receive a Whole House incentive. Contractors may also recommend that improvements are conducted on an individual basis (through the Individual Improvements program path). Homes are allowed to participate in both the Individual Improvements and Whole House path if the home can still achieve a 25% consumption reduction after the Individual Improvements measure(s) are installed. As shown in Figure 49 in the Individual Improvements section above, this dual participation approach was quite common during 2020 and Q1 2020.

While the 25% reduction in modeled household electric energy consumption can come from any number of upgrades, LED lighting and attic insulation were the two most common upgrades in this cycle and accounted for most of the reported savings. Figure 53 presents the total reported energy and summer demand savings for the first 15 months of the 2020 – 2022 cycle by measure category. LED lightbulbs were the leading measure for energy savings and insulation was the leading measure for summer peak demand savings.

Figure 53. Whole House Single Family Reported Savings by Measure Category 2020 + Q1 2021



While HEIP Whole House continues to be a flagship offering within Georgia Power's residential DSM portfolio for over a decade, the review period for this evaluation was different in several important ways.

- Program delivery was managed in-house by Georgia Power instead of a third-party implementation contractor.
- The COVID-19 pandemic caused disruptions for Georgia Power and its network of HEIP contractors and slowed customer participation. Participation was lower in part because marketing for the program was paused for much of 2020 due to the pandemic. Safety protocols also limited the ability of contractors to visit homes and perform upgrades for much of 2020. When marketing resumed, it was focused on do-it-yourself Individual Improvements measures to avoid having a contractor enter customers' homes.
- The pandemic limited Georgia Power staff's ability to perform in-person QA/QC, and instead relied on photo QA/QC.
- Most homes participated in both the Whole House and Individual Improvements path rather than just the Whole House path. The most common Individual Improvements measure completed as part of these dual participation projects was air sealing.

- A single contractor was responsible for 77% of the reported energy and peak demand savings within Whole House Single Family. This contractor worked in a small geographic area in Northwest Georgia and primarily treated rental properties. Figure 54 shows a time-series view of reported energy savings with the most active contractor and all other contractors grouped separately. Importantly, it should be noted that the demographics of the customers served by this contractor appear to be different from other contractors, and different from past participants. Figure 55 compares the distribution of survey responses regarding household income for the most active contractor and all other contractors.

Figure 54. Reported Energy Savings by Month and Contractor

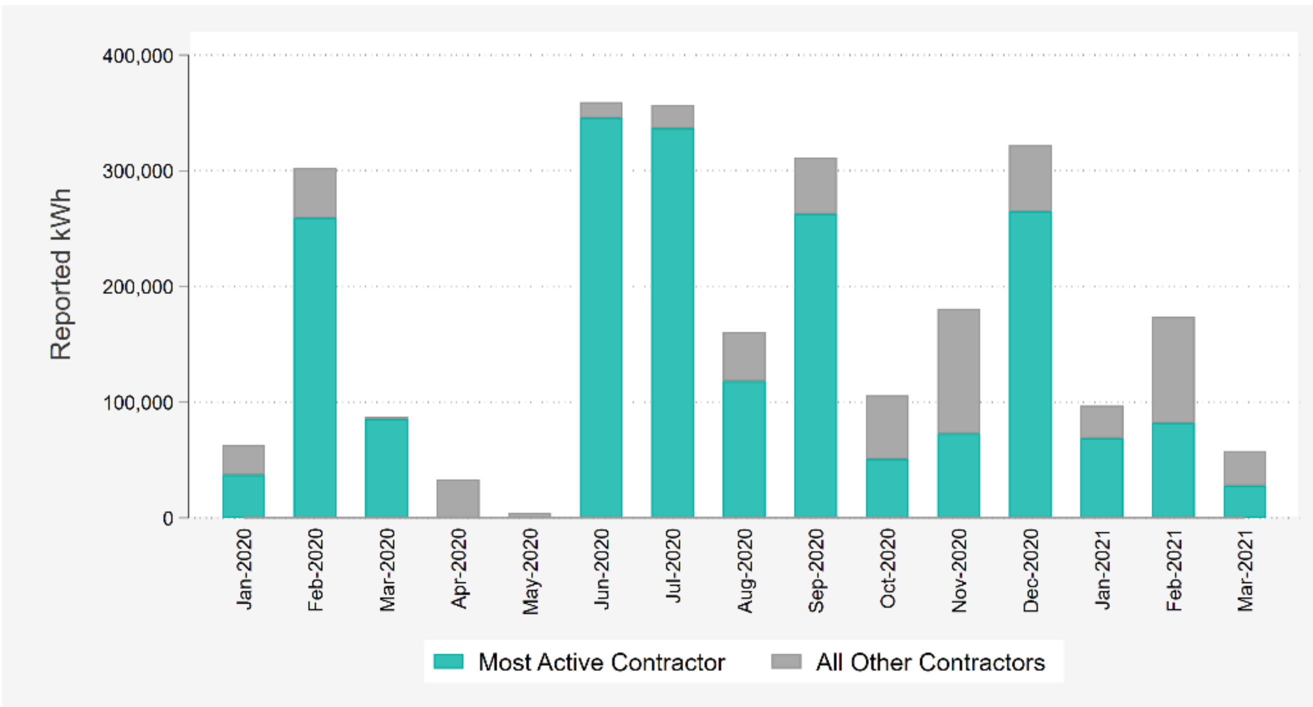
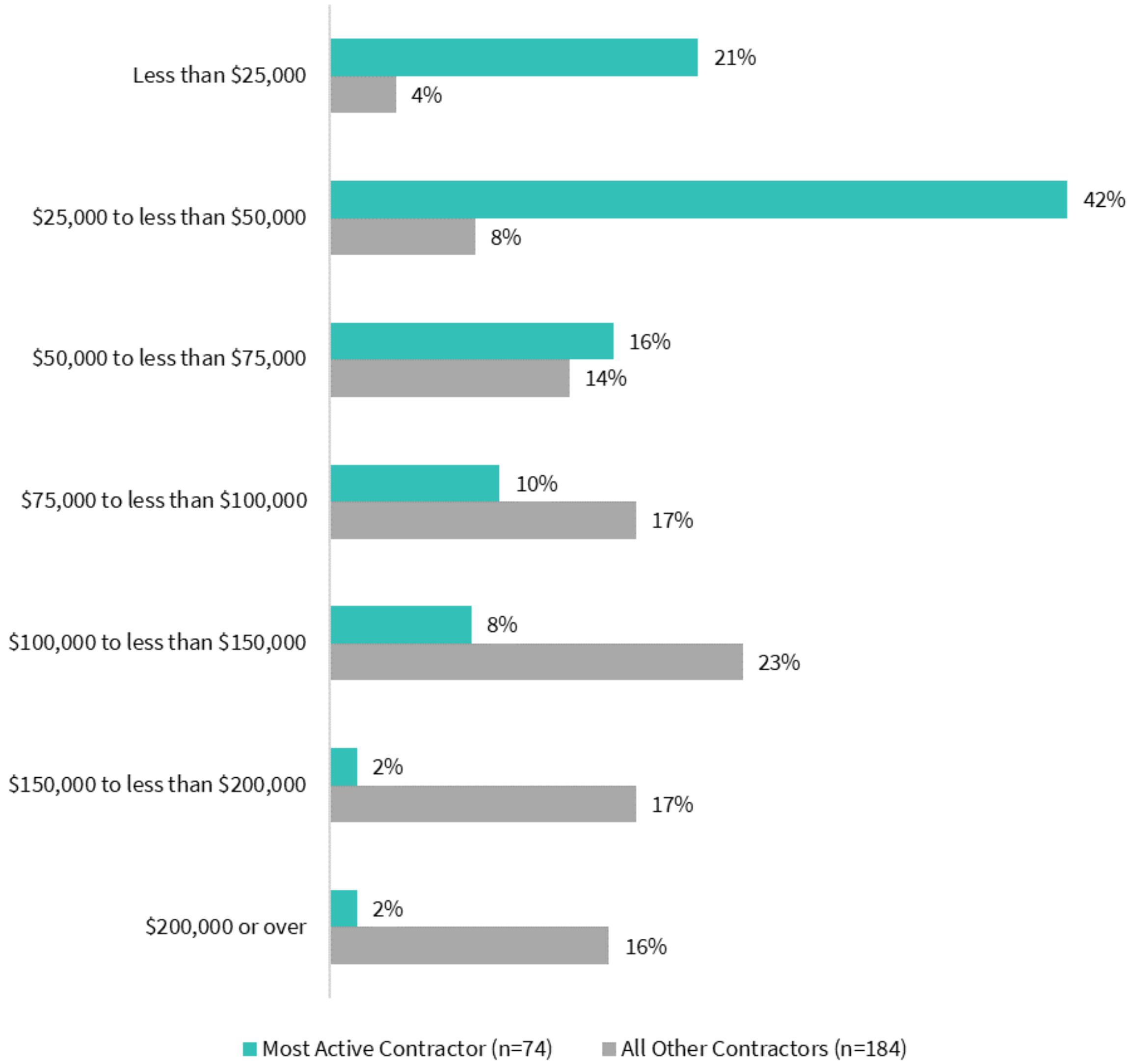


Figure 55. Distribution of Household Income – 2020 and Q1 2021



Note the percentages may not sum to 100% due to rounding.

To underscore the difference in the housing stock serviced during this cycle, Table 64 and Table 65 summarize the annual consumption and home sizes analyzed in the 2011, 2014, and 2017 evaluations. Table 66 shows similar metrics for this evaluation for comparison. In the current cycle and all prior cycles, the reported savings for each participating household were estimated using the Beacon HEA energy simulation software. In prior cycles, Nexant estimated verified savings using a pre-post billing analysis to estimate weather-normalized energy consumption before and after the installation and then calculated savings as the difference between the estimate of pre-retrofit and post-retrofit consumption. Tracking data for the current cycle does not distinguish homes by heating fuel, but prior cycles did so we preserve that distinction below. [46]

Three key trends emerge when we compare Table 64 and Table 65, with Table 66.

- **Single family homes participating in the Whole House path to date in this cycle are smaller on average than prior cycles**. This is evident in the square footage and weather normalized pre-retrofit kWh columns.

- **Despite serving smaller homes, the average reported savings per household is consistent with prior cycles**. We include the claimed savings from Individual Improvements measures (if applicable) in this comparison. The average reported savings per home represents 33% of the evaluation team's estimate of pre-retrofit annual consumption based on an analysis of participants' billing histories.

- **Realization rates for HEIP Whole House have been consistently low across each of the three prior impact evaluations**. Historically, verified savings determined via billing analysis have been lower than the claimed savings generated by Beacon HEA. Based on the results of prior evaluations, we would expect a home that shows 25% savings in Beacon HEA to experience ~10 to 15% savings in billed electric consumption.

Table 64. Prior Evaluation Results for Electric Heat Homes – Per Home Averages

EVALUATION CYCLE	AVERAGE CLAIMED KWH	WEATHER NORMALIZED PRE-RETROFIT KWH	VERIFIED KWH	AVERAGE % REDUCTION IN ANNUAL ELECTRIC CONSUMPTION	REALIZATION RATE	AVG. HOME SQUARE FOOTAGE
2011 (25% Reduction)	4,789	18,430	3,223	17%	67%	-
2014 (25% Reduction)	4,892	18,882	2,916	15%	60%	2,552
2017	4,563	19,249	1,763	9%	39%	1,936

[46] During the 2011 and 2014 evaluation cycles, Georgia Power offered three savings packages for 20%, 25%, and 30% reductions for whole home energy usage. The 25% reduction group is used in the tables for continuity with the current program offering

Table 65. Prior Evaluation Results for Gas Heat Homes – Per Home Averages

EVALUATION CYCLE	AVERAGE CLAIMED KWH	WEATHER NORMALIZED PRE-RETROFIT KWH	VERIFIED KWH	AVERAGE % REDUCTION IN ANNUAL ELECTRIC CONSUMPTION	REALIZATION RATE	AVG. HOME SQUARE FOOTAGE
2011 (25% Reduction)	3,797	13,836	1,755	13%	63%	-
2014 (25% Reduction)	3,700	17,916	1,946	11%	53%	2,691
2017	3,936	14,364	1,413	10%	36%	2,041

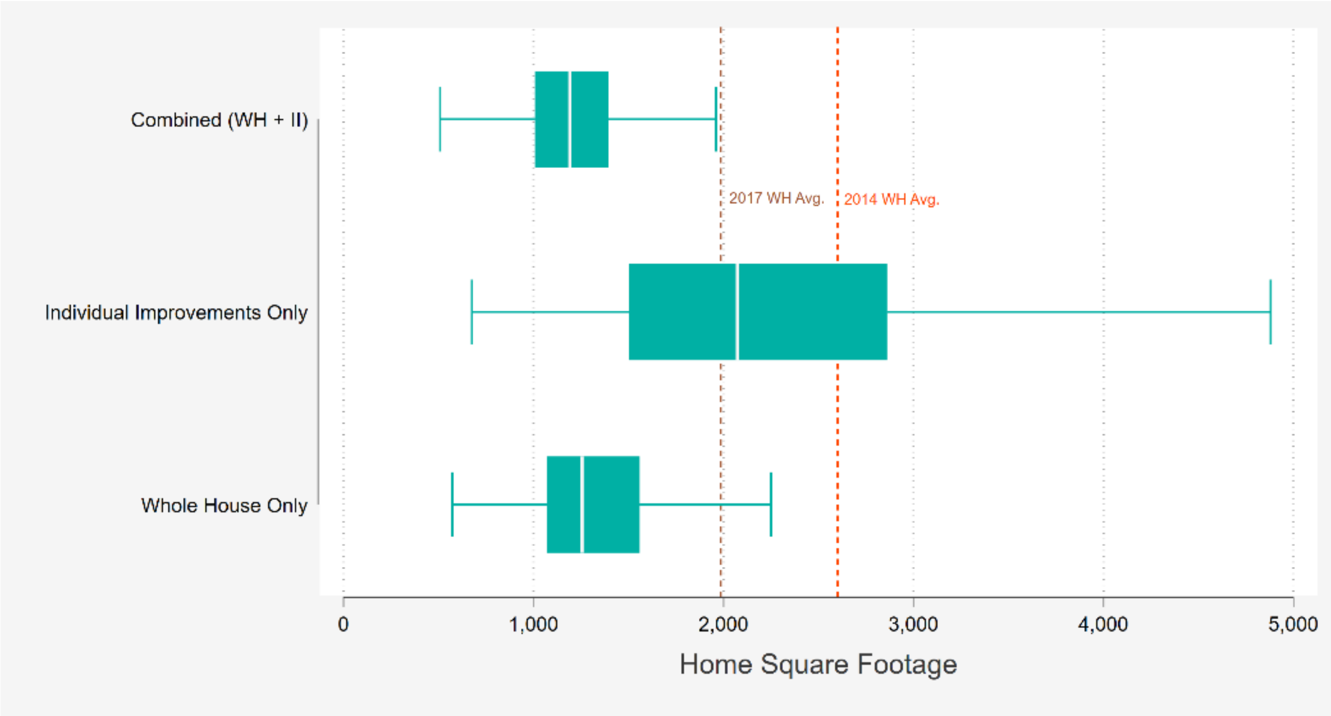
Table 66 shows the Whole House path characteristics for the current evaluation cycle. Because dual participation was so common, we include the reported savings from Individual Improvements in homes that also participated in the Whole House track. The estimate of pre-retrofit annual energy is based on the evaluation team's regression analysis of utility bills using the same methods as the three prior cycles.

Table 66. Evaluation Cycle 2020

EVALUATION CYCLE	AVERAGE CLAIMED WHOLE HOUSE KWH	AVERAGE CLAIMED INDIVIDUAL IMPROVEMENTS KWH	AVERAGE TOTAL CLAIMED KWH	WEATHER NORMALIZED PRE-RETROFIT KWH	AVG. HOME SQUARE FOOTAGE
2020 – 2022	2,881	1,588	4,469	13,402	1,270

Figure 56 shows the distribution of home sizes by participation path during the first 15 months of the 2020-2022 cycle. The green box stretches from the 25th percentile to the 75th percentile and the white line represents the median. For comparison, the figure shows the average size of homes that participated in the Whole House path during the two previous cycles. Homes serviced through the Whole House path during 2020 and Q1 2021, either standalone or in combination with an Individual Improvements measure, tended to be smaller than Whole House homes in prior cycles or Individual Improvements homes in this cycle.

Figure 56. Distribution of Home Square Footage by Program Path



Verified Gross Savings Approach

While the evaluation team was unable to quantitatively verify savings for the Whole House Single Family track, the team completed several impact evaluation activities that resulted in findings to inform program design and delivery. The impacts of the COVID-19 pandemic and frequency of dual participation across the Whole House and Individual Improvements paths caused the evaluation team to pivot from the original EM&V plan for HEIP Whole House Single Family. Safety protocols did not allow for in-person site visits until July 2021, so the team increased the desk review sample size and lowered the number of originally planned site inspections. Approximately half of the site inspections were completed virtually.

Additionally, the approved EM&V plan for HEIP Whole House primarily called for a "calibrated simulation" approach to estimate verified gross savings for this program component. This procedure multiplies the results of the consumption analysis by the percent savings estimated by the Beacon HEA software. For example, if the weather normalized pre-retrofit consumption estimate for the sample home shown in Figure 57 (shown later in this section) was 10,000 kWh/year, the gross verified savings for the home would be 10,000 * 32.8% = 3,280 kWh. The evaluation team identified several concerns with this approach:

- Most participants in the Whole House Single Family track also completed an Individual Improvements installation. As a result, the pre-retrofit consumption estimated via billing analysis is the wrong baseline. Baseline consumption would need to be adjusted to reflect savings from the Individual Improvements measure, to avoid double counting.

- Approximately one-third of Whole House Single Family participants had less than 12 months of billing history at the retrofitted premise prior to project completion. The evaluation team attributes this finding to the large proportion of rental properties serviced by the most active contractor.
- Homes with a full 12 months of billing history had a mixture of billing records that spanned before and during the pandemic, which further complicates the weather normalization procedures.
- Prior evaluation results have consistently shown Beacon HEA percent savings to overstate the actual energy savings in participating homes.
- Site inspections revealed that key attributes like heating fuel, water heating fuel, and air conditioning system type were not always entered correctly in the Beacon HEA report. For example, at two of the eight homes receiving in-person site visits, the evaluation team found the space heating fuel in Beacon HEA was incorrect. If the Beacon HEA tool thinks that a home with electric heating has natural gas heat, savings estimates from weather dependent upgrades like attic insulation are unreliable. As noted previously, Georgia Power has worked with the contractor and taken corrective action to ensure that these data will be collected and documented accurately going forward.
- Site inspections revealed inconsistencies between the existing conditions for attic insulation reported in Beacon HEA and in the field. Two of the eight homes in the evaluation on-site sample had at least some attic insulation prior to HEIP participation but were entered as having zero attic insulation. Because Beacon HEA uses the change in R-value to calculate savings, this data entry issue creates further concerns with the Beacon HEA percent savings estimates. As noted previously, Georgia Power has worked with the contractor and taken corrective action to ensure that these data will be collected and documented accurately going forward.
- As shown in Figure 53 (above), direct installation of LED lightbulbs accounted for 45% of all claimed energy savings for the Whole House Single Family track during the first 15 months of the 2020 – 2022 cycle. By default, the Beacon HEA simulation tool assigns 55.8 kWh of annual energy savings to each installed LED. This is approximately 75% higher than the gross verified per-unit savings for LED lamps elsewhere in the residential portfolio. Some participants also indicated that the replaced lightbulbs were CFLs. The wattage differential and resulting energy savings from converting a CFL to an LED is considerably lower than the incandescent to LED change assumed in Beacon HEA.

Upon review and completion of other evaluation tasks, the evaluation team determined that the COVID-19 pandemic and resulting impact on program design and delivery was too significant to allow for an accurate estimate of savings, and ultimately abandoned the calibrated simulation approach. The evaluation team considered moving to a regression-based analysis but decided that the prevalence of rental properties with inconsistent occupancy, dual participation in Individual Improvements, and the COVID-19 pandemic created too many confounding factors to reliably measure program savings using billing analysis. Instead, the team completed several impact evaluation activities to help inform current program performance and future program planning. Table 67 lists the samples sizes for each completed evaluation activity and is followed by a description of each activity.

Table 67. Whole House Single Family Evaluation Sample Sizes

EVALUATION ACTIVITIES	NUMBER OF PROJECTS
Database Review	Census
Engineering Reviews of Program Documentation	50
Consumption Analysis	Census
In-Person Site Inspection	8
Virtual Site Inspection	7
Web/Phone Survey	100

Database Review

The VisionDSM tracking system stores all key information for HEIP Whole House Single Family and is the system of record for all reported gross energy and peak demand savings values. Although projects and incentives are assigned at the household level, savings are computed at the measure level in the Beacon HEA tool and stored at the measure level in VisionDSM. The evaluation team reviewed tracking data and independently replicated the reported savings totals for the first 15 months of the 2020 – 2022 cycle. The evaluation team collected participant and contractor contact information from the tracking data and gathered account numbers for the billing data request. Participant email contact information for Whole House Single Family was generally poor because the field often contained the contractor's email instead of the participant's email address.

When a household participates in both the Whole House and Individual Improvements paths, Georgia Power assigns separate project numbers. The evaluation team merged the Whole House and Individual Improvements tracking data by account number and service address to identify dual participation households.

Engineering Desk Reviews

For a sample of 50 Whole House Single Family projects, the evaluation team downloaded and reviewed supporting documentation from VisionDSM. In addition to the Beacon HEA report, project documentation included contractor invoices, equipment specification sheets, and photographs. The team cross-checked measure list and quantity between the Beacon HEA reports and program tracking data and found the data to be perfectly aligned in all cases. Evaluation team engineers also cataloged key information about the home and recommended upgrades that are shown in the Beacon HEA report but not captured in the program tracking data. This review provided insights regarding the baseline insulation levels contractors entered in the Beacon HEA tool and informed assumptions about average HVAC efficiency in the Individual Improvements analyses. During site visits technicians sought to independently verify the project-specific details recorded during the engineering desk reviews.

Figure 57. Home and Measure Information Extracted from Beacon HEA Reports

Description of Existing Home

House Type:	Single-Family Detached
Conditioned Floor Area:	1456 Sq.Ft.
Number of Bedrooms:	3
Number of Occupants:	2
Year Home Was Built:	Post 2005
Stories Above Grade:	1
Primary Foundation Type:	Slab

Existing Systems

Heating Systems:	80 AFUE Natural Gas Furnace / Central AC
Cooling Systems:	13 SEER Furnace / Central AC
Water Heating Systems:	40-Gallon Natural Gas Storage (Tank)

Home Improvement Recommendations

As a result of the Home Performance Assessment, we recommend the following improvements for your home:

Measure Category	Existing Condition	Improved Condition	Estimated Annual Savings
Insulation			
Attic Insulation - Attic Area 1	Area is not currently insulated	Insulate 1456 square feet w/ Fiberglass (open blow): 14 inches	$335.55
Domestic Hot Water System			
Water Heater - System 1	Current DHW system is 2006-2014 Storage (Tank) with energy factor (EF) of 0.54	Performance Tune-Up or Repair	$1.08
Water Heater Temperature - System 1		Change the Water Heater Temperature - System 1 to 120 F	$27.05
Lighting, Appliances & Smart Strips			
Replacement Lighting		Install 24 Energy Efficient Lamps	$160.83

Consumption Analysis

The evaluation team conducted a consumption analysis to validate the Beacon HEA estimate of pre-retrofit annual electric usage. In the Beacon HEA tool, contractors can enter actual consumption records for a home. However, this functionality is not integrated with Georgia Power's Customer Information System, so the process is manual and requires participants to provide their billing records. Absent actual billing records, the Beacon HEA software estimates annual consumption of the home based on size, vintage, number of occupants, heating fuel, and other attributes entered by the auditor. The evaluation team requested monthly billing records for participants since January 2018 and estimated pre-retrofit weather normalized annual consumption via regression analysis. Figure 58 shows a sample output from a Beacon HEA report. The recommended upgrades to this home are projected to save 3,737 kWh per year, or 32.8% of the estimated annual consumption of 11,393 kWh.

Figure 58. Sample Beacon HEA Report

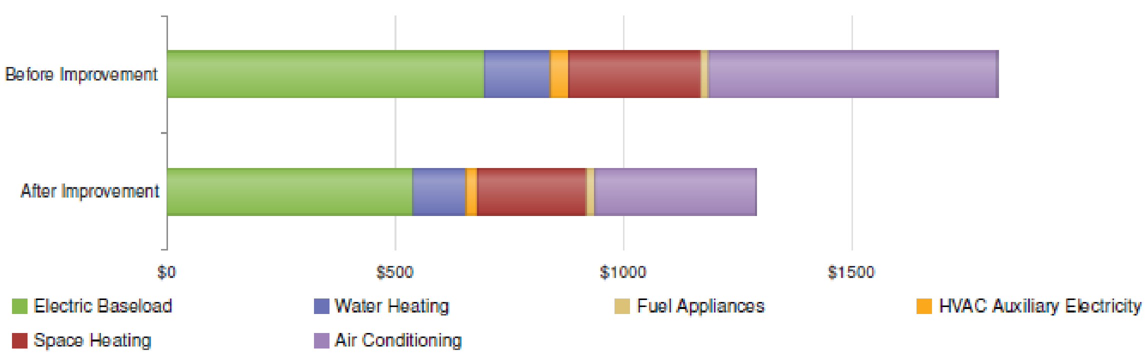
Your Estimated Annual Energy Savings

The following table shows the projected energy savings from the proposed measures, broken into the same major categories of use in your home as shown in the analysis of current energy usage on Page 2. For each category, the table provides the projected annual dollar savings, a breakdown of the savings by fuel type and the percentage of energy saved relative to your existing usage.

End Use Category	Electricity kWh	Natural Gas Therms	Electricity kW	Cost Savings	Percent Energy Savings
Space Heating Savings	N/A	44	N/A	$48	16.6%
Air Conditioning Savings	2,286	N/A	1.21	$274	43.6%
Water Heating Savings	N/A	26	N/A	$28	19.5%
Electric Baseload Savings	1,340	N/A	0.20	$161	23.0%
HVAC Auxiliary Electricity Savings	110	N/A	N/A	$13	33.0%
Total Project Savings	3,737	70	1.41	$525	N/A
Total Percent Savings	32.8%	16.9%	N/A	28.8%	24.6%

Projected Reduction in Annual Utility Costs

If you install all of the measures recommended above, your projected annual energy cost savings would be $525 and would potentially change as follows by end use category:



Site Inspections

The evaluation team completed eight in-person and four virtual site visits with participants who received both an Individual Improvements and Whole House project at their home. The team completed three additional virtual site visits with participants who only completed a Whole House project. Whether completed in-person or virtually, the objective of a site inspection is to independently verify the installation of all claimed measures and the accuracy of the home characteristics that can affect savings such as heating fuel and water heating fuel. Where observable, field staff collected information on both existing conditions and improved conditions to report on the accuracy of the characteristics entered by contractors.

Participant Surveys

The evaluation team completed 100 surveys with Whole House participants. Participants in the Whole House Single Family track were surveyed both online and by phone. Like site inspections, participant surveys seek to independently confirm the type and quantity of efficiency upgrades stored in the program tracking data. While site inspections go in-depth with a limited number of participants, participant surveys allow us to perform lower rigor verification with many participants.

Gross Savings Key Findings

Below we provide an overview of the key findings stemming from our impact evaluation activities.

Beacon HEA Modeling Assumptions

Impact evaluation results have consistently underperformed the electric savings assumptions in Beacon HEA since the evaluation of Georgia Power's 2011 DSM Portfolio. The evaluation team believes that assumptions that feed into the utility bill disaggregation feature are potentially inaccurate, including that water heating, appliances, and other baseloads are underrepresented and heating and cooling consumption are overstated. LED savings are also high as they generally assume all replaced lamps are incandescent and have a higher hour of use than the assumptions used for the Specialty Lighting program. Ideally, baseline wattages should be collected by the contractor and the hours of use should be aligned with the rest of the residential portfolio.

Participation Dominated by a Single Contractor

The Whole House path is designed to be sold and marketed by a network of approved program contractors. In 2020, volume lagged for most contractors due to the pandemic, while one contractor ramped up production. This contractor's jobs are different in two distinct ways: (1) participant home characteristics and (2) depth/quality of upgrades.

The jobs occurred in homes that are different from the home characteristics assumed in the current HEIP planning estimates. Specifically, the homes served by this contractor tended to be older, smaller, rental homes, and occupants had a lower income than customers served by other contractors and historical HEIP participants. These homes were also located in a very specific geographic location in a small city in northwest Georgia. This deviates significantly from average participants who typically participate in the HEIP Whole House program via other contractors in more "typical" years. This likely indicates that impacts to energy and demand estimated across the evaluated timeframe are not directly comparable to past years and may not be meaningfully representative of potential program performance to be used in planning for future years. Table 64, Table 65, and Table 66 showed that the average square footage of Whole House Single Family homes during the evaluation period was 1,270 square feet compared to averages of 2,000 to 2,500 square feet in prior cycles. The energy savings potential, end use breakdown, and demographics of these smaller homes can be quite different from larger single family homes.

The home types, customer demographics, and discrete geographic location also limited the evaluation team's ability to conduct certain analyses (such as a billing analysis) to estimate savings, as finding a reliable and accurate matched comparison group to this very specific demographic is difficult, if not impossible.

In many cases, the home energy assessment, Individual Improvement(s), and Whole House upgrades all happened on the same day within an hour or two. Often there was no out-of-pocket cost to the tenant or homeowner for the job and they never saw the Beacon HEA report, which is more similar to how a direct install program might work compared to how the Whole House path has typically operated.

Dual Participation

Dual participation was allowed if a home could achieve a 25% energy reduction after installing an Individual Improvements measure. Under the 2020 – 2022 program design, there is not a way for incentive amounts to scale based on the percent improvement. A project achieving 40% reduction in Beacon HEA gets the same incentive as a project achieving 25% reduction, meaning contractors are motivated to shift any measures possible from Whole House to Individual Improvements to maximize the incentive amount. As described above, however, this limits the ability of the program to account for interactive effects and accurately assess energy savings resulting from these projects.

Accuracy of Home Energy Audit Data Collected

During site visits, the evaluation team identified that home characteristic and baseline information was often not being captured correctly in Beacon HEA, driven by the most active contractor. Home and system characteristics like square footage, heating fuel, and water heating fuel are critical inputs that feed into energy savings calculations; for some projects these basic characteristics were found to be captured incorrectly in Beacon HEA during the on-site visit. Baseline conditions are similarly important. In several homes, the evaluation team found that the baseline condition entered for attic insulation as "0," but upon inspection the team found evidence of prior insulation.

Table 68 illustrates the importance of accurate existing insulation levels in energy modeling software. The outputs in the table come from Georgia Power's EnerSim modeling results as documented in the TRM, but the trend should hold true in Beacon HEA as well. Going from no insulation to some insulation saves a significant amount of energy, but there are diminishing returns on a per-inch or per-R-value basis in homes with existing insulation. At least a subset of homes in Whole House Single Family would not have shown 25% savings in Beacon HEA if the baseline insulation level had been entered correctly.

Table 68. EnerSim Modeling Results for Attic Insulation Upgrades – Georgia Power TRM V2.0

TRM MEASURE	MODELED HOME SIZE (SQUARE FEET)	HVAC SYSTEM	ANNUAL ENERGY SAVINGS (KWH)
Ceiling Insulation R0-R38	2,200	3.11-ton ASHP – 9.2 SEER	4,146
Ceiling Insulation R11-R38	2,200	3.11-ton ASHP – 9.2 SEER	1,863
Ceiling Insulation R19-R38	2,200	3.11-ton ASHP – 9.2 SEER	803
Ceiling Insulation R30-R38	2,200	3.11-ton ASHP – 9.2 SEER	221

In on-site visits as well as surveys, the evaluation team asked customers if they recalled the installation of measures installed in their homes per Beacon HEA. Overall, customers frequently remembered attic insulation and lighting, but sometimes did not recall other measures installed or services performed. Most notably, most on-site participants (five out of eight) did not recall a blower door test being performed at their home, which is a critical input to building envelope measures.

The evaluation team communicated these concerns as soon as possible with the Georgia Power team, who has taken steps to conduct additional QA/QC with this contractor and address these findings. It should be noted that all projects reviewed by the evaluation team were conducted during a time in which Georgia Power was not able to conduct in-person QA/QC with contractors and had to rely on contractor-submitted photos and other verification.

Realization Rates

Table 69 shows the evaluation team's recommended values for verified gross and verified net savings for the Whole House Single Family track. As discussed previously, we recommend using the energy and demand realization rates from the 2017 evaluation going forward because the housing stock, participant demographics, and contractor mix in 2020 are not expected to be representative of the program for the remainder of this cycle and beyond. The net-to-gross ratio of 74% shown in Table 69 is inclusive of freeridership and participant spillover but does not include nonparticipant spillover.

Table 69. HEIP Whole House Single Family

SAVINGS TYPE	AGGREGATE SAVINGS		
	KWH	SUMMER KW	WINTER KW
Reported Gross 2020 + Q1 2021	2,615,898	827	N/A
Realization Rate [a]	37%	40%	N/A
Verified Gross 2020 + Q1 2021	**973,114**	**330**	**241**
Net-to-Gross Ratio [a]	74%		
Verified Net 2020 + Q1 2021	**721,077**	**244**	**179**

[a.] *Referenced from 2017 Georgia Power EM&V report and applied to 2020-2021 savings; see Net-To-Gross section below for additional detail.*

Impact Evaluation: Whole House – Multifamily

Verified Gross Savings Approach

The Multifamily component of HEIP's Whole House program was evaluated independently from the Single Family component of the program. A total of 43 multifamily projects were completed during the evaluation period accounting for 292 individual dwelling units. Almost 94% of reported kWh savings in this track came from legacy projects that were initiated during the 2017 – 2019 cycle but completed and paid during this cycle. Eighteen of the projects took place at one of two large residential developments. The 18 projects accounted for 222 of the 292 dwelling units, and approximately 70% of the overall Whole House – Multifamily reported savings.

Engineering Desk Reviews

A sample of 22 projects were selected for detailed desk review of the supporting documentation gathered during implementation. The evaluation team obtained project files for these projects which included program applications, contractor work orders, invoices, Beacon HEA reports, and other related documents. The evaluation team reviewed the documents for all 22 projects, focusing primarily on each project's Beacon HEA report.

Each Beacon HEA report provides total electricity and natural gas savings, as well as a percentage savings for each. By dividing the savings magnitude by the percentage savings for each sampled project, the evaluation team was able to extrapolate the baseline electricity and gas consumption the Beacon HEA model assumed for each unit. For homes with any gas usage (water heating and/or space heating), the average extrapolated consumption was 256 therms per year per dwelling unit. For those same homes, the average extrapolated electricity consumption was 8,139 kWh per year. For all-electric homes in the sample, the extrapolated baseline electricity consumption was 9,484 kWh per year. The average square footage of the dwelling units in the sample set was 764 square feet, ranging from 578 square feet to 1,320 square feet.

Site Visits

The verified gross savings evaluation effort for the Whole House Multifamily component culminated with a set of site visits targeted at the two largest housing developments that participated in the program, one in Stone Mountain and one in Douglasville. A total of six dwelling units were visited by the evaluation team across the two complexes. The visits focused on measure installation verification and questioning site contacts regarding baseline conditions. The following is a partial list of what was inspected, as applicable, during site visits:

- Window vintage, glazing, and sealing
- Entry door weather stripping
- Perimeter wall outlet and switch box gasketing
- Ductwork arrangement, location, sealing, and insulation
- HVAC system type, configuration, vintage, capacity, and efficiency level
- Domestic hot water heater type, capacity, volume, and presence of heat trap
- Location, make/model, age, condition, and ENERGY STAR rating of clothes washer, dishwasher, and refrigerator
- Type, wattage, and quantity of lightbulbs

Engineering Calculations

Findings from the site visits were used to calculate verified gross savings for all projects associated with each of the two housing developments. Several measures accounted for in the projects' Beacon HEA reports were either not found on-site or did not exceed code minimum baseline efficient levels. Note that the COVID-19 pandemic limited Georgia Power staff's ability to perform in-person QA/QC. The evaluation team calculated verified gross savings using the following steps:

1. For each measure that was not installed or did not meet efficiency criteria, the dollar savings value was taken from the Beacon HEA report.
2. The dollar savings for each measure was divided by the $0.12 per kWh cost of electricity noted in the Beacon HEA reports to calculate measure-level savings. Beacon HEA only reports dollar savings at the measure level, not energy savings.
3. The calculated measure-level savings for each applicable measure was subtracted from the project's reported savings to determine that project's verified energy savings.

4. To calculate summer and winter demand savings, a weighted-average demand-to-energy ratio was developed. Demand-to-energy ratios for each relevant end-use were weighted by the contribution of each measure's savings.

5. The winter and summer demand-to-energy ratios were multiplied by each project's energy savings to calculate summer and winter demand savings.

Additional detail on site visits and resulting verified gross energy savings calculations can be found in Appendix 4B. Multifamily Site Visit Results and Verified Gross Savings Results

Verified Gross Results

Table 70 highlights notable adjustments made to *reported* gross savings to determine *verified* gross estimates using the steps described above.

Table 70. HEIP Whole House – Multifamily Notable Adjustments to Reported Gross Savings to Determine Verified Gross Savings

MEASURE	REPORTED SOURCES AND ASSUMPTIONS	ADJUSTMENT MADE AND PRIMARY REASONS FOR ADJUSTMENT
Dishwasher	Beacon HEA attributes $20.14 savings to ENERGY STAR dishwashers, or 168 kWh.	Dwelling units at both Stone Mountain and Douglasville developments did not have dishwashers. Savings were removed.
Clothes Washer	Beacon HEA attributes $44.40 savings to ENERGY STAR clothes washers, or 370 kWh.	Except in the handicap-accessible dwelling units, which had new front-loading clothes washers, the new top-loading clothes washers were not ENERGY STAR certified models. Savings were removed since the installed units are code-minimum efficiency. This adjustment only applies to the Stone Mountain complex.
Heating System	Beacon HEA attributes between 296 kWh and 361 kWh for savings from air source heat pumps.	Units installed were code minimum, or in some cases marginally better than code. Savings were removed or reduced to reflect the marginal efficiency gain relative to code. A portion of the savings attributed to this end use in Beacon HEA (22%) accounts for the applicable savings from duct sealing to the end use. Duct sealing savings was added back to accurately account for the savings from the duct sealing measure.
Central Air Conditioner	Beacon HEA attributes between 220 kWh and 456 kWh for cooling savings from air source heat pumps.	Units installed were code minimum, or in some cases were marginally better than code. Savings were removed or reduced to reflect the marginal efficiency gain relative to code. A portion of the savings attributed to this end use in Beacon HEA (22%) accounts for the applicable savings from duct sealing to the end use. Duct sealing savings was added back to accurately account for the savings from the duct sealing measure.

Table 71 shows the reported savings and verified gross savings on a dwelling unit basis for two housing developments, one in Stone Mountain and one in Douglasville. For the Stone Mountain development, the verified gross savings excludes savings associated with dishwashers and most clothes washers, as well as the portion of the cooling and heating end use savings associated with air source heat pump equipment upgrades.[47] The savings from duct sealing, 22% of reported savings for the heating system and central air conditioner end uses, was retained. For the Douglasville development, the verified gross savings excludes savings associated with dishwashers, as well as the applicable portion of the cooling and heating savings associated with air source heat pump equipment upgrades.

Table 71. HEIP Whole House Multifamily Reported & Average Verified Gross Savings Values Per Dwelling Unit for Subject Buildings

HOUSING DEVELOPMENT LOCATION	BUILDING	QUANTITY OF DWELLING UNITS	REPORTED SAVINGS			VERIFIED GROSS PER-UNIT SAVINGS		
			KWH	SUMMER KW	WINTER KW	KWH	SUMMER KW	WINTER KW
Stone Mountain	A	16	3,075	0.62	n/a	2,101	0.81	0.79
Stone Mountain	B	16	3,062	0.61	n/a	2,086	0.81	0.79
Stone Mountain	C	16	3,062	0.61	n/a	2,087	0.81	0.79
Stone Mountain	D	16	3,113	0.63	n/a	2,145	0.83	0.81
Stone Mountain	E	16	3,075	0.62	n/a	2,102	0.81	0.80
Stone Mountain	F	16	3,077	0.62	n/a	2,475	0.96	0.94
Stone Mountain	G	16	3,079	0.61	n/a	2,101	0.81	0.79
Stone Mountain	H	16	2,906	0.60	n/a	1,921	0.74	0.73
Stone Mountain	I	16	2,991	0.61	n/a	2,013	0.78	0.76
Stone Mountain	J	16	2,943	0.60	n/a	1,959	0.76	0.74
Stone Mountain	K	6	3,109	0.69	n/a	2,151	0.83	0.81
Stone Mountain	L	4	3,258	0.72	n/a	2,318	0.90	0.88
Douglasville	5	10	4,324	1.04	n/a	3,681	1.41	1.38
Douglasville	6	10	4,361	1.03	n/a	3,745	1.44	1.41
Douglasville	7	8	4,337	1.04	n/a	3,710	1.42	1.40
Douglasville	8	5	4,440	1.05	n/a	3,853	1.48	1.45
Douglasville	9	8	4,238	1.02	n/a	3,540	1.36	1.33
Douglasville	10	11	4,301	1.03	n/a	3,575	1.37	1.34
Evaluation Sample Total		222	742,746	159		548,871	212	207

[47] Clothes washers in Building F, which consists of handicap units, were ENERGY STAR rated. The savings for those clothes washers was retained.

Realization Rates

Table 72 shows the *reported* and *verified* savings totals for the Whole House Multifamily component of HEIP during the first 15 months of the 2020 – 2022 cycle. For comparison, the energy realization rate from this program component in the 2017 evaluation was 73% and the summer demand realization rate was 69%.

Table 72. 2020 + Q1-2021 HEIP Whole House – Multifamily Reported & Verified Gross Energy Savings and Summer and Winter Peak Demand Reduction

SAVINGS TYPE	REPORTED GROSS SAVINGS	VERIFIED GROSS SAVINGS	REALIZATION RATE
Energy (kWh)	1,067,096	788,558	74%
Summer Demand (kW)	250	305	122%
Winter Demand (kW)	N/A	298	N/A

Verified gross energy savings was determined by applying the overall realization rate from the sampled projects to the total Whole House Multifamily reported gross energy savings. The summer and winter demand savings were calculated by distributing the overall verified gross energy savings for each measure category across measure-specific end use load shapes.

Net-To-Gross

For all Individual Improvements and Whole House projects, the evaluation team recommends carrying forward the net-to-gross ratios from the 2017 evaluation (without nonparticipant spillover, as that is not included this cycle).

This decision was primarily driven by the following considerations:

- COVID-19 implications on program design and delivery. As discussed previously, the Whole House and Individual Improvements pathways of the HEIP program did not operate typically during the evaluation period. Participation was dominated by one contractor, who offered services to lower-income customers typically in rental homes, in a specific geographic region. This resulted in a skewed and homogeneous participant group, that does not represent typical program operations and would not be appropriate to use for future planning.

- Data collection challenges. Related to the above bullet, the evaluation team had challenges reaching customers for customer surveys (discussed in detail below). Many customers were missing key contact details in the tracking data, as contractor contact data were populated instead. While the team was able to merge on contact information from other sources to reach some customers, it is likely that this introduced biases to our data collection that would impact the accuracy of net-to-gross results. Additionally, landlord contact information was not tracked in the data base, which would have likely been necessary to accurate assess NTG for rental properties.

Below we present estimates of net-to-gross for both the Individual Improvements and Whole House pathways. The 2017 evaluation report does not delineate net-to-gross findings between single family and multifamily projects, so these are presented at the pathway level. These incorporate both 2017 EM&V freeridership and participant spillover results, but not nonparticipant spillover.

Table 73. Estimated Net-to-Gross Based on 2017 Evaluation Findings

SAVINGS TYPE	2017 - ESTIMATED FREERIDERSHIP	2017 - ESTIMATED PARTICIPANT SPILLOVER	ESTIMATED NET-TO-GROSS RATIO FOR FUTURE PLANNING
Individual Improvements	38%	4%	66%
Whole House	27%	1%	74%

Process Evaluation

The evaluation team completed customer surveys and contractor interviews in July and August 2021 as part of the process evaluation. Customer surveys were a key method to gain an understanding of customer experiences and satisfaction with different aspects of HEIP, including but not limited to the ease of the program participation process, interactions with program auditors/contractors, and timeliness of the rebate check being issued. In addition, we included questions to gain an understanding of why customers participated and to seek recommendations for program improvement.

The evaluation team also interviewed contractors who were active in HEIP. Contractors are the cornerstone of HEIP outreach and program delivery and are often the face of the program to a customer. Our interviews with program contractors probed for insights into program processes that can help improve program design and delivery. The interviews gathered perspectives on trends within the markets and trades where HEIP operates, and the influence Georgia Power programs have on the market.

Individual Improvements and Whole House Surveys

In July and August 2021, the evaluation team surveyed 258 customers who participated in HEIP between February 2020 and April 2021 to understand their source of awareness, reasons for participating, and experience and satisfaction with the program. Customer surveys were mixed mode, meaning they were fielded via both the web and phone. Survey respondents included customers who participated through the Individual Improvements, Whole House, or Combined paths (Table 74).[48]

[48] The "combined" path refers to customers who received both Individual Improvements and Whole House rebates. See the Changes from Previous Cycle Design section for more information.

Table 74. Number of Survey Respondents by Program Path

PROGRAM PATH	NUMBER OF RESPONDENTS	PERCENT OF RESPONDENTS
Individual Improvements	158	61%
Whole House	26	10%
Combined	74	29%

The processes to participate in the Whole House and Combined paths were generally similar. Most of these customers first worked with a contractor to complete a home energy assessment, and then installed multiple recommended measures, which may have been rebated through either the Whole House or Individual Improvements paths. Customers who participated exclusively in the Individual Improvements path generally did not complete a home energy assessment, and only implemented one or a few measures. Therefore, for the purposes of this survey analysis, the evaluation team investigated responses for customers who were part of the Whole House or Combined paths together and compared to responses received from the Individual Improvements path.

Tracking Data Discrepancies

While fielding the survey and developing the sample, the evaluation team encountered discrepancies and gaps in the tracking data. The following section describes these discrepancies and their implications related to the survey results.

Contact Information

While developing the survey sample, the evaluation team found that a relatively high number of customers were missing contact information or the contractor's contact information was listed. This was much more prevalent for Whole House and Combined path, where the customer phone and emails fields were typically populated with contractor (not customer) information. To address this, the evaluation team pulled in data from Georgia Power's general population customer list, which was able to provide some additional options for phone and emails for Whole House and Combined customers and improve the survey response rate for these customers.

In addition, more Whole House and Combined path customers were missing valid emails than the Individual Improvements path customers. This caused most Whole House/Combined customers to complete the survey via phone while most Individual Improvements customers completed the survey via web (Table 75). While we analyzed all survey responses comprehensively, it is important to note that each survey mode may bias or skew the comparison of results and should be considered while reviewing results.

Table 75. Percent of Survey Mode Responses by Program Path

PROGRAM PATH	PERCENT COMPLETED VIA WEB	PERCENT COMPLETED VIA PHONE
Individual Improvements	81%	19%
Whole House/Combined	22%	78%

The evaluation team did not conduct statistical significance testing between responses for the Whole House/Combined and Individual Improvements paths, since we cannot definitively determine if the differences occurred due to response mode or the paths themselves. However, to provide additional context for the program and customer experience, we do show comparisons between paths in cases where large differences were identified and where those differences were not expected to occur due to the survey mode.

Actual Measures Installed

As part of the survey screening questions, respondents were asked to confirm the measures recorded in the tracking data were correct and aligned with what was installed in their home. Whole House/Combined customers reported the list of measures was incorrect at a much higher rate than Individual Improvements participants. Of the 157 Whole House/Combined customers who started the survey, 21 customers (13%) reported issues. Only three Individual Improvements customers reported issues.

The Whole House/Combined customers were shown lists of measure categories that typically included six or seven different measure categories, and those who indicated issues were asked to clarify what was incorrect.[49] Customers most frequently recalled the insulation and lighting, but often did not recall other measures. For example, when customers were asked what was incorrect in the list they were shown, two customers said, "Everything apart from the insulation." and, "All they did was the home energy assessment, insulated the attic, and changed lightbulbs." Note that due to a lack of clarity in the tracking data, 'changes to a participants' water heater thermostat settings' were incorrectly assigned to the "Changes to your thermostat settings" category. However, the specificity of customer responses provides confidence that the issues customer identified in most, if not all, cases were broader than that single measure category.

Finally, due to the safety restrictions imposed by COVID-19, program staff were unable to perform in-person visits for much of 2020 into 2021. Some of the verification issues identified by the evaluation would have likely been identified and corrected as part of implementation under typical operating conditions. We provide

[49] Note that due to a lack of clarity in the tracking data, 'changes to a participants' water heater thermostat settings' were incorrectly assigned to the "Changes to your thermostat settings" category. However, the specificity of customer responses provides confidence that the issues they are identifying in most, if not all, cases were broader than that single measure category.

recommendations for virtual QA/QC strategies in the Conclusions and Recommendations section, for any cases when in-person visits may not be possible.

Notable Demographic and Customer Characteristic Differences

Notably, some home and respondent characteristics and demographics differed between the Whole House/Combined path and Individual Improvements path customers. To provide context for interpreting results, the evaluation team presents some key demographic differences between the two pathways below.

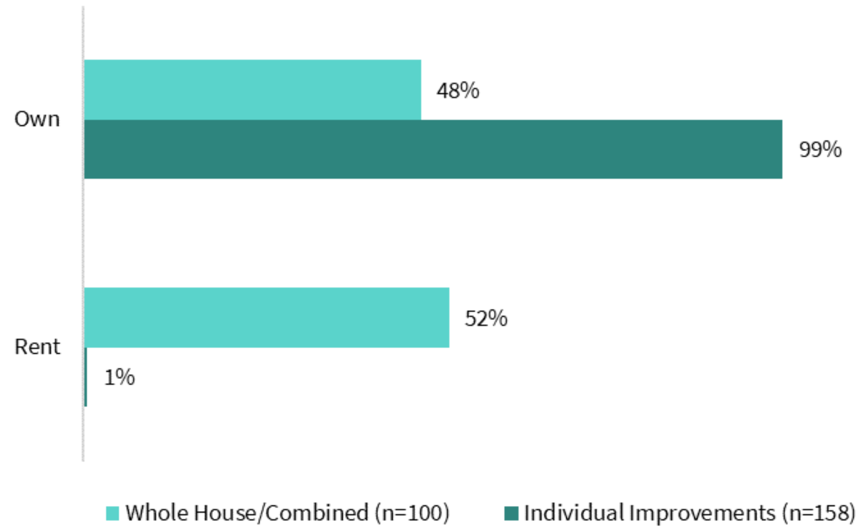
In summary, the evaluation team identified early on (during the impact evaluation) that Whole House projects were dominated by smaller rental homes, conducted by the program's most active contractor in a small city in northwestern Georgia. During the survey, the evaluation team confirmed that participants in Whole House were much more likely to be renters and have lower incomes than Individual Improvements participants. Overall, most respondents in the Whole House pathway had participated via the most active contractor. This contractor serves a traditionally hard-to-reach customer base with low-income customers and renters, and the significance of this achievement should be noted. The evaluation team encourages Georgia Power to explore mechanisms to ensure these customers continue to be reached in the future, either through HEIP or other energy efficiency offerings.

Table 76. Number of Survey Responses by Contractor

PARTICIPANT GROUP	NUMBER OF COMPLETED SURVEYS	
	MOST ACTIVE CONTRACTOR	ALL OTHER CONTRACTORS
Whole House/Combined	71 (71%)	29 (29%)

Notable demographic differences are presented below, with additional demographics presented at the end of this section. First, 99% of Individual Improvements respondents owned their home, while slightly less than half (48%) of Whole House/Combined respondents owned their homes.

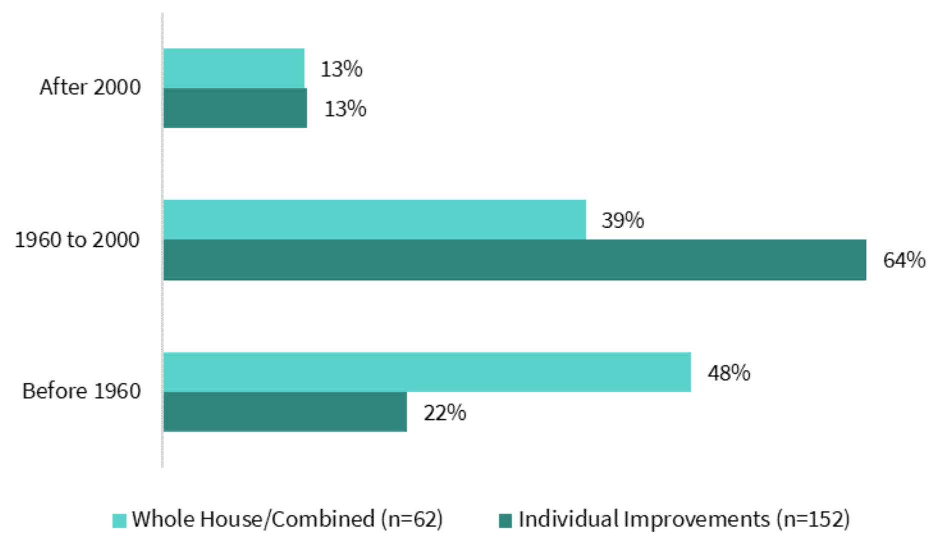
Figure 59. Home Ownership Status



Source: HEIP customer survey. A5. Do you own or rent this home?
Note the percentages may not sum to 100% due to rounding.

In addition, Whole House/Combined path participants more frequently lived in older homes, with 48% reporting they lived in homes built prior to 1960, compared to just 22% for Individual Improvements respondents (Figure 60).

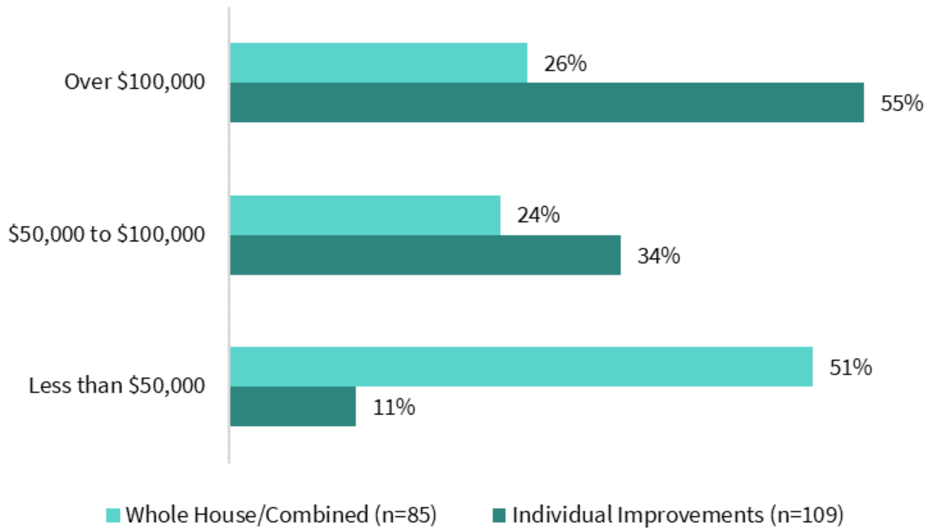
Figure 60. Year Home Built



Source: HEIP customer survey. N6. When was your home built?
Note the percentages may not sum to 100% due to rounding.

Household income also differed (Figure 61). Roughly half (51%) of Whole House/Combined customers had an annual income of less than $50,000 (with 20% of customers reporting an income below $25,000), compared to only 11% for Individual Improvements customers. Conversely, over half (55%) of Individual Improvements respondents had an annual income over $100,000, while only one-quarter (26%) of Whole House/Combined customers did.

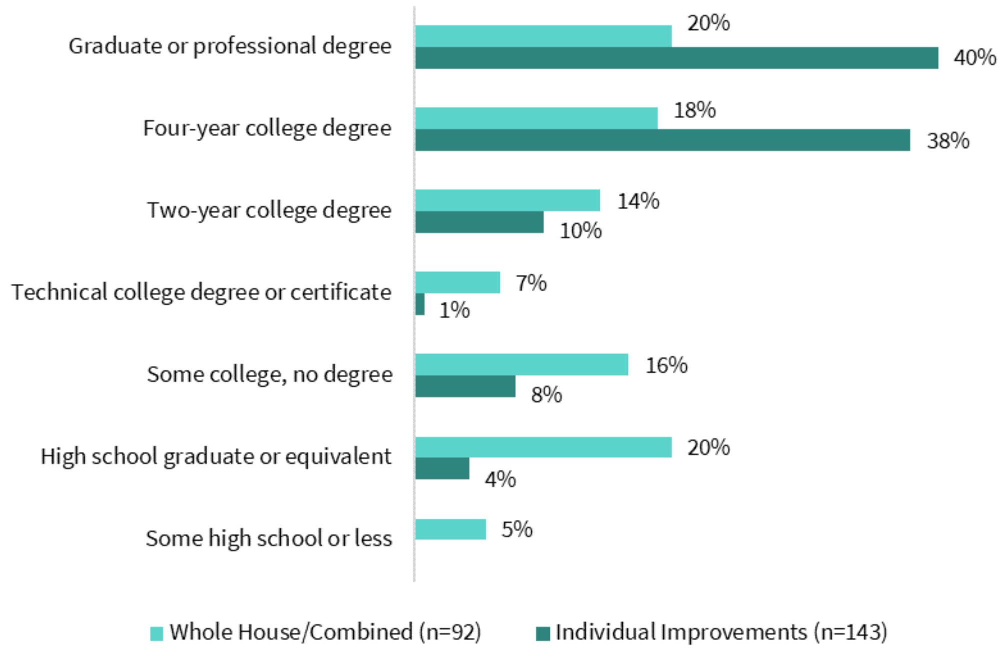
Figure 61. Annual Household Income



Source: HEIP customer survey. N10. Which of the following categories best represents your total annual household income before taxes?
Note the percentages may not sum to 100% due to rounding.

Whole House/Combined path customers also held college degrees less frequently than Individual Improvements (Figure 62). Over three-quarters (78%) of Individual Improvements respondents held four-year college or graduate degrees, compared to 38% for Whole House/Combined customers. The highest level of education completed for one-quarter (25%) of Whole House/Combined respondents was finishing some or all high school, compared to just 4% for Individual Improvements.

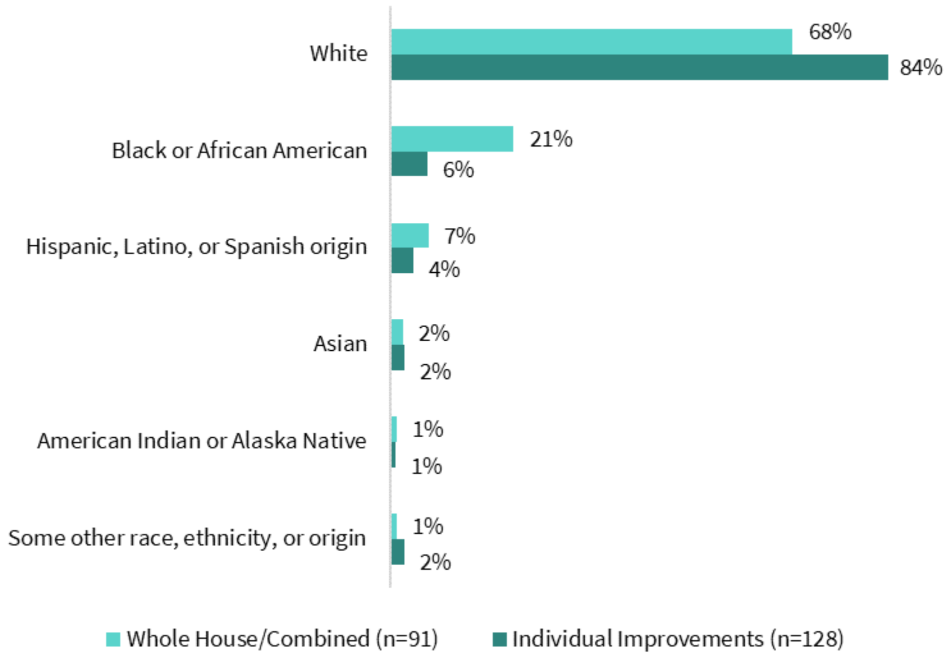
Figure 62. Education Level



Source: HEIP customer survey. N11. What is the highest level of education you have completed?
Note the percentages may not sum to 100% due to rounding.

Finally, Whole House/Combined customers less frequently identified as White (Figure 63). Instead, they more commonly identified as Black or African American (21% compared to 6% for Individual Improvements), or Hispanic, Latino, or of Spanish origin (7% compared to 4% for Individual Improvements).

Figure 63. Participant Race/Ethnicity



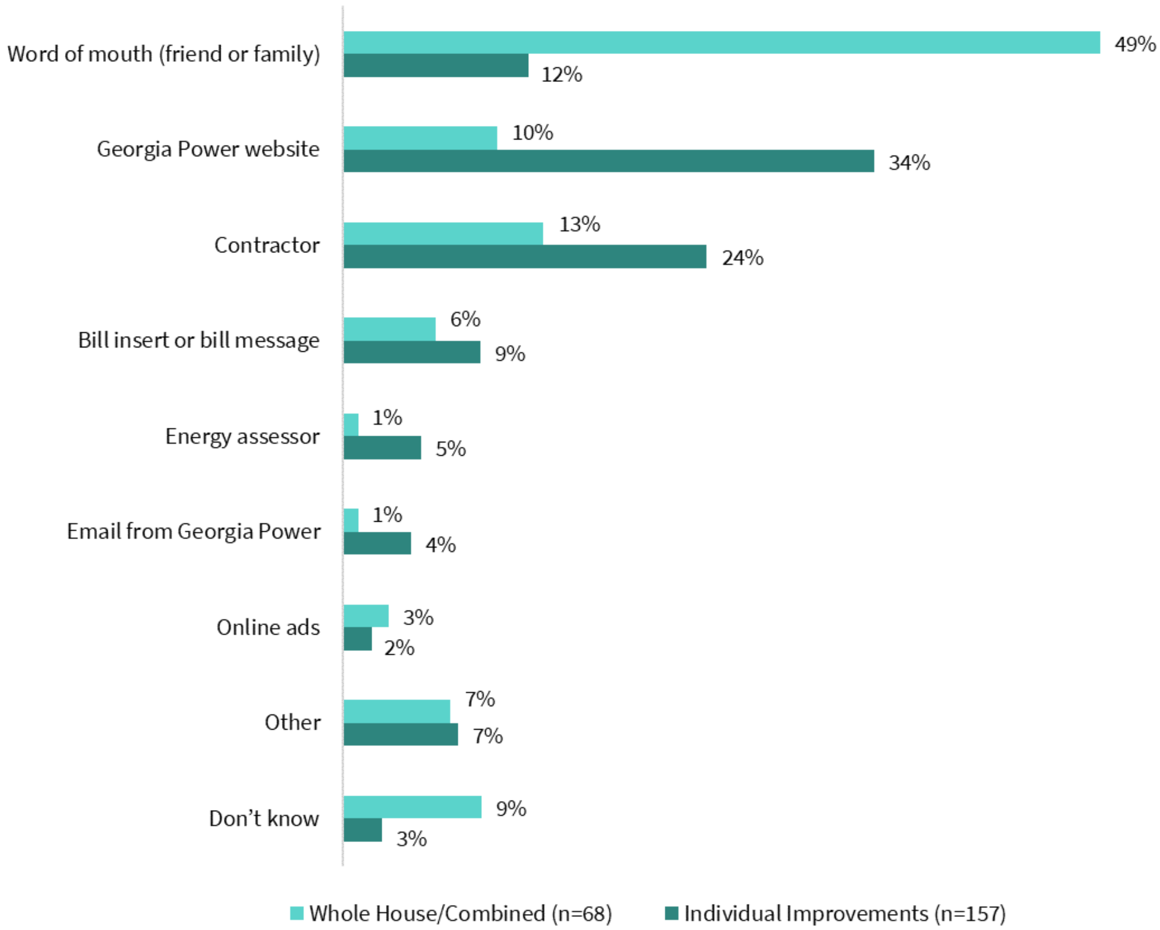
Source: HEIP customer survey. N14. Which categories describe you? Please select all that apply.
Note the percentages may not sum to 100% due to rounding.

Program Awareness

The top three ways customers learned about HEIP were through Georgia Power's website, word of mouth, and their contractor. However, there were distinctly different trends by program path (Figure 64). Respondents in the Whole House/Combined path were more likely to learn about the program through word of mouth, while Individual Improvements respondents most often heard about the program from the Georgia Power website or a contractor.

Note that program marketing was paused for much of 2020 due to the pandemic. When it resumed, it was focused on do-it-yourself Individual Improvements measures to avoid having a contractor enter customers' homes. Therefore, the source of program awareness may be different in future program cycles when program marketing operates under normal conditions.

Figure 64. Sources of Program Awareness

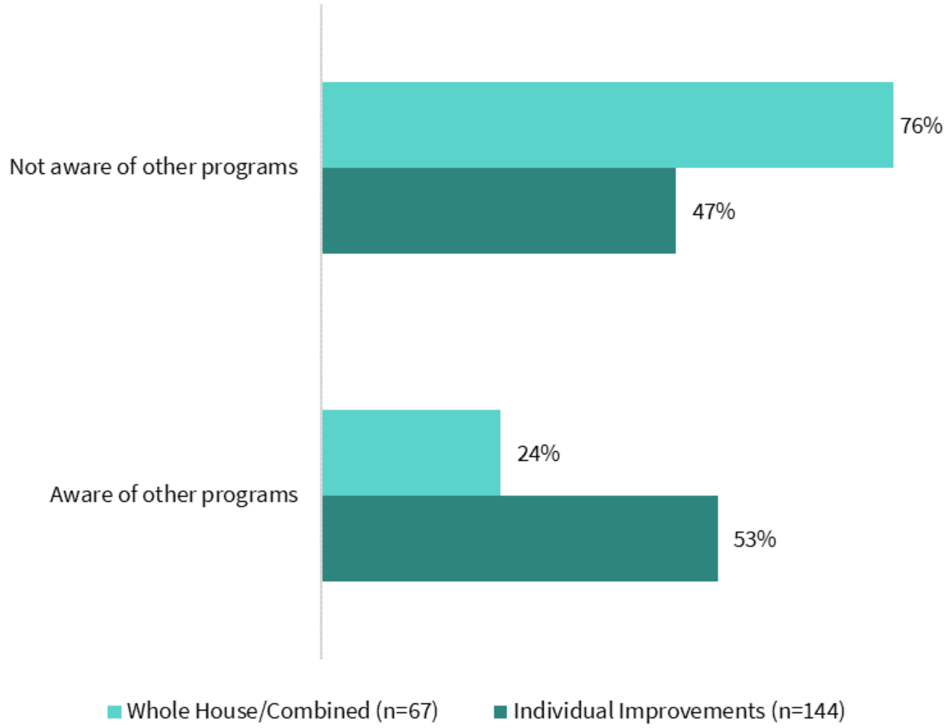


Source: HEIP customer survey. B1. How did you first learn about the Georgia Power Home Energy Improvement Program? Note the percentages may not sum to 100% because multiple response options were allowed.

For HEIP participants overall, over half (53%) reported that they were not aware of any other Georgia Power energy efficiency programs. Again, there were different trends by program path (Figure 65). Among the Whole House/Combined customers, three-quarters (76%) reported they did not know about any other Georgia Power programs, while the Individual Improvements customers were more evenly split with 53% reporting awareness and 47% reporting they were not aware of other programs.

This awareness divide among program paths could be related to the pandemic-related marketing pause, and to *how* customers learned about the opportunity. More Individual Improvements customers learned about the opportunity through Georgia Power's website which may have exposed them to other programs. The Whole House/Combined customers predominantly learned about the opportunity through word of mouth and their contractor, which may have funneled them directly to HEIP without exposure to other opportunities.

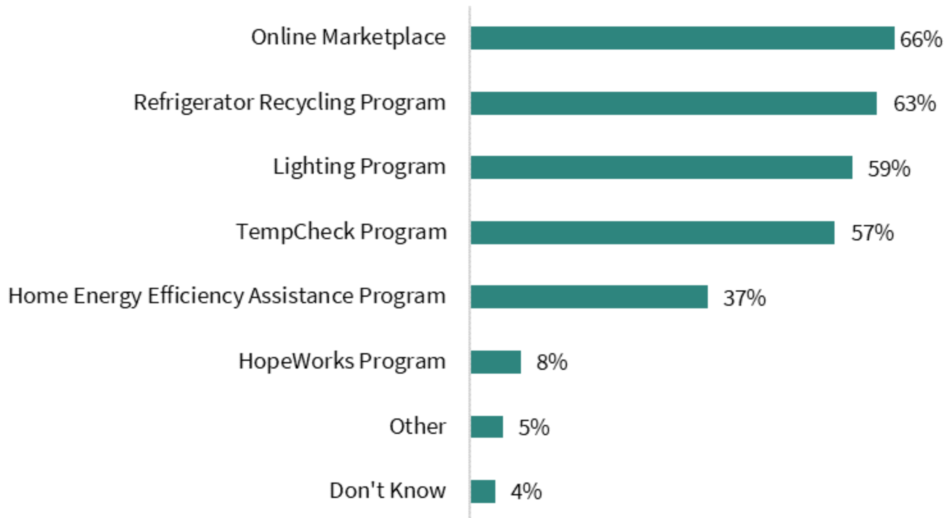
Figure 65. Awareness of Georgia Power Energy Efficiency Programs



Source: HEIP customer survey. B2. Are you aware of any other Georgia Power energy efficiency programs?
Note the percentages may not sum to 100% due to rounding.

Figure 66 shows that Individual Improvements respondents were most frequently aware of the Online Marketplace (66%), Refrigerator Recycling program (63%), Lighting program (59%), and Temp✓ program (57%). Among the few (n=16) Whole House/Combined customers who knew about other Georgia Power energy efficiency programs, the most known were the Home Energy Efficiency Assistance Program (n=9) and the Lighting program (n=9).

Figure 66. Awareness of Specific Georgia Power Programs for Individual Improvements Respondents (n=76)

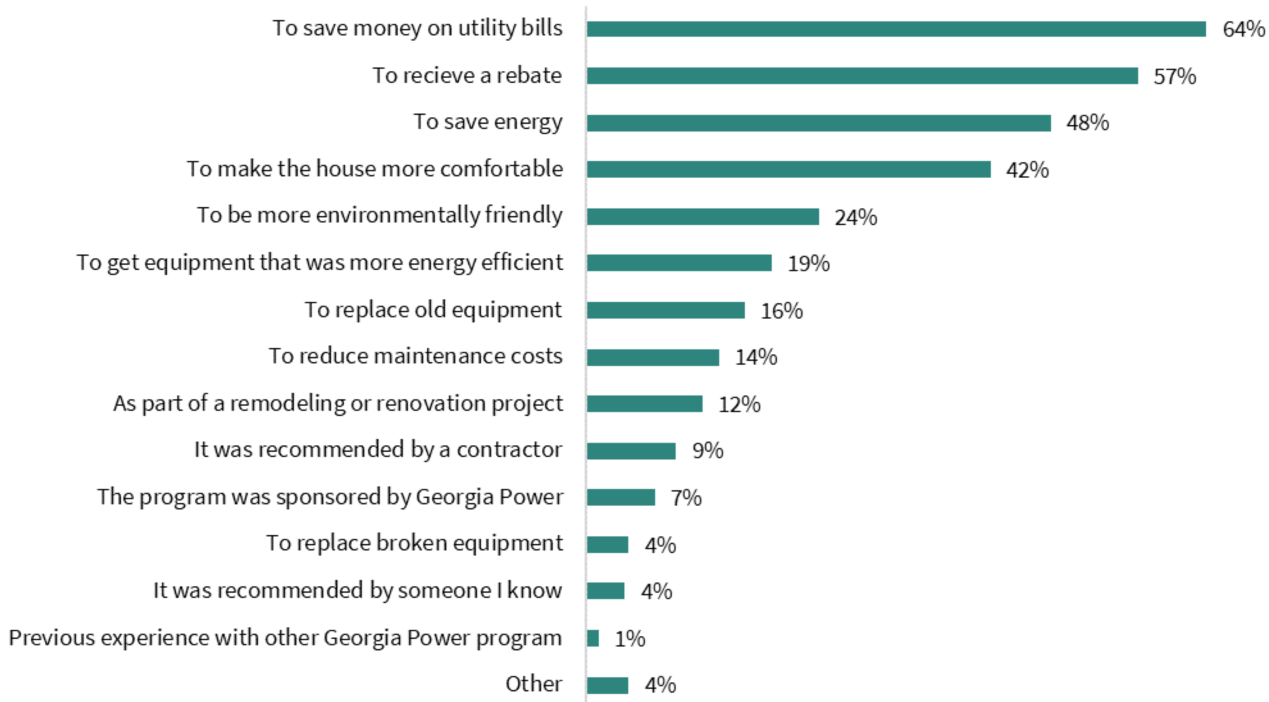


Source: HEIP customer survey. B3. What energy efficiency programs are you aware of? Please select all that apply. Note the percentages may not sum to 100% because multiple response options were allowed.

Motivations and Decision-Making

To understand drivers and barriers to participation, the evaluation team asked respondents to explain what motivated them to participate in HEIP. Overall, two-thirds (64%) of respondents were motivated to participate in HEIP to save money on their utility bills (Figure 67). Other top motivators were receiving the rebate (57%), saving energy (48%), and to make their home more comfortable (42%). The top motivators were consistent across the Whole House/Combined and Individual Improvements paths.

Figure 67. Motivations for HEIP Participation (n=225)



Source: HEIP customer survey. C1. What motivated you to participate in the Home Energy Improvement Program? Please select all that apply.
Note the percentages may not sum to 100% because multiple response options were allowed.

Program Path Selection

Most (57%) Individual Improvements customers did not know about the Whole House path. This may be related to the pandemic-related marketing pause. This also aligns with information provided by HEIP contractors, who indicated they may never discuss the Whole House path if a customer's home is already too efficient to achieve the 25% savings requirement, or if they assume it is cost prohibitive for the customer to participate in the Whole House path. Those who were aware of the Whole House approach most often decided to participate in the Individual Improvements path because:

- They did not think they needed the other measures offered in the Whole House option (42%)
- They thought the Whole House path was too expensive (34%)

A quarter (25%) of Whole House/Combined respondents participated in the Whole House path because their home needed many improvements. Another quarter (24%) were unsure why they participated in Whole House instead of Individual Improvements, indicating their contractor may not have made them aware of the options.

Measure Installation

Across both paths, most customers who received a home energy assessment ultimately proceeded with measure installations that were rebated through HEIP (80%). Of the 33 respondents we identified as having only received the home energy assessment (i.e., they had no other measures recorded in the tracking data as of April 2021), 21 customers reported that they had moved forward with improvements. Fourteen reported that they had made the improvements through HEIP and received a rebate (likely too recently to be recorded in the tracking data at the time of the data pull), while seven reported that they completed the improvements themselves and did not apply for or receive a rebate.

The 12 customers who received a home energy assessment but did not proceed with any improvements cited various reasons:

- Cost or budget was a barrier (n=5)
- Intend to install measures, but have not had time yet (n=4)
- Had issues finding a contractor (n=2)

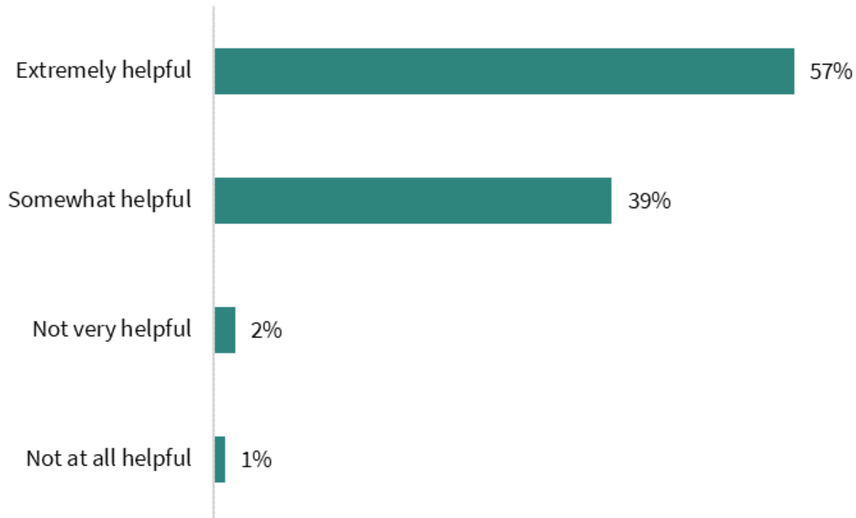
Eleven of these twelve customers indicated that they plan to move forward with the improvements within the next year.

Home Energy Assessments

The evaluation team asked customers a series of questions related to the home energy assessment to understand their experience and satisfaction with the process to complete the assessment and the delivered report. All survey respondents in the Whole House/Combined path received a home energy assessment, while only 18% of Individual Improvements respondents received a home energy assessment along with the other rebated measures they installed.

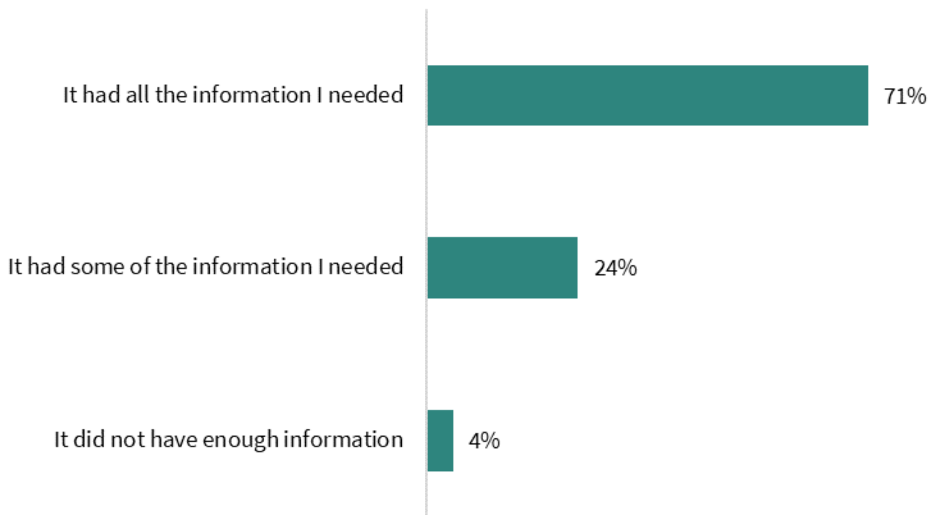
Overall, nearly all customers who received a home energy assessment (96%) reported that it was somewhat or extremely helpful (Figure 68). In addition, most of these respondents (71%) found that the home energy assessment included all the information they needed to inform their decision about which improvements to make (Figure 69). These trends were consistent across both the Whole House/Combined and Individual Improvements paths.

Figure 68. Home Energy Assessment Report Helpfulness (n=94)



Source: HEIP customer survey. F1. Our records indicate you received a home energy assessment. How helpful did you find the ho me energy assessment?
Note the percentages may not sum to 100% due to rounding.

Figure 69. Information Included in the Home Energy Assessment Report (n=94)



Source: HEIP customer survey. F3. Did the home energy assessment report provide the information you needed to decide which improvements to make?
Note the percentages may not sum to 100% due to rounding.

For cases when customers said the report did not have enough information, they were asked what additional information would have been helpful. Most of their open-ended responses asked for information about topics such as detailed home and appliance energy performance or consumption data, or additional energy efficiency improvements they could make. However, customers did not indicate issues comprehending the report contents.

"More of a breakdown of what is using my energy – like a breakdown by appliance."

- Georgia Power HEIP survey respondent

"How can I seal the place up tight after the improvements have been done? Final tips the homeowner can accomplish themselves, etc."

- Georgia Power HEIP survey respondent

Program Experience

The evaluation team also asked customers about their experience while participating in various aspects of the program. Their responses are summarized and described in the following sections.

Experience with Contractors

Most respondents (85%) found it somewhat or extremely easy to find a contractor to perform their home energy assessment. These customers most often found their contractor through:

- A referral from a friend, family, or neighbor (33%)
- A web search (18%)
- Georgia Power's "Find a Contractor" feature (14%)

Nearly all customers who completed the survey reported that they were extremely or somewhat satisfied with the quality of work provided by their contractor (96%), and this trend was consistent across both program paths. Two-thirds (66%) of respondents used the same contractor who conducted their home energy assessment to install equipment as well, which also indicates they were satisfied with their contractor during the assessment phase. Customers in the Whole House/Combined path often reported using the same contractor (73%). For Individual Improvements respondents, it was split with nine using the same contractor and 10 using someone different. Customers in both paths (n=15) who chose to work with a different contractor cited various reasons for doing so:

- Contractor services did not include the work that was needed (n=7)
- Never intended to use the same contractor (n=3)
- Scheduling did not work out (n=2)
- Could not remember the contractor who performed the home energy assessment (n=1)
- Decided to do the work myself (n=2)
- Landlord chose the contractor (n=1)
- Quoted price was too high (n=1)

Experience with Self-Installation

Some customers who participated in the Individual Improvements path chose to complete the measure installations themselves. The survey respondents who did so (n=35) most often cited cost savings (n=24), ease (n=14), speed (n=3), and quality (n=3) as the main reasons for completing the work themselves. Seventy-four percent of the customers who self-installed equipment did not experience any challenges.

Experience with Rebate Application and Payment

Most customers who completed the application reported that they completed the rebate application form online (85%), and only 4% said they completed it over the phone with a Georgia Power program advisor. However, this trend varied by program path, with only 43% of Whole House/Combined customers completing the application online, 14% completing it over the phone, and another 43% reporting they were uncertain how the application was completed. This likely indicates the contractor managed the application for these customers. This compares to 89% of Individual Improvements respondents reporting they completed the application online, 3% who did over the phone, and 7% who did not know.

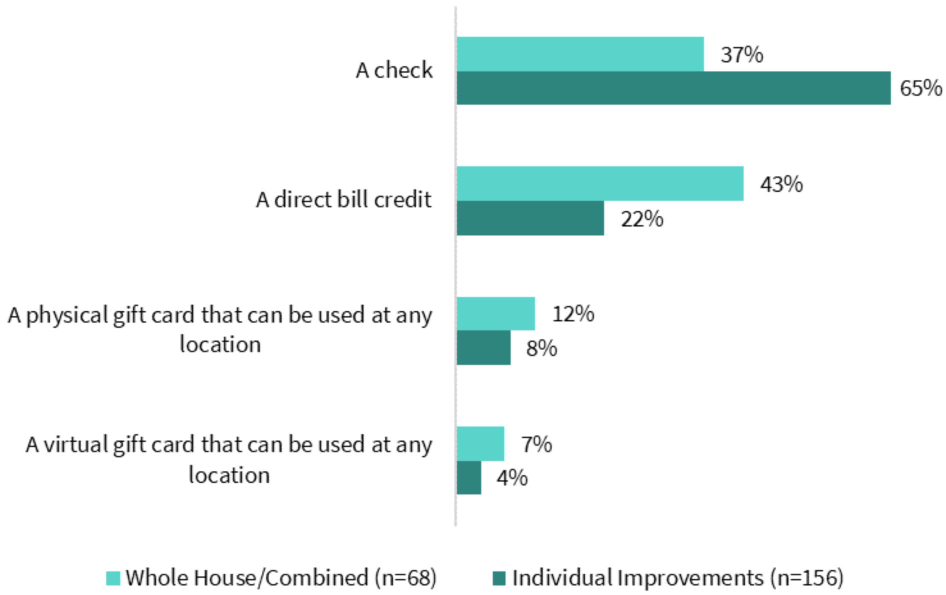
In addition, most customers (90%) regardless of program path found it somewhat or extremely easy to complete and submit the application form, and 81% of customers experienced no problems, delays, or difficulties with the rebate application and payment process. Customers who experienced issues with either the application or payment process most frequently said there were too many steps in the application process (n=7), or they experienced issues getting the invoice correct (n=7).

Customers who reported experiencing issues were also asked what would have improved the process. Seven customers requested a clearer process with better instructions or examples. Customers also suggested a simplified or shorter process (n=3), improved communication between Georgia Power and their contractor (n=3), and the ability to track the status of their rebate (n=2).

> *"Your staff was exceptional. My issue was a combination of lack of information on my part and communication with my contractor."*
>
> \- Georgia Power HEIP survey respondent

Finally, customers were asked their preferred method to receive their rebate. Most respondents either wanted to receive a check (56%) or a direct bill credit (28%). This varied by program path (Figure 70), with a higher proportion of Individual Improvements customers requesting a check, while there was a more even split between a check and a direct bill credit for the Whole House/Combined respondents. Few customers in either path preferred a physical or virtual gift card.

Figure 70. Customer Preference for Rebate Delivery Method



Source: HEIP customer survey. G17. How would you prefer to receive the rebate?
Note the percentages may not sum to 100% due to rounding.

When asked how to improve the rebate application process, a few customers also requested that it be made clearer whether they would ultimately be eligible for the rebate, and for the rebate amount to be communicated earlier. These customers cited that they did not know until they received the rebate what the amount would be, or if they would even receive a rebate at all. One customer noted they had reached out to Georgia Power to clarify but did not receive a response.

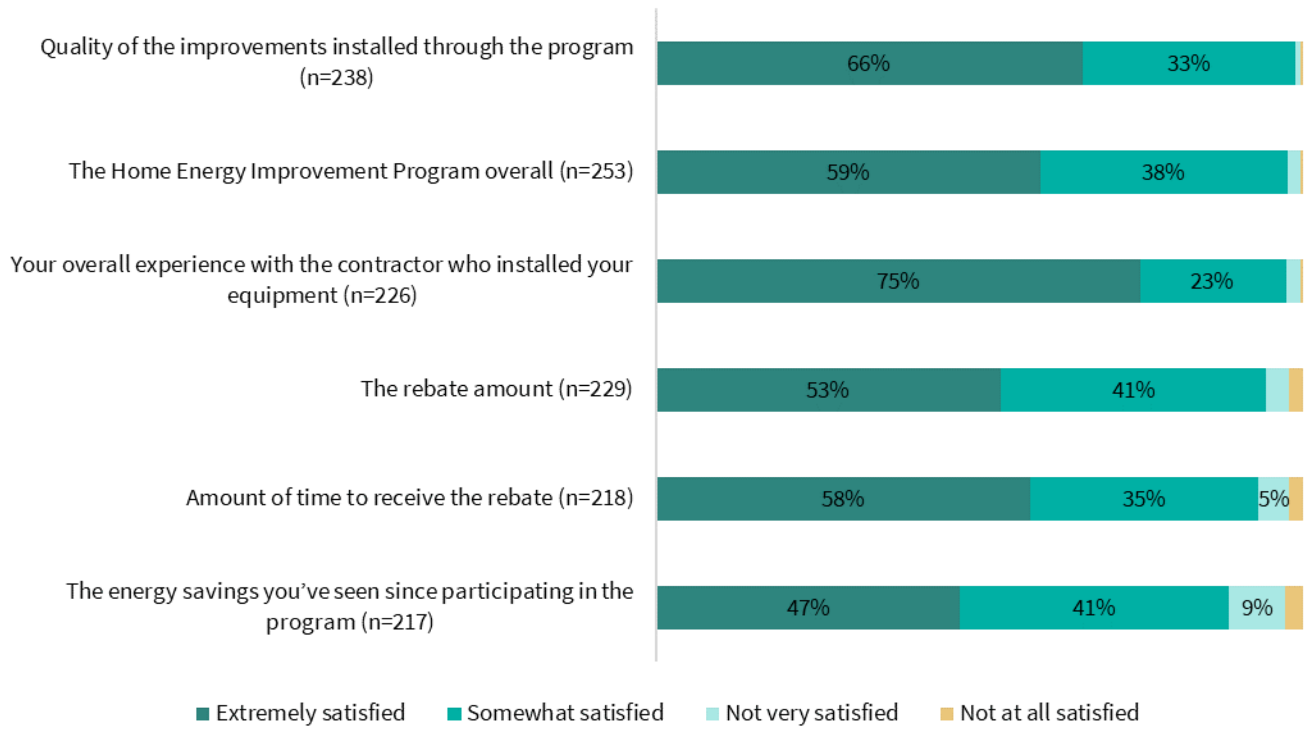
Program Satisfaction

The following section describes respondents' satisfaction with HEIP and Georgia Power overall. In both cases, respondents were overall satisfied with their experiences.

Satisfaction with HEIP

Virtually all customers (98%) were either very satisfied or satisfied with HEIP overall (Figure 71). Most aspects of HEIP were also rated very highly; at least 90% were very satisfied or satisfied with the quality of improvements, contractor experience, the rebate amount, and the amount of time it took to receive the rebate. The lowest satisfaction customers reported was for the energy savings they have seen since participating in the program, where 12% of customers indicated they were not very or not at all satisfied. These trends were consistent across programs paths for all aspects of program satisfaction.

Figure 71. Satisfaction with HEIP



Source: HEIP customer survey. L1. Please answer a few questions about your satisfaction with your experience with the Home Energy Improvement Program. How satisfied are you with the following aspects of the Home Energy Improvement Program?

When asked how likely they would be to recommend HEIP to a friend or colleague, three-quarters (75%) rated their likelihood as a 9 or 10 on a scale of 1 to 10 where 1 was "not at all likely" and 10 was "extremely likely". Only 8% rated their likelihood as a 6 or below.

The evaluation team also asked participants whether their level of comfort had changed since they made improvements through HEIP. Most customers (79%) reported that their home is now more comfortable, with another 15% indicating they have not noticed a change. This increase in comfort occurred despite most customers (47%) either using the same thermostat temperature settings or using more efficient settings (22%).[50]

[50] More efficient temperature settings were described in the survey as keeping their home "warmer in the summer and cooler in th e winter."

In addition, several customers specifically noted in response to the question about their comfort that they noticed energy or bill savings:

> *"Power bill greatly reduced."*
>
> - Georgia Power HEIP survey respondent
>
> *"Lower energy consumption."*
>
> - Georgia Power HEIP survey respondent

Satisfaction with Georgia Power

Overall, HEIP participants were satisfied with Georgia Power (Figure 72). Over three-fourths (78%) of customers rated their satisfaction as an 8, 9, or 10 on a scale of 1 to 10 where 1 was "not at all satisfied" and 10 was "extremely satisfied." The mean satisfaction score was 8.4 out of 10.

Figure 72. Satisfaction with Georgia Power (n=258)

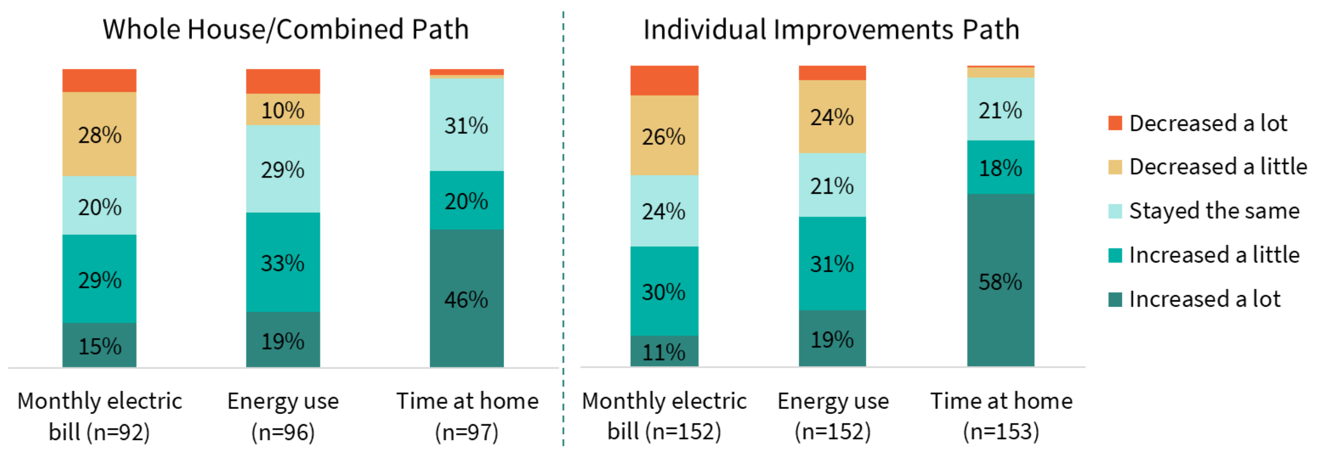
Source: HEIP customer survey. L4. Taking into consideration all aspects of your utility service experience, please rate your current *satisfaction with Georgia Power overall.*
Note the percentages may not sum to 100% due to rounding.

Effects of COVID-19

Given the timing of the HEIP customer survey and evaluation activities, the evaluation team included questions to assess the effects of the COVID-19 pandemic on customers' energy-related behavior in their home (Figure 73). Trends between the Whole House/Combined path and the Individual Improvements paths were similar. Slightly less than half of customers reported an increase in their energy bill compared to 2019 (45% for Whole House/Combined and 40% for Individual Improvements), while a greater percentage also noticed an increase in their energy consumption (52% for Whole House/Combined and 50% for Individual Improvements).

However, responses differed by path when asked how their time at home had changed due to COVID-19. Two-thirds (66%) of Whole House/Combined participants reported their time at home increased a lot or a little, compared to three-quarters (75%) of Individual Improvements respondents. This is potentially due to the differences in demographics between Individual Improvements and Whole House customers.

Figure 73. Effects of COVID-19 on Energy-Related Behavior



Source: HEIP customer survey. M1. Please think about the amount of time you spend at your home in a given week. Compared to this time in 2019, would you say the time your household spends at home has…? M2. Please think about the amount of energy your household uses in a given week. Compared to 2019, would you say your household energy use has…? M3. Now, please think about your monthly electric bill. Since 2019, would you say your electricity bill has…?

Participant Survey Demographics

Finally, customers were asked a series of demographic questions (Appendix 4C. Survey Demographics includes detailed demographic data, and demographics detailing key differences between pathways are reported at the beginning of this section). Most surveyed customers reported living in single family homes (96%). About half of customers had lived in their homes for three years or less (48%) and most homes were less than 60 years old, with 70% built in 1960 or later. Customers used a relatively even mix of electric and natural gas as their primary heating fuel (46% and 50%, respectively) and for water heating (48% and 49%, respectively). Most customers reported between one and four people living in their household (90%) and that their household size stayed the same between 2019 and 2020 (79%).

Nearly half of surveyed customers (47%) were younger than 45 years old. Most surveyed customers indicated their employment situation had not changed since 2019 (82%). Most customers reported speaking English in their home (96%).

Contractor Qualitative Interviews

The evaluation team interviewed seven contractors who actively participate in HEIP.[51] At the time of the interviews each of these contractors' completed projects within the past year that received incentives through the Individual Improvements path of the program, and four of these contractors completed Whole House projects within the past year. One of the contractors participated in the multifamily portion of the program, but the employee interviewed was unable to provide specific insights into those projects.

Overall, contractors agreed that, aside from the Beacon HEA software, the processes directly related to program participation including communication with Georgia Power, application submission and management, testing, and documentation, all worked well and presented no barriers to their participation. Most of our findings detailed here focus on contractor and customer program perceptions, sales approaches, the Beacon HEA software, and ideas for potential improvements.

Overall Program Perceptions

Overall, contractors expressed high levels of satisfaction with HEIP and its various components. Each contractor spoke highly of HEIP staff and gave considerable praise to the Georgia Power team for transitioning to self-implementation of the program during the pandemic.

> *"Since they brought the programs in house it's been much more efficient for us, and the team that they have managing these programs has definitely been contractor focused. Often times (with the previous implementer), I felt like we were sometimes left dangling at the end of the rope, but I don't feel like that at all now, it's just an amazing change in the whole culture."*
>
> \- Georgia Power HEIP contractor

Program Sign-Up and Onboarding

Each of the contractors interviewed indicated they had longstanding relationships with Georgia Power. Each indicated experience with previous iterations of HEIP, and to a certain extent had incorporated the program offerings into their business models. Because of this, it was difficult for most contractors to discuss the sign-

[51] The most active contractor in 2020 was interviewed early in the evaluation process but is not included in the findings from contractors reported in this section, as that contractor's approach deviated significantly from typical program operation and the interview focused on QA/QC.

up and onboarding process for HEIP, as each contractor had been involved with the program for multiple years.

> *"It was a normal process; an application, provide your insurance and licensing information… we're more like a subcontractor for Georgia Power so, anytime you're becoming a subcontractor with anything they're asking the same information. The process was fairly normal."*
>
> \- Georgia Power HEIP contractor

Contractor Business Structure

There were three distinct business structures utilized among the interviewed contractors. Contractors can be generally categorized as:

- Assessment Only: only conduct home assessments and do not employ contractors who do the physical work
- Assessment and Labor: conduct home assessments and employ a team of contractors who perform some of, or the full spectrum of physical work
- Specialized Labor Only: only perform labor for specific types of work (insulation, HVAC, etc.)

The business structure utilized by a contractor has direct implications on the type of work they recommend and the type of work they perform. Assessment only contractors pride themselves on being able to offer objective, non-biased opinions to their customers. They strive to educate their customers and provide them with the information that they need to make informed decisions on their own, without any sales pressure. Similarly, contractors who provide both assessments and labor noted that they provide value to their customers in a similar manner by providing education so they can make their own decisions, without sales pressure for any one *specific* type of work.

> *"We're an independent 3rd party type group, not selling insulation or air conditioners like some of the people. I check the consultant box. We're not doing this so we can then sell you stuff, we're giving you our opinion of, if it was our house, I'd do this this and this in this order."*
>
> \- Georgia Power HEIP assessment-only contractor
>
> *"Most customers don't understand their house and how it works. After an audit, I spend an hour or two sitting down with them and really like to educate them so they can make wise decisions and how their house works. I find it so rewarding to educate people about that, and that people need to think about a systems perspective of their house. After the audit we sit down for two hours and go through, and then it becomes an issue of their budget."*
>
> \- Georgia Power HEIP assessment and labor contractor

For contractors who only perform specialized labor, the singular focus of their program work is on the specific type of work that they offer. While this is expected for these specialized types of contractors, this may have implications for homeowners who may have more needs that are different than the specific services offered by that contractor. One example from a contractor was if a customer reaches out to an HVAC contractor to have a comfort issue addressed, they may only be presented with options related to new HVAC equipment, when their true problem is related to insufficient attic insulation.

Furthermore, there are contractors who only participate in the Individual Improvements path, but who indicated they work with customers who may benefit from the Whole House path. These contractors expressed that they do not promote measures they do not offer, and most do not refer customers to other contractors who install those measures. There may be value in encouraging participating customers to receive a home energy assessment from an objective third-party who can educate customers on the full scope of improvements to improve their home efficiency.

"We used to do tons of Whole House, but then they changed the program and the rebates and it's just a much more difficult rebate to be able to achieve with the offerings that I have. The minimum is 25% kWh reduction, and with insulation there's just no way to do that. If I was a HVAC company bundling these services together it could work but, I don't get into those types of projects."

- Georgia Power HEIP specialized labor contractor

"In the HVAC industry they don't test ducts. I hate seeing brand new efficient ACs and furnaces with 80% leaky ducts. Companies will sell people on whole house dehumidifiers when really the AC should do that, but their ducts are so leaky. So that's why we focus on that."

- Georgia Power HEIP assessment and labor contractor

"If it's weatherization we can do that no problem. If it's HVAC or electrical upgrades, then we need to hire out for that because we're not qualified for that. We have people who we use but the client can pick whoever they want."

- Georgia Power HEIP assessment and labor contractor

Customer Engagement

Contractors described similar approaches to how they offer the program to their customers and how their customers perceive and engage with the program, while noting some differences in customer engagement that were related to their business structure. All contractors said they see themselves as educators and seek to provide their customers with the information necessary for them to make educated decisions on their own. All contractors noted that they rarely, if ever, use the available incentives as sales tools. Rather, contractors typically indicate that a customer's project will likely qualify for some type of rebate, rather than quoting them an incentive value (this is somewhat influenced by the unknown of whether a project will qualify for a Whole House rebate or not).

"The majority of the time they don't know (about the rebates). I bring them up and introduce the subject – if they're on Georgia Power then I tell them that their project will likely earn a rebate, and we talk about how that works."

- Georgia Power HEIP contractor

Once contractors develop a sense for the customer's budget and constraints, they seek to identify the measures that will provide the maximum benefit for the lowest cost.

"Once they give us their financial situation, we let them know what's best for the money available; this will get you the best energy upgrades."

- Georgia Power HEIP contractor

The four contractors who had completed Whole House projects within the past year each indicated that there is little that differentiates the approach they take with customers who eventually receive Individual Improvements rebates compared to those who participate in the Whole House path. Contractors noted that most customers are existing homeowners who either have comfort issues, high bills, or a combination of both. Contractors unanimously concluded there are two primary factors that dictate whether a customer will participate through the Individual Improvements or Whole House path: the customer's financial situation and the physical characteristics of their house. Some contractors noted that most of their customers cannot afford all the work necessary to qualify for the Whole House incentive, and/or their homes are already too efficient to achieve the requisite 25% energy savings. Below are quotes illustrating the experiences of contractors who work with newer, more efficient housing stock and more affluent customers.

"98% of my customers don't qualify for Whole House. I do a lot of newer homes so, most of my clientele live in $300,000 homes, so to do the Whole House model you'd have to save them 25% of the house to get a $1000 rebate, and there's no way to do that."

- Georgia Power HEIP contractor

"I find it's hard to reach that 25% energy savings. Part of this is the homes we're looking at - a lot are already at levels where we can improve comfort without hitting those savings. In a year I'll do 50-60 assessments and we really don't do that many Whole House projects; partly because the customer doesn't want to buy that much but it's also really hard to achieve. I can't get a rebate out of a 2005 home because it's hard to get those savings. Sometimes I just tell my clients that the rebate will just be a bonus – let's solve your issues first and then if we get a rebate that's great."

- Georgia Power HEIP contractor

"The houses I work with are too big. If you have a two-story house, there's no chance. If you have a 1960 ranch house that's 1,500 square feet, it might work. But I'm in Alpharetta, very affluent, the median income of my homeowners is over $100,000, the average house is $300,000, the majority of the houses are $500,000 plus. So, these houses aren't falling apart, they already have double paned windows, they're nice houses."

- Georgia Power HEIP contractor

Contractors also noted that the reduction in rebate value compared to previous years is limiting participation in the Whole House path. The program previously offered tiered incentives relative to the level of energy savings achieved, whereas now the program only offers one incentive level.

"The incentive levels – when I was doing it before it was a three-tiered rebate program, 20%/25%/30% energy savings with different monetary levels. They switched it to straight 25% and made some other changes which I'm sure they had good reasons to do, but I find it's hard to reach that 25% savings."

- Georgia Power HEIP contractor

"These days it (HEIP) is maybe 20 – 25% of what I do. It's gotten smaller. It used to be 100%. In the beginning it was Individual Improvements only, then they moved into Whole House, and it was paying a lot more and I got a lot more calls. Then two things started happening: they cut the rebates in half and the phone quit ringing."

- Georgia Power HEIP contractor

Additional Suggested Measures and Markets

Two HEIP contractors who also participate in Georgia Power's Home Energy Efficiency Assistance Program (HEEAP) identified a need among moderate-income customers, who are excluded from the HEEAP but are unable to afford measures through the HEIP program, or without a program at all.

"This program is for people with money. If you don't have $5,000 - $6,000 in disposable income, you can't do this."

- Georgia Power HEIP contractor

Contractors also noted two additional measures they would like the program to consider adding: HVAC repairs or replacements and windows.

"We used to incentivize high efficiency HVAC and that went away – I understand why they don't want to pay on HVAC especially when it's something that has to be done."

- Georgia Power HEIP contractor

Other Contractor Recommendations

Two contractors who provide the full spectrum of program services expressed a desire to see "back-end" energy savings results. The contractors expressed that they are confident the measures they recommend and the work that they do provides their customers with the energy savings they claim. However, they explained that they would gain greater insight into which measures are the most beneficial to their customers if they were able to see actual quantitative savings results on a house-by-house basis. Contractors also expressed concern over asking the customers for this data directly, as it could lead to disputes if the savings had not materialized as expected.

"We sure would love to see the metrics on the back-end. When we do a Whole House improvement, we're not privy to what the actual power reduction is. It would be nice from our perspective to know what's working and what's not. We get all their data on the front end, but it would be great to see what the actual performance was. It would make us better contractors if we knew what was and wasn't working without having to open up a can of worms with the customer."

- Georgia Power HEIP contractor

This speaks to a desire among participants and contractors to verify that they have realized the energy savings they invested in. The ability to measure and report realized energy savings on a household level could provide a substantial benefit to both participants and participating contractors.

"The Beacon [HEA] model is deeply flawed in my opinion, but I don't have the back-end data to back that up. I'm working on one now and the customer wants Whole House rebates and insulating the sub-floor is showing up in the model as a money loser. You don't lose money when you insulate the sub-floor. Another is spray foam encapsulation insulation. The model seems more geared towards big time savings for encapsulating a crawl space, but in an attic in the model you get more savings by using fiberglass. In reality that's not true, you get a lot more savings encapsulating an attic for heating and cooling. We have a lot of really happy customers over the years, but the model doesn't give us much credit for it."

- Georgia Power HEIP contractor

"The model only allows you to model 3 HVAC systems; you run into homes that don't fit though. A more sophisticated model would be welcome. We go to a 9,000 square foot house with 6 HVAC systems – Beacon [HEA] only has room for 3 – how do you model that?"

- Georgia Power HEIP contractor

*"I've never been a fan of it, and I've been using it for 10 years. There are mixed entries – things like, what's the front of the house and the side of the house, then later they'll ask you what percent of the first floor is on the foundation – instead of using square foot for square foot they use percentages. Mixed math is annoying. Coming from a construction background why can't I say that my basement is 12*20 instead of X% of this and that? There's some redundancy in the e ntry stuff. I've never found it user friendly, and I'm not sure about its overall accuracy."*

- Georgia Power HEIP contractor

Beacon HEA

Contractors expressed several concerns over the modeling software, Beacon HEA, used by the program. The overarching concern is that the model does not accurately represent energy savings at the household or the measure level, with the savings from certain measures being overstated, and others being understated. It is worth noting that to some extent, contractors expressed uncertainty with the savings attributed to the measures their business specialized in (insulation, air sealing, HVAC, etc.).

Conclusions and Recommendations

Conclusion 1: Claimed savings for the air sealing Individual Improvements measure are inconsistent with the home size and level of infiltration reduction observed during the first 15 months of the 2020 – 2022 cycle.

The average CFM reduction in HEIP was approximately 1,000 CFM – or 30% of the pre-retrofit CFM50. While this is a significant improvement, the homes participating in HEIP's Individual Improvements path were relatively small at an average of less than 1,500 square feet. The overall air flow and HVAC consumption in a home is proportionate to size, so smaller homes have less heating and cooling energy to save than larger homes, on average. Small home sizes and overstated assumptions about air sealing performance during the heating season resulted in substantially lower verified gross savings as compared to reported savings.

Recommendations:

- Consider applying savings per-CFM to estimate savings more accurately. The evaluation team recommends using 0.9 kWh per CFM reduced for air sealing in electrically heated homes and 0.7 kWh per CFM reduced for air sealing measure in homes heated with fossil fuel heat. For peak demand, we recommend 0.4 kW per 1,000 CFM reduced for summer peak demand reduction and 0.1 kW per 1,000 CFM reduced for winter peak demand reduction for homes with electric heat.
- Air sealing savings are more pronounced in the summer cooling season in Georgia due high latent cooling requirements. This drives the limited incremental savings per CFM for electrically heated homes.

Conclusion 2: Dual participation between the Whole House and Individual Improvements path was common during the first 15 months of the 2020 – 2022 cycle. Submitting air sealing upgrades as an Individual Improvements measure in addition to the Whole House project allowed contractors and participants to maximize the rebate amount but presented challenges in accurately estimating savings resulting from those projects.

The most common dual participation strategy was an air sealing Individual Improvements measure followed by a Whole House project. Contractors handled this correctly in the Beacon HEA tool and entered the blower door test-out CFM level as the existing condition for the Whole House project so there is no double-counting. However, the Whole House project lowers the effectiveness of the air sealing measure from an energy savings standpoint.

Recommendations:

- There are complex interactive effects between air sealing and Whole House measures like attic insulation that are better addressed through building simulation software. The evaluation team recommends Georgia Power consider a tiered incentive strategy for Whole House projects that allows contractors and participants to earn higher incentive payments for different levels of home energy reduction. We believe this would eliminate the need for dual participation across program paths.

Conclusion 3: Attic insulation levels, pre- and post-improvement, are important for energy savings estimation.

For Individual Improvements, the program tracking database captured a mix of added R-values and post-installation R-values for attic insulation Individual Improvements but did not capture baseline R-values. While some invoices and work orders listed the thickness or R-value of added insulation and the estimated resulting R-value, allowing for extrapolation of baseline R-value, the actual baseline was typically not documented. Project characteristics, especially baseline (in-situ) insulation depth and condition, and ultimately R-value, substantially impact ceiling insulation project savings. These characteristics should be required of contractors, captured in the program tracking database, and ideally used to calculate energy and demand savings on a per project basis. Attic insulation was a primary measure within the Whole House path and our site visits identified issues with the baseline attic insulation values entered in the Beacon HEA tool. Table 68 showed how different savings from attic insulation projects with the same post-retrofit R-value can be based on the baseline level of insulation.

Recommendations:

- Capture baseline and installed attic insulation R-values. For Individual Improvements, consider using site-specific values, to calculate energy savings by project using the savings methodology shown in Appendix 4A. Algorithms and Assumptions.
- Since program rules require less than R-11 of baseline insulation, capturing baseline R-value electronically for each measure would allow program staff to quickly validate eligibility.
- Require photo documentation for any home claiming zero attic insulation in the baseline.

Conclusion 4: Reported peak demand reduction is significantly overestimated for several Individual Improvements measures.

Peak demand reduction for attic insulation, duct sealing, and air sealing were reported as being between two times (air sealing with electric heat) and seven times (attic insulation with gas heat) higher than the verified summer peak demand reduction. Our verified energy savings and demand reduction calculations are performed using site-specific information where available and result in lower savings likely due to characteristics like home size, HVAC efficiency levels, and other details.

Recommendations:

- We recommend reviewing the home size, HVAC system efficiency levels, and other relevant energy simulation parameters used to determine deemed peak demand savings. On average, homes in HEIP Whole House tended to have systems with efficiency values in the 13 to 14 SEER range recorded in Beacon HEA. This is significantly higher than the inputs used in the EnerSim modeling documented in the Georgia Power TRM.
- Generally, the summer peak demand savings for measures should be similar across heating fuels because all homes use air conditioning similarly. The reported peak demand savings for duct sealing

and air sealing in homes with gas heat are roughly double their electric heat counterparts. This resulted in much lower summer demand realization rates for homes with natural gas heat.

Conclusion 5: Program-supported heat pump water heaters were significantly more efficient than the minimum requirement. This led to high realization rates for the measure.

Reported energy and summer peak demand savings for the heat pump water heater measure are deemed at 1,479 kWh and 0.03 kW. The deemed values are based on a calculation that uses an energy factor of 2.0 for the efficient case – which is the minimum efficiency required to qualify for a rebate. The units installed as part of HEIP's Individual Improvements path had an average energy factor of 3.7, with 97% of units having an energy factor greater than or equal to 3.5.

Recommendations:

- Update the water heater energy savings assumptions to reflect the average efficiency levels of the units rebated during 2020 and the first quarter of 2021. This is feasible because energy factor is captured for each installation, and the file entries are accurate based on our desk review of sampled projects.

Conclusion 6: It is difficult to separate the performance of the program from the performance of the most active contractor.

The sampling, data collection, and analysis activities in this evaluation examined the participating homes during the first 15 months of the 2020 – 2022 cycle. The most active contractor accounted for 77% of Whole House Single Family reported energy savings and 57% of the Individual Improvements reported energy savings. This contractor predominantly served customers who rent smaller and older homes in Northwest Georgia, and who are lower income.

Our evaluation activities also uncovered quality control issues for this contractor which are currently being addressed by the program delivery team. The evaluation team does not expect a single contractor to dominate the program moving forward, and we also expect these issues to be addressed. These factors weighed heavily in our recommendation to apply the results of the 2017 evaluation to the Whole House Single Family track.

Recommendations:

- When and/or where it is safe, resume in-person QA /QC.
  - In the meantime (or in addition), conduct follow-up telephone interviews with customers, and consider other virtual QA/QC options to ensure contractors are completing jobs as desired.
- Consider dynamic QA/QC targets. A standard target is to review 10% of contractors' jobs. This target can be loosened if you find no issues or increased to 20% or higher if you do identify problems. In situations where many issues are identified, consider adding the contractor to a performance improvement plan or placing them on a probationary status.

Conclusion 7: Beacon HEA is a useful tool for program delivery but tends to overstate energy savings. Both contractors and participants also noted dissatisfaction with energy savings that stemmed from the Beacon HEA estimates.

Impact evaluation results have consistently underperformed the electric savings assumptions in Beacon HEA since the evaluation of Georgia Power's 2010 DSM Portfolio. Program contractors also expressed that they believe the model does not accurately represent energy savings at the household or measure level, with the savings from certain measures being overstated, and others being understated. Finally, of all program aspects, participants were least satisfied with the energy savings realized after their improvements were complete, indicating they may not see the cost or energy reductions they expected in their utility bills.

Recommendations:

- If Georgia Power continues to use the Beacon HEA software in future cycles, consider the following recommendations.
    - If possible, consider applying the realization rates in Table 56 to Beacon HEA outputs for reporting purposes. This strategy would ensure that Georgia Power's claimed savings and earnings more closely reflect evaluation findings. In addition, this may establish more realistic savings expectations for participants.
    - Work with the Beacon HEA modeling team to create a saving calculation approach for "replace on burnout" HVAC upgrades. Consistent with program modeling rules, energy savings for replacement of HVAC equipment that had reached the end of its useful life should use a code minimum baseline efficiency.
- Alternatively, Georgia Power could explore modifications to the tool to reflect the realistic energy and bill savings participants can expect from their project. Modifications might include:
    - Updates to the assumptions that underpin the utility bill disaggregation feature. The evaluation team believes that water heating, appliances, and other baseloads are underrepresented in Beacon HEA, and heating and cooling consumption are overstated. The US Energy Information Administration's Residential Energy Consumption Survey (RECS) is a useful resource for this type of information. RECS 2015 results are currently available, and RECS 2020 results are scheduled for release in 2022.
    - Aligning the assumptions used to compute LED lighting savings with the rest of the residential portfolio.
- Georgia Power might also explore alternative software solutions to support the home energy assessment and Whole House components of HEIP. However, the evaluation team recognizes that other tools may not align with program design and delivery priorities.

Conclusion 8: In 2020, contact information was not accurately tracked in the program tracking data for many participants. This limited the ability of the evaluation team to reach and interview program participants.

Customers in the tracking data frequently had missing contact information, or the information listed was for the contractor instead of the customer. This made it challenging for the evaluation team to reach customers and meet the established quotas of 100 survey completes for each program path. This, along with other challenges, also limited the evaluation team's ability to assess net-to-gross via self-report.

Recommendations:

- Track resident, landlord/property owner (where applicable), and contractor contact information separately and clearly to facilitate verification.
- Include an indication if the resident is a tenant or homeowner to facilitate reaching the decision-maker for future evaluations and verification efforts.

Conclusion 9: Many customers, particularly those part of the Whole House path, reported they were not aware of any other Georgia Power energy efficiency programs.

For HEIP participants overall, over half (53%) reported that they were not aware of any other Georgia Power energy efficiency programs. Among the Whole House/Combined customers, three-quarters (76%) reported they did not know about any other Georgia Power programs, while the Individual Improvements customers were more evenly split with 53% reporting awareness and 47% reporting they were not aware of other programs. Per program staff, in 2021 Georgia Power started sending automated emails to customers, in which they note other energy efficiency program.

Recommendations:

- Encourage all HEIP contractors to make customers aware of other Georgia Power programs during their touchpoint.
- Develop simple leave-behind materials with information about HEIP and other offerings for contractors to review with customers and leave for their future reference.

Conclusion 10: There were notable demographic differences between the customers reached through the Whole House/Combined path and the Individual Improvements path.

Nearly all customers who participated through Individual Improvements only owned their home, while slightly less than half of Whole House/Combined respondents reported being homeowners. In addition, Whole House/Combined path participants more often lived in older homes, with roughly half reporting they lived in homes built prior to 1960, compared to just 22% for Individual Improvements respondents.

Roughly half of Whole House/Combined customers had an annual income less than $50,000 (with 20% of customers reporting an income below $25,000), compared to only 11% for Individual Improvements customers. Conversely, over half (55%) of Individual Improvements respondents had an annual income over $100,000, while only one-quarter of Whole House/Combined customers did.

Whole House/Combined path customers also held college degrees less frequently than Individual Improvements. Roughly three-quarters of Individual Improvements respondents held four-year college or graduate degrees, compared to 38% for Whole House/Combined customers. Finally, Whole House/Combined customers more commonly identified as Black or African American (21% compared to 6% for Individual Improvements), or Hispanic, Latino, or of Spanish origin (7% compared to 4% for Individual Improvements).

Conclusion 11: Satisfaction among participants and contractors is high for nearly all aspects of HEIP.

Virtually all customers (98%) were either very satisfied or satisfied with HEIP overall. Over three-quarters of respondents (78%) rated their satisfaction with Georgia Power as an 8, 9, or 10 on a scale of 1 to 10 where 1 was "not at all satisfied" and 10 was "extremely satisfied."

In addition, nearly all customers (96%) who received a home energy assessment reported that it was somewhat or extremely helpful. The same percentage of survey respondents also reported that they were extremely or somewhat satisfied with the quality of work provided by their contractor.

Similarly, contractors expressed high levels of satisfaction with HEIP and its various components. Each contractor spoke highly of HEIP staff and gave considerable praise to the Georgia Power team for transitioning to self-implementation of the program during the pandemic.

Program participants were less satisfied with the energy savings realized after completing improvements (see Conclusion 7). In addition, there was a divide between participants for the best rebate delivery method, with some preferring a physical check and others requesting a direct bill credit. The primary area of dissatisfaction for contractors was the tendency for Beacon HEA to inaccurately estimate energy savings at the household or measure level (see Conclusion 7).

Recommendations:

- Continue to offer rebates for measures through the Georgia Power Home Energy Improvement Program (if cost-effective).
- Consider whether it is feasible to provide options to customers in terms of how they receive the rebate, either in the form of a physical check or a direct bill credit.

Conclusion 12: The primary barriers to participation through the Whole House track are that homes are already too efficient to reach the 25% energy savings threshold, or that customers cannot afford all the work to reach this savings level.

Contractors interviewed this cycle unanimously concluded there are two primary factors that dictate whether a customer will participate through the Individual Improvements or Whole House path: the customer's financial situation and the physical characteristics of their house. Put simply, most customers simply cannot afford all the work necessary to qualify for the Whole House incentive, and most homes are already too efficient to achieve the required 25% energy savings.

In addition, contractors who also participate in Georgia Power's income-qualified Home Energy Efficiency Assistance Program identified a need among moderate-income customers, who are excluded from HEEAP but are unable to afford measures through the HEIP program, or without a program at all.

Recommendations:

- Consider offering multiple tiered savings options through the Whole House track. This could help reach customers in more efficient homes who cannot reach the current energy savings threshold, but who can still benefit from energy efficiency improvements. In addition, this could benefit more lower- and moderate-income customers, who cannot afford to make all the improvements needed to reach the current savings threshold.
- Consider whether it is possible to offer a bill financing option for lower- and moderate-income customers.
- Ensure contractors are aware of other Georgia Power energy efficiency program offerings so they can direct customers to appropriate programs and participating contractors. For example, income-qualified customers could be connected directly to the online Home Energy Efficiency Assistance Program application to determine if they may be eligible for program participation.

5. HOME ENERGY IMPROVEMENT PROGRAM - THERMOSTAT MARKETPLACE

Program Design and Delivery

The Home Energy Improvement Program (HEIP) is composed of multiple distinct subcomponents designed to serve different constituents in the residential customer class. One component, covered in this chapter, is smart, Wi-Fi enabled thermostats. All other components are discussed in Home Energy Improvement Program – Individual Improvements and Whole House.

Instant rebates on qualified Wi-Fi connected smart thermostats are a core offering of Georgia Power's Online Marketplace (Marketplace). The Marketplace offers rebates to residential customers in both single family and multifamily residences, and the per-unit reported savings vary depending on premise type. Most thermostats (92%) were installed in single family residences. Over the course of the reporting period, there were 29,483 distinct customers who purchased a thermostat through the Online Marketplace, which results in an average of 1.4 thermostats per home.

Energy and peak demand savings from smart thermostats rebated on the Marketplace are claimed under HEIP. Thermostat purchasers through most of 2020 had the option to enroll in the Temp✓ demand response program at the same time or later, and all demand reductions associated with dispatchable demand response events were claimed under the Temp✓ program.

Changes from Previous Cycle Design

The Thermostat Marketplace channel of HEIP operated relatively similarly to the last cycle, with no major changes to program design or delivery.

Implications of the COVID-19 Pandemic

The evaluation team recognizes that this evaluation occurred during a timeframe in which the COVID-19 pandemic impacted daily life for residential customers in Georgia. As described previously, the HEIP program has several channels with very different design and delivery mechanisms, and the pandemic impacted each of these differently. As the Thermostat Marketplace channel operates through Georgia Power's Online Marketplace, it was able to operate relatively normally during 2020.

Evaluation, research, and analysis nearly always have the potential for introduced and inherent biases and exogenous factors that may influence results. Ideally, evaluators attempt to control for these factors in analyses, such as through sample design. Where controlling for them is not possible, evaluators will attempt to identify and characterize the factors that may have influenced evaluation results. For all program evaluations conducted this cycle, the evaluation team has carefully considered possible ways the unprecedented events of the COVID-19 pandemic and related factors may have impacted our results. There is much that is still unknown about how the COVID-19 pandemic has influenced household energy use and behavior in the US, and it is likely that the pandemic has affected households differently depending on household size, location, employment status, and other demographic factors (such as income, race, age, etc.). Additionally, whether and at what speed these factors return to pre-2020 conditions are occurring at varying degrees and speeds across different demographics and populations.

The evaluation team's impact evaluation approach to modeling the energy and peak demand impacts of smart thermostats utilized a regression analysis of hourly household electric consumption. The evaluation team used a matched comparison group which is best practice when a randomized controlled trial design is not possible, and especially important for our analysis this cycle given the COVID-19 pandemic. Using this method attempts to control for the unknown effects of the pandemic – which should have, in theory, affected both the treatment and comparison groups similarly. While the analysis leverages a matched comparison group of nonparticipant homes (who also experienced the pandemic), it is possible that the energy savings generated by a smart thermostat during a period of increased remote work and school are different from typical conditions. It is unknown what magnitude and direction this may affect savings, if at all. However, our results align with similar trends we see in the industry more broadly and given the circumstances we believe they are the current best and most reasonable estimates for planning. Throughout this report, the evaluation team provides triangulation for our results as well as points of comparison. Additional research in the near-term future may be helpful to confirm savings estimates for future planning as well.

Program Performance

Table 77 summarizes energy and summer peak demand savings delivered by the Thermostat Marketplace channel. As Georgia Power does not track goals by this program component, goals are not included here.

Table 77. HEIP Thermostat Marketplace Savings

METRIC	TIME PERIOD	REPORTED SAVINGS	ESTIMATED GROSS SAVINGS	VERIFIED NET SAVINGS	REALIZATION RATE
Electric Energy Savings (MWh/yr.)	2020 - Q1 2021	17,764,063	11,049,212	8,507,893	62%
Summer Peak Demand Reduction (kW)	2020 - Q1 2021	7,390	3,003	2,312	41%

Table 78 shows the reported savings by measure at the per unit (thermostat) basis and in aggregate. Multifamily residences received a slightly higher savings per unit for both energy and demand savings but were less prevalent than single family participants. In total, the multifamily measure accounts for less than 10% of the total reported thermostat energy and demand savings.

Table 78. Marketplace Thermostats Reported Savings Summary 2020 - Q1 2021

MEASURE	THERMOSTAT COUNT IN REPORTING PERIOD	REPORTED PER-UNIT ENERGY SAVINGS (KWH)	REPORTED PER-UNIT SUMMER PEAK DEMAND SAVINGS (KW)	REPORTED TOTAL ENERGY SAVINGS (KWH)	REPORTED TOTAL SUMMER PEAK DEMAND SAVINGS (KW)
Single Family	37,924	424	0.1764	16,079,776	6,689
Multifamily	3,531	477	0.1983	1,684,287	700
Total	**41,455**	**n/a**	**n/a**	**17,764,063**	**7,390**

Research Questions

This section provides the research questions for the evaluation of Thermostat Marketplace. These research questions guided the direction of this program's evaluation activities, including the focus of the data collection activities.

Process Questions

- How are customers learning of the program? Are program marketing initiatives resonating with customers?
- What influences customers' decisions to participate in the program?
- How satisfied are customers with the program overall as well as individual program components?

Impact Questions

- How do the gross and net verified per-unit energy assumptions compare to planning estimates? How and why should they be adjusted?
- Is this program as implemented cost-effective under the Total Resource Cost test?
- What are the average annual energy savings associated with installing a smart thermostat, by heating system type? How accurately are customers who purchase smart thermostats through the Georgia Power Marketplace able to self-report their HVAC system type?

Impact Evaluation

Verified Savings Approach

To evaluate savings for the 2020 to Q1 2021 period, the evaluation team analyzed consumption patterns for Georgia Power customers who purchased a smart thermostat through the Marketplace in 2019 or Q1 2020.

The data processing included thorough cleaning and preparation steps which resulted in the removal of some customers. The counts included in the verified savings estimation represent the accounts that “survived” the full cleaning process. The key filters included in the data cleaning process are listed below.

- Customers without AMI data are removed (occurred rarely)
- Customers without a full year of AMI data prior to thermostat purchase and a full year after purchase are removed to ensure consumption patterns are observed during a full range of seasons
- Customers without important characteristics such as zip code and premise type are removed
- Customers with unrealistically low or high usage for a residential premise are removed
- A small number of customers that do not have an adequate comparison group match are removed

There were 20,754 customers that purchased at least one thermostat through the Marketplace during this analysis period, but cleaning and matching reduced the number of customers that are used in the analysis to 13,091 customers (63%). Almost all attrition is due to the requirement that a customer must have a full year of AMI data before and after their thermostat purchase. Table 79 shows the distribution between premise types for the participating customers included in the regression analysis. Like the reporting period, the split by premise type was approximately 90% single family and 10% multifamily.

Table 79. Thermostat and Customer Distribution by Premise Type – Analysis Sample

PREMISE TYPE	PARTICIPATING CUSTOMERS IN ANALYSIS SAMPLE	THERMOSTATS PER CUSTOMER
Single Family	11,731	1.45
Multifamily	1,360	1.40
Total	**13,091**	**1.45**

Customers are limited to two thermostats per residence, but in 2020 and early 2021 a small proportion of customers (1.3%) bypassed this restriction due to an error in the Marketplace software that tracked the number of purchases per customer. This was most apparent for customers who purchased LUX, Hive, or multiple thermostat brands (Table 80), for which the average number of thermostats per customer was over the two-thermostat limit. This has since been corrected by Georgia Power and the program implementer. On average, customers purchased 1.45 thermostats per customer.

Various brands are offered on the Marketplace. Table 80 shows the distribution of thermostats sold during the 2019 to Q1 2020 analysis period. Google Nest was the most common with two-thirds of Marketplace thermostat sales. Customers with multiple thermostats occasionally have a mix of brands, so we classified a customer as having “Multiple Brands” if they purchased more than one brand of thermostat from the Marketplace. If all thermostats purchased by a customer are under the same manufacturer, they were included in that specific brand.

Table 80. Thermostat Distribution by Manufacturer – Estimation Sample

MANUFACTURER	CUSTOMERS	THERMOSTATS	THERMOSTATS PER CUSTOMER
Google Nest	8,631	12,520	1.45
ecobee	2,093	2,927	1.40
Honeywell	1,446	1,978	1.37
Emerson	651	919	1.41
LUX, Hive, Multiple Brands	270	625	2.31
Total	**13,091**	**18,969**	**1.45**

While the thermostats in the estimation sample were purchased during the 2019 to Q1 2020 timeframe, our reporting period for the HEIP evaluation covered 2020 to Q1 2021. The use of 2019 participants was necessary because we required at least 12 months of pre- and post-installation data. Participants from late 2020 and early 2021 simply do not have sufficient post-installation consumption data for modeling according to industry best practice. The only change to the Thermostat Marketplace offering between 2019 and 2020 was to exclude LUX and Hive brands. However, there were only about 50 LUX and Hive thermostats included in the analysis in total, so per-unit savings can reasonably be applied from the analysis period to the reporting period.

While the Georgia Power thermostat program offering maintained consistency between the two periods, there was an important change to Google Nest and ecobee devices. Both manufacturers launched optimization platforms for their devices which rolled out in 2020. Google Nest deployed its Seasonal Savings offering and ecobee deployed the eco+ thermostat optimization in spring 2020 on an opt-in basis.[52] These optimization offerings have been demonstrated to increase the energy efficiency savings relative to the "out of the box" smart thermostat through more aggressive setpoint modifications. Our post-installation data ranged from February 2019 to March 2021 depending on participation date, so the effect of these optimization algorithms is at least partially reflected in the Nest and ecobee results.

We used a two-stage matching process based on both monthly billing data and hourly AMI data to select a matched comparison group of customers who first purchased a thermostat via Marketplace in 2019 through Q1 2020. Prior to analysis, Temp✓ event days were removed from the data. We performed the modeling using

[52] https://www.ecobee.com/en-us/eco-plus/ (ecobee) https://blog.google/products/google-nest/seasonal-savings-nest-thermostat/ (Nest)

a difference in difference regression analysis, more fully defined in Appendix 5A: Methodology. The approach estimated weather normalized per-thermostat impacts for each hour of the year. The analysis of whole home data produced impacts at the customer or home level, but the savings results were divided by the number of Marketplace thermostats per customer to arrive at per-unit impacts. Because the analysis was conducted with hourly AMI data, summer and winter peak demand savings were estimated directly.

The use of a matched comparison group is necessary for a variety of reasons. Notably, the matched comparison group also experienced the COVID-19 pandemic and associated lifestyle changes in 2020 and 2021. We observed an increase in weather-normalized energy consumption in both groups during the pandemic but were theoretically able to remove the non-program-related changes observed in the comparison group to isolate the effect of the thermostat measure amongst the participant group.

In addition, this type of regression analysis directly estimates net savings because we assume the matched comparison group (composed of nonparticipating customers) does what the participants "would have done" in the absence of the program – including potentially purchasing and installing a smart thermostat. The following sections discuss our verified net savings results. We also provide estimated gross savings, to facilitate comparisons to past evaluations.

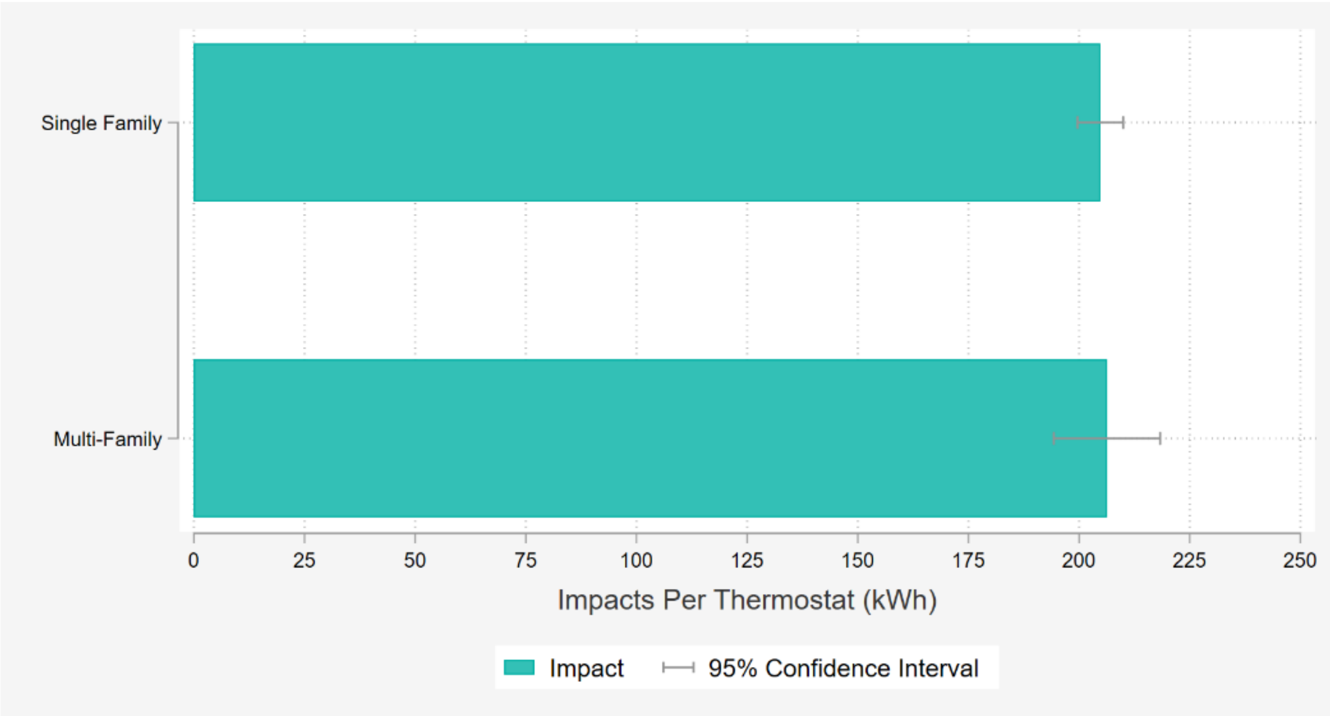
Verified Net Savings Results

The evaluation team performed the analysis on a variety of subgroups to understand measure performance across segments of interest. The core analysis focused on single family versus multifamily residences since Georgia Power's reported savings vary by premise type, but also examined the number of rebated devices. In addition, the evaluation team investigated energy savings as a share of end use load and demand reduction.

Net Savings by Premise Type

Figure 74 shows the estimated absolute energy savings were consistent between premise types based on the segmented results of single family and multifamily residences.

Figure 74. Annual Per-Thermostat Net Annual Energy Savings by Premise Type



While absolute energy impacts were similar between premise types, the percent impacts varied due to the differences in average consumption between premise types. Table 81 shows the average annual whole home consumption and savings for single family and multifamily participants. The per-home savings presented in Table 81 are divided by the average number of thermostats per-home to calculate the savings per thermostat, or per unit. The annual per-unit savings are 205 kWh for single family and 206 kWh for multifamily.

Multifamily homes used less energy on average, but exhibited similar energy savings per home, so the percent reduction in whole house consumption is larger than single family residences.

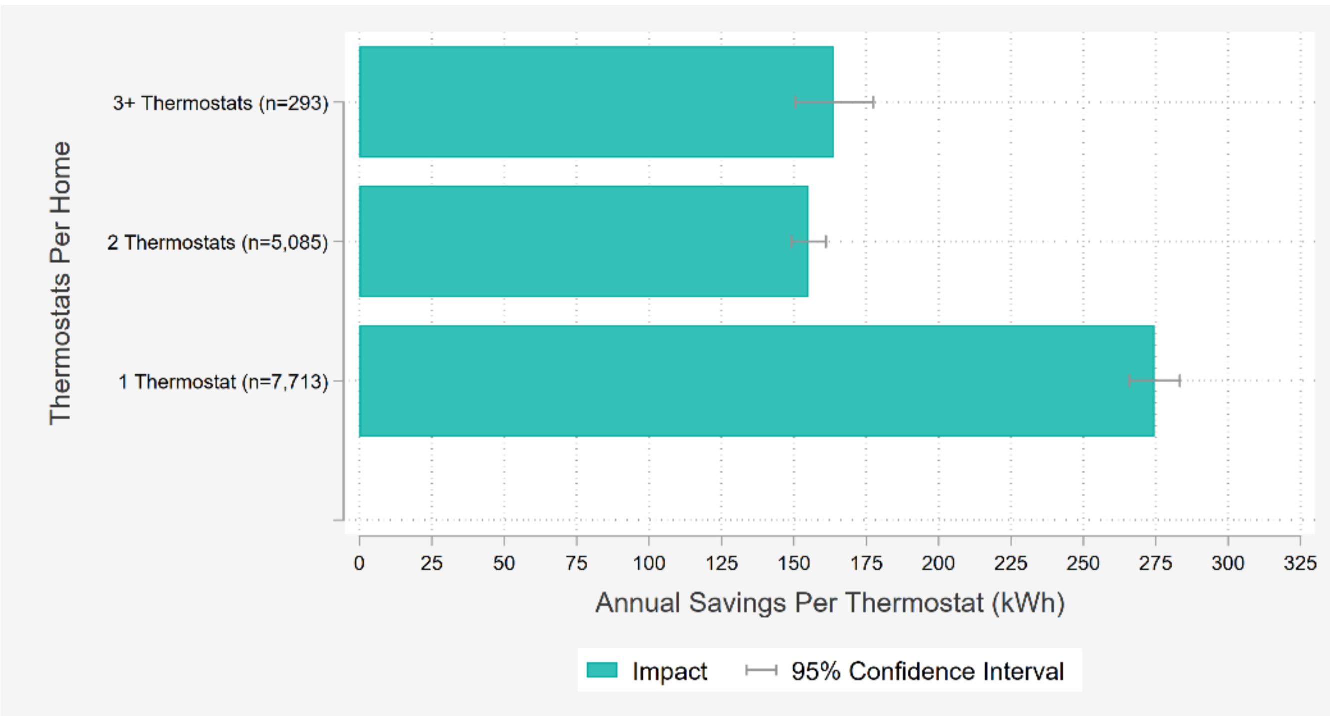
Table 81. Per-Home Percent Net Savings by Premise Type

PREMISE TYPE	ANNUAL BASELINE ENERGY CONSUMPTION (KWH/HOME)	ANNUAL NET ENERGY SAVINGS (KWH/HOME)	ANNUAL NET ENERGY SAVINGS (KWH/THERMOSTAT)	PERCENT NET SAVINGS (OF WHOLE HOME CONSUMPTION)
Single Family	14,958	298	205	2.0%
Multifamily	8,457	286	206	3.4%

Net Savings by Number of Rebated Thermostats

Some customers purchased more than one thermostat from the Marketplace. The existing reported savings process allows for each additional thermostat to receive the same per-unit savings as the first. Figure 75 shows the per-unit savings based on number of thermostats rebated per customer, and that the savings do not increase linearly with additional thermostats. Figure 75 shows the per-unit savings based on number of thermostats rebated per customer as well as the number of customers in the estimation sample having that number of Marketplace thermostats. Customers with one thermostat saved 275 kWh per year, while customers with two thermostats saved 155 kWh per unit annually. This equates to 310 kWh per year for the home. Lastly, customers with three or more devices saved 164 kWh per unit, per year. There are only 293 customers in this category and these homes have an average of 3.7 thermostats per home.

Figure 75. Impacts by Rebate Quantity



Net Savings as a Share of End Use Load

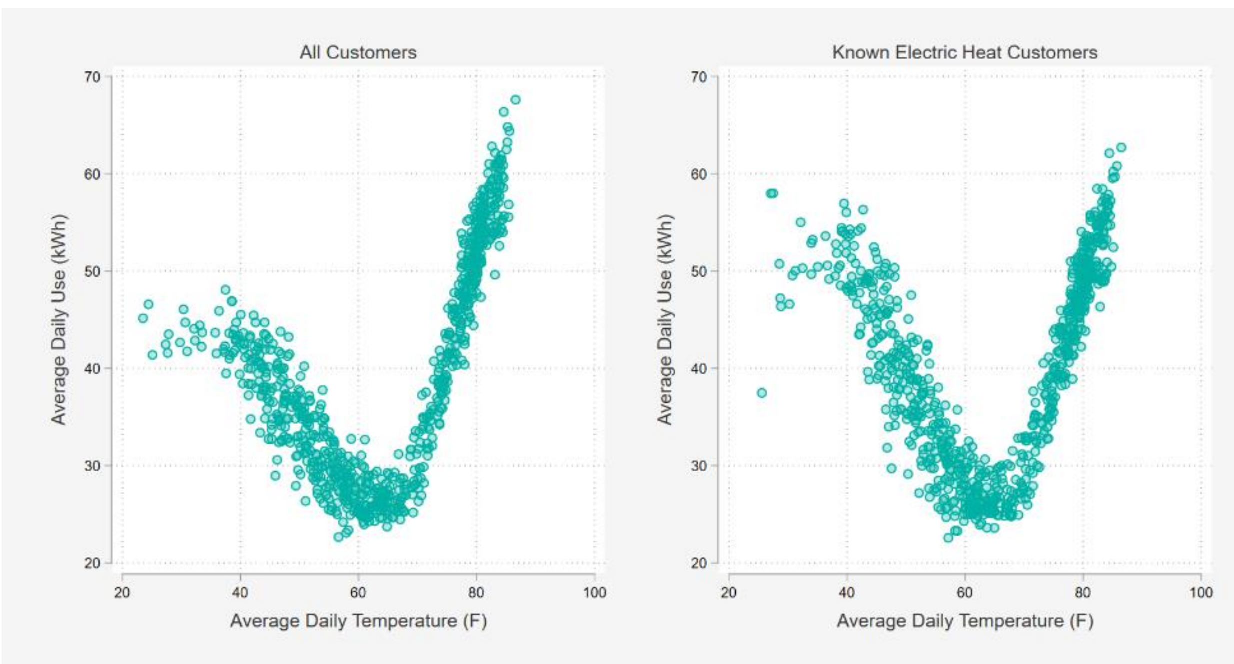
Thermostat savings are constrained by the amount of energy used by the HVAC system, for both heating and cooling purposes. To more closely evaluate the effectiveness of Marketplace Thermostats, we estimated the daily energy attributable to the HVAC system (Table 82). The weather-normalized estimate of pre-period HVAC consumption for our sample is approximately 5,376 kWh per year. We estimated that participant homes had an average annual heating energy use of 1,941 kWh and annual cooling energy use of 3,435 kWh. A per-home savings of 296 kWh translates to a 5.5% reduction in electric HVAC consumption.

Table 82. Savings as a Percent of HVAC Load

METRIC	VALUE
Annual HVAC Load (kWh/home)	5,376
Annual Energy Savings (kWh/home)	296
Savings Per Home as a Percent of HVAC Load	5.5%

While Georgia Power does not collect customer information around heating fuel, nearly 60% of survey respondents reported using electricity as their primary heating fuel. The general population survey found a similar proportion of customers self-reporting electricity as their primary heating fuel. We expect savings to be larger in homes with electric heating than those without. This is because the base HVAC load (of 5,376 kWh) would not be diluted by homes with fossil fuel heat that only use electricity for cooling and ventilation. Figure 76 shows the relationship between average daily use and temperature for the pre period. The left panel shows this relationship for all customers, and the panel on the right shows a subset of customers who are enrolled in Temp✓. It is a requirement for customers in Temp✓ to have electric heat. As is evident in the figure, on very cold days, the electric heating subset used more energy than the full group. Because electrically heated homes use more weather dependent electricity over the course of the year, targeting homes with electric heating will provide higher average savings for the Marketplace Thermostat measure.

Figure 76. Daily Use by Average Daily Temperature



The evaluation team performed a high-level calculation to estimate the difference in annual electric energy and demand savings for homes with a heat pump and homes with gas heat and a central air conditioning system. These values were estimated using the heating and cooling energy usage values described earlier in this section, and assuming 60% of program participants have electric heating (based on survey responses). Table 83 includes these estimated savings values, and again shows the higher average savings that can be achieved by electrically heated homes. Again, these are high level estimates and should be interpreted as such, but may be helpful for future planning.

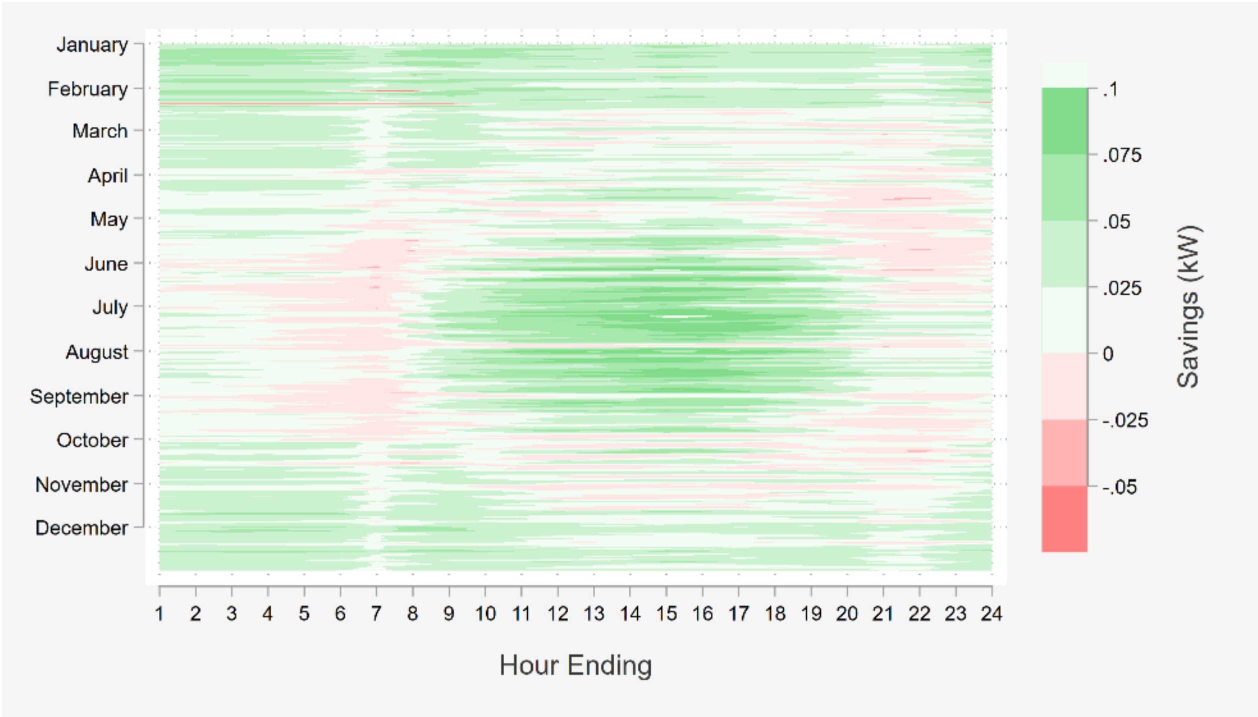
Table 83. Estimated Savings for Homes with Electric versus Gas Heat

HVAC EQUIPMENT	ANNUAL ENERGY SAVINGS (KWH/THERMOSTAT)	SUMMER DEMAND REDUCTION (KW/THERMOSTAT)	WINTER DEMAND REDUCTION (KW/THERMOSTAT)
Heat pump	253	0.06	0.07
Gas heat and central air conditioning	130	0.06	-

Demand Reduction

While reported savings for the 2020 – 2022 cycle only include a summer peak demand savings value, we present both winter and summer demand savings. To obtain the seasonal impacts we ran a time of week and temperature (TOWT) model to distribute the annual savings calculated in the core analysis. We applied the TOWT model to the same estimation sample as the core regression but used temperature and hour of week (1 through 168) as the predictors to understand the savings. The regression coefficients were predicted for hourly TMY3 weather data to create a weather-normalized 8760-hour load shape. The heat map in Figure 77 shows the distribution of savings over the course of a typical weather year. Savings are most pronounced during the daytime hours of summer months. There also appears to be some amount of load shifting in addition to the overall energy savings. Averaging the savings across July weekdays from 4:00 to 5:00 pm results in the summer demand savings of 0.06 kW. Averaging the savings across January weekdays from 8:00 to 9:00 am returns the winter demand savings of 0.04 kW.

Figure 77. Heat Map of 8760 Savings Load Shape: Per-Unit Net



Realization Rates

As noted previously, the results of the billing analysis are inclusive of all adjustments typically made to thermostat impact results, including in-service rates and net-to-gross. However, previous evaluation results for thermostats resulted in *gross* savings, making comparisons of program savings across cycles challenging. To facilitate comparisons across cycles and provide an estimate of gross energy and demand savings, the evaluation team conducted a secondary literature review of current net-to-gross values developed for peer utilities. For this review, the evaluation team focused on similar program designs, where thermostats are rebated and self-installed by the customer. We included the 2017 Georgia Power evaluation net-to-gross results in this review, excluding nonparticipant spillover, as this is not included in the evaluation this cycle. The evaluation team then averaged the net-to-gross results, resulting in an average 77% net-to-gross ratio.

Figure 78. Smart Thermostat Net-to-Gross Literature Review

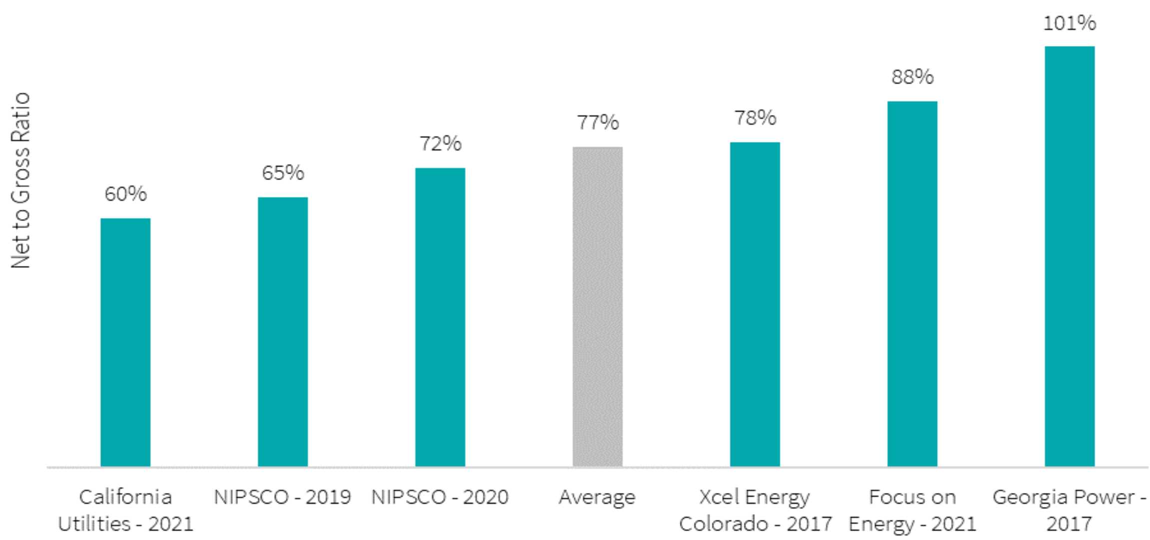


Table 84 shows the per-unit savings for verified net and estimated gross, which results in 267 kWh per thermostat per year once the net-to-gross ratio is backed out.

Table 84. Marketplace Thermostats Verified Net and Estimated Gross Per-Unit Savings Values

SAVINGS TYPE	UNIT OF MEASURE	ANNUAL VERIFIED PER-UNIT SAVINGS		
		ENERGY (kWh)	SUMMER DEMAND (kW)	WINTER DEMAND (kW)
Verified Net	Thermostat (Combined)	205	0.06	0.04
Estimated Gross	Thermostat (Combined)	267	0.07	0.06

The evaluation team applied the 77% average net-to-gross ratio to the verified net per-unit and aggregated savings to estimate gross savings for comparison and development of realization rates. Table 85 shows the aggregate savings for verified net, estimated gross, and resulting realization rates based on the 41,455 thermostats claimed in the reporting period.

Table 85. Marketplace Thermostats Nest and Gross Aggregate Savings Values

SAVINGS TYPE	AGGREGATE SAVINGS		
	ENERGY (kWh)	SUMMER DEMAND (kW)	WINTER DEMAND (kW)
Reported Gross	17,764,063	7,390	n/a
Estimated Gross	11,049,212	3,003	2,383
Verified Net	8,507,893	2,312	1,835
Realization Rate *(Estimated Gross/ Reported Gross)*	62%	41%	n/a

Table 86 highlights notable differences between reported and verified estimates. The net verified savings of 8,508 MWh are 48% of the reported savings of 17,764 MWh.

Table 86. Marketplace Thermostats Notable Differences Between Reported & Verified Savings

REPORTED SOURCES AND ASSUMPTIONS	VERIFIED GROSS SOURCES AND ASSUMPTIONS	PRIMARY REASONS FOR DIFFERENCES
Reported kWh savings are based on the 2017 evaluation which utilized pre-post billing analysis without a comparison group.	Verified savings are based on AMI data and a difference in difference matched comparison group analysis.	This cycle's study was designed to use a matched comparison group consistent with industry best practice. The COVID-19 pandemic underscored the importance of this methodological decision as weather-normalized residential customer usage increased between the pre and post period, likely due to the increase in quantity and duration of customers spending time at home.
Per-unit reported summer peak demand savings are higher than the 2017 evaluation (0.16 kW) or Georgia Power TRM (0.10 kW)	Verified savings are based on AMI data and a difference in difference matched comparison group analysis.	Reasons for this difference are twofold. (1) Overall energy savings for the measure are lower than the claimed savings (2) the evaluation methodology is a departure from prior savings characterizations. Our approach relies on hourly load data from the Georgia Power revenue meter to estimate peak demand impacts. Despite the methodological differences, the evaluation teams estimated gross per-unit impact of 0.08 kW is relatively close to the TRM default of 0.10 kW.
Reported savings are expressed on a gross basis and do not reflect adjustments for freeridership or spillover.	Verified savings are direct estimates of net savings.	Because our approach directly estimates net savings, the HEIP evaluation plan did not call for assessment of NTG. To facilitate an "apples-to-apples" comparison we reviewed recent industry studies to estimate the net-to-gross ratio embedded in our verified net savings. Once this assumed NTGR is "backed out" of the net savings estimates as discussed above, the evaluation is somewhat closer to the reported per-unit kWh assumptions.

As a point of comparison to provide additional triangulation for the research findings, the evaluation team conducted a brief secondary literature review of recent thermostat billing analyses. Comparing evaluated savings for thermostats can sometimes be challenging, as they are often reported in a variety of ways (such as percent of HVAC load, percent of household consumption, absolute savings, etc.) using various methodologies, and are often reported delineated by heating and cooling type and specific HVAC equipment. Additionally, climate zone can impact results. The evaluation team identified one recent study, also completed in 2021, that investigated savings for smart thermostats installed through a variety of Maryland utility EE programs. This study was like the Georgia Power analysis in several ways:

- Heating fuel – the electric savings account for customers with a mix of electric and non-electric heat.
- Air conditioning – virtually all customers in the analysis had air conditioning.
- Climate – the climate in the main population centers in Georgia and Maryland (Atlanta and Baltimore, respectively) is relatively similar, with both falling within a mixed-humid climate as defined by the Department of Energy's Office of Energy Efficiency and Renewable Energy.[53] Both regions have similar average high and low temperatures (within 10°F) during the year, and relative humidity is similar in both regions, generally hovering between 70% and 75% throughout the year.[54]
- Thermostat manufacturer – the analysis included primarily Nest, ecobee, Honeywell, and Emerson thermostats, with fewer installations from a variety of other manufacturers.
- Program design – the analysis included many thermostats that were purchased through a utility Online Marketplace and included only a small portion of thermostats purchased through direct install programs.
- Study methodology – the analysis also used a matched comparison group, although the Maryland study leveraged one composed of future program participants (instead of nonparticipants).

Savings estimated by the two studies are very similar and not statistically different. Gross, annual electric savings in Maryland were estimated to be 245 kWh per thermostat, compared to the estimated 267 kWh gross savings per thermostat in Georgia.[55] The Maryland study aligns closely with findings in Georgia and provides additional confidence in the savings estimated by the evaluation team.

[53] https://www.energy.gov/eere/buildings/maps/building-america-climate-specific-guidance-image-map
[54] Temperature and humidity data was collected from NOAA and weather-us.com, respectively.
[55] The confidence interval is ±91 kWh per thermostat, calculated at the 90% level.

Process Evaluation

Thermostat Marketplace Surveys

In July 2021, the evaluation team surveyed 213 customers who purchased thermostats through the Online Marketplace between November 2019 and April 2021. Survey respondents included customers who purchased either one or two thermostats (Table 87) across a variety of thermostat manufacturers (Table 88). The following sections describe the results related to source of awareness, reasons for participation, experience and satisfaction with the program, and program impacts on customers.

Table 87. Number of Survey Respondents by Thermostat Quantity Purchased

THERMOSTAT QUANTITY PURCHASED THROUGH THE ONLINE MARKETPLACE	NUMBER OF RESPONDENTS	PERCENT OF RESPONDENTS
One thermostat	141	66%
Two thermostats	72	34%

Table 88. Number of Survey Respondents by Thermostat Manufacturer

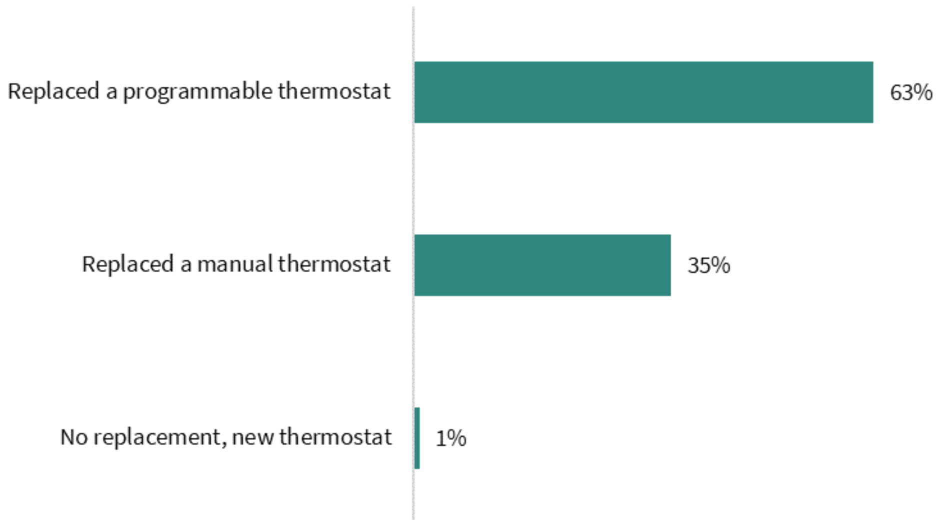
THERMOSTAT MANUFACTURER	NUMBER OF RESPONDENTS	PERCENT OF RESPONDENTS
Nest	126	59%
Ecobee	38	18%
Honeywell	28	13%
Emerson	21	10%

Note that some subsequent comparisons are provided by thermostat manufacturer. However, sample sizes for all brands except Nest are small and interpretations should be made with caution.

About a third of respondents (34%) had purchased two thermostats through the program, and 28% reported they also had additional thermostats installed that were not purchased on the Marketplace. Of all customers, 66% said they only had one thermostat installed in their home, indicating that about one-third of customers have multiple thermostats installed in their homes. All customers reported that the thermostat was purchased for their residence (not for a business).

To gain a directional understanding of the baseline, survey respondents were asked what type of thermostat their smart thermostat replaced. There were 185 customers who responded to survey questions asking about the type of thermostat replaced. These 185 customers installed a total of 240 thermostats, of which 63% replaced a programmable thermostat (Figure 79). About one-third of thermostats (35%) replaced a manual thermostat.

Figure 79. Baseline Thermostat Type for Customers who Purchased a Single Thermostat (n=185 customers, 240 thermostats)

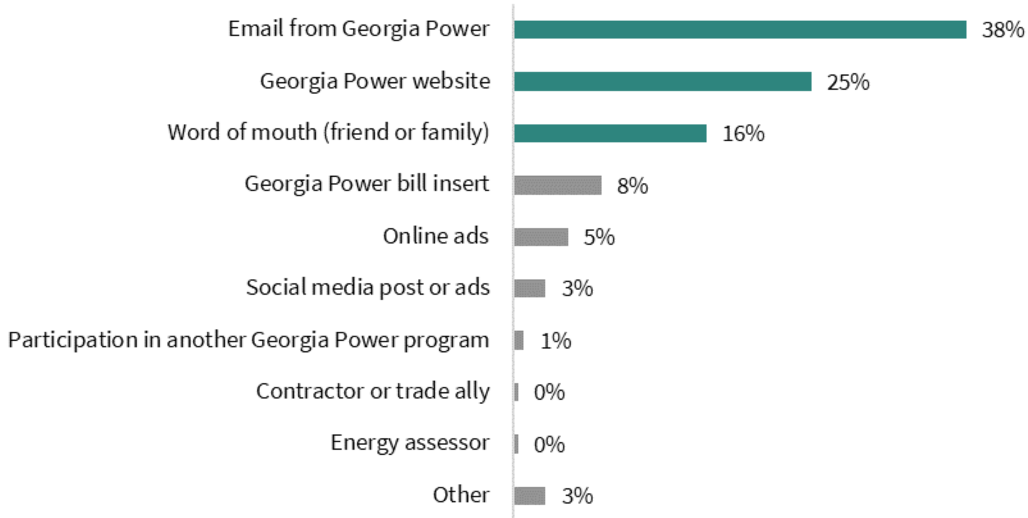


Source: Online Marketplace customer survey. C5. What type of thermostat did it replace? C8. How many of each thermostat type did you replace?

Online Marketplace: Motivations and Awareness

To understand drivers and barriers to participation, the evaluation team asked respondents to describe how they heard of the Online Marketplace, and what motivated them to purchase a thermostat there. The largest drivers of participation to the Online Marketplace were email marketing campaigns promoting the Online Marketplace (38%, Figure 80). Other common sources of awareness were the Georgia Power website (25%) and word of mouth (16%).

Figure 80. Sources of Program Awareness (n=213)

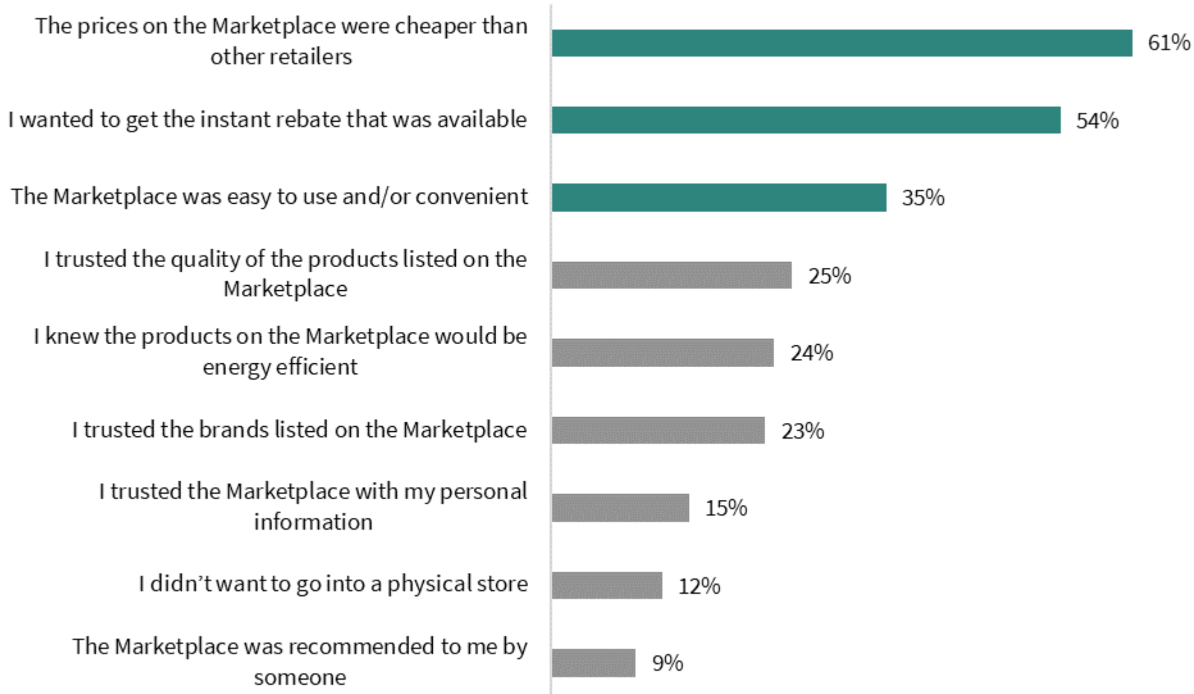


Source: Online Marketplace customer survey. B1. How did you first learn about the Georgia Power Marketplace?

Customers predominately used the Online Marketplace because of the product cost, rebate, and the site's convenience/ease of use (Figure 81). When asked why they chose to purchase a thermostat through the Online Marketplace instead of another retailer, almost two-thirds of customers (61%) said that the prices on the Online Marketplace were cheaper than other retailers.[56] Another half said that they used the Online Marketplace to get the instant rebate that was available (54%). Over one-third of customers also reported choosing to purchase from the Online Marketplace because it was easy to use and/or convenient (35%). Most customers said they would use the Online Marketplace if they were to purchase a thermostat again in the future (86%).

[56] Prices for thermostats on the Online Marketplace appear lower because Georgia Power's instant rebate is automatically incorporated into the price displayed on the website.

Figure 81. Reasons for Purchasing from the Marketplace Instead of Another Retailer (n=212)



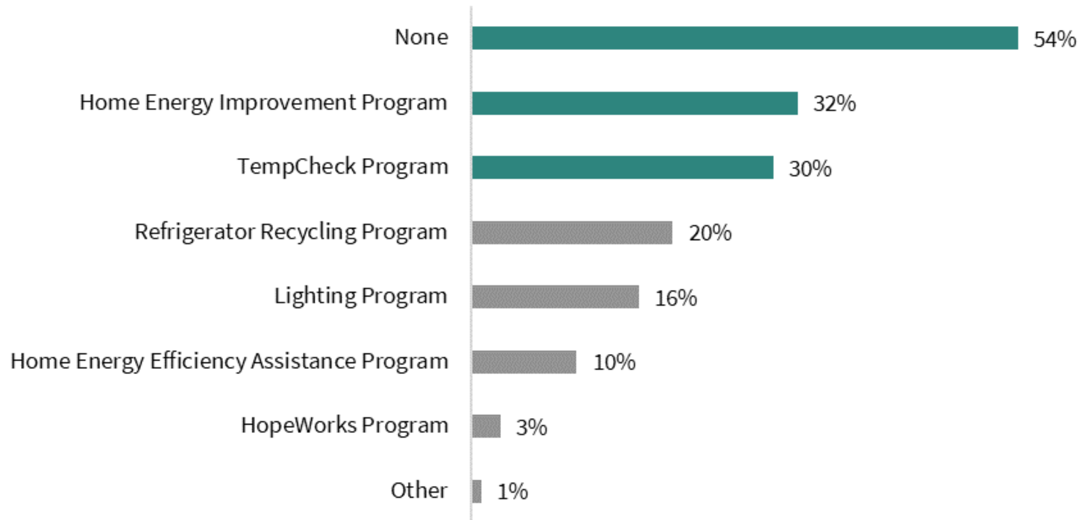
Source: Online Marketplace customer survey. E5. Why did you decide to buy a smart thermostat from the Georgia Power Marketplace instead of another retailer? Please select all that apply.

The marketing of manufacturer sales also proved to be effective to drive thermostat purchases through the Online Marketplace. Of the 42 customers (20%) who were identified as having purchased a thermostat during a manufacturer sale, 24 were aware of the sale. Of those, 21 indicated that the manufacturer sale was influential in their decision to purchase the type and quantity of thermostat that they did.[57] Twelve of the 24 customers reported that they would not have purchased the same thermostat without the sale.

Even though the Thermostat Marketplace is part of the larger HEIP offering, over half (54%) of the survey respondents indicated they were not aware of any other Georgia Power energy efficiency programs (Figure 82). Furthermore, only about one-third of customers were aware of HEIP (32%) and Temp✓ (30%).

[57] We identified manufacturer sale purchases based on the date of purchase falling within the timeframe of each manufacturer sal e.

Figure 82. Awareness of Georgia Power Energy Efficiency Programs (n=213)[58]



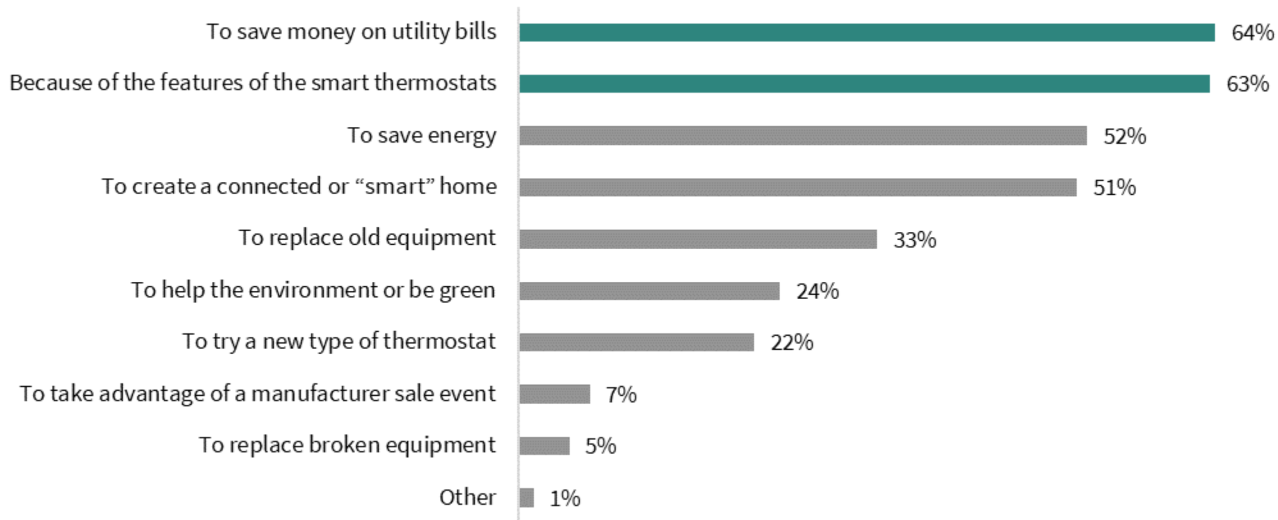
Source: Online Marketplace customer survey. B2. Besides the Marketplace, are you aware of any Georgia Power energy efficiency programs? B3. What other programs are you aware of?

Thermostat: Purchase Decision-Making

When asked to describe their overall motivations for purchasing a smart thermostat at the time that they did, the majority of respondents mentioned that they wanted to save money on their utility bills (64%) as well as the features of the smart thermostats (63%, Figure 83). Respondents also indicated that they wanted to save energy and create a connected or "smart" home. As noted above, for customers who recalled purchasing a thermostat during a manufacturer sale, those additional discounts also motivated customer purchases.

[58] "None" is an exclusive response, while customers who indicated they were aware of other Georgia Power energy efficiency programs were able to select more than one response.

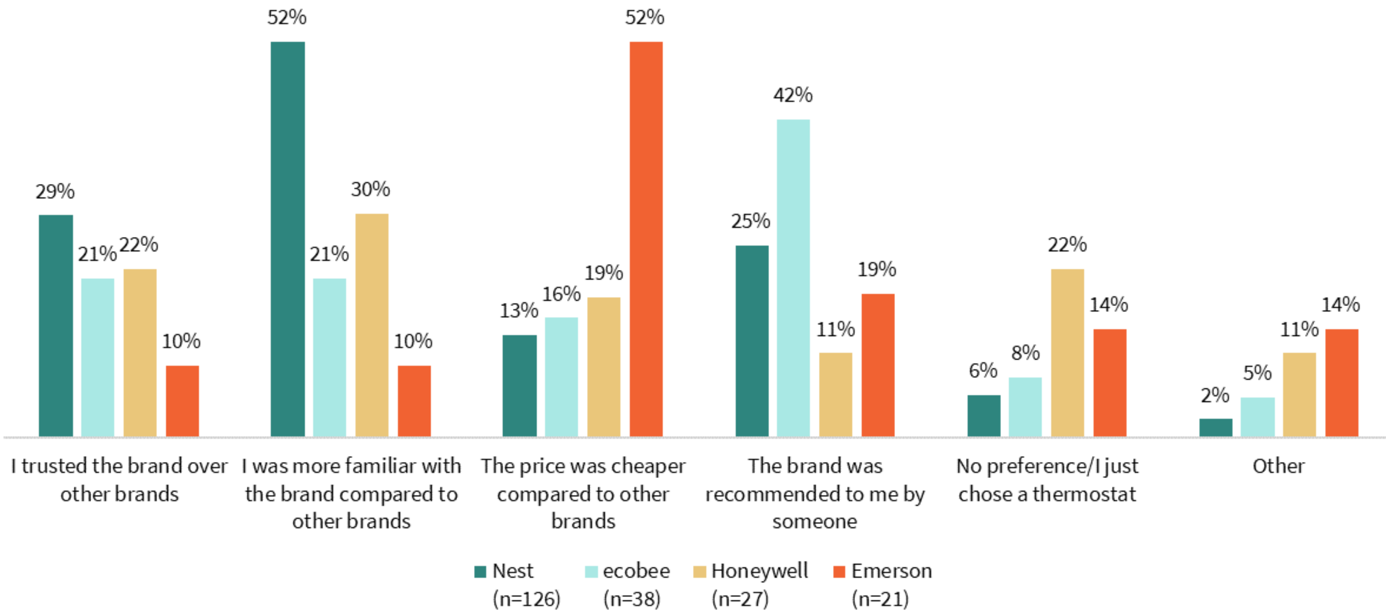
Figure 83. Reasons for Decision to Purchase a Smart Thermostat (n=213)



Source: Online Marketplace customer survey. E1. Why did you decide to buy a smart thermostat at the time you did? Please sele ct all that apply.

The evaluation team also wanted to understand what drove participants to purchase the specific brand of thermostat they did. This varied depending on the brand of thermostat purchased (Figure 84). Brand recognition is important for customers choosing a Nest thermostat. These customers most frequently chose Nest because they were familiar with the brand (52%), trusted the brand (29%), or because it was recommended to them (25%). Brand familiarity was also important for customers who chose Honeywell (30%), though less strongly compared to Nest. Customers most frequently selected an ecobee thermostat because someone had recommended it to them (42%), while customers chose Emerson because it was cheaper (52%).

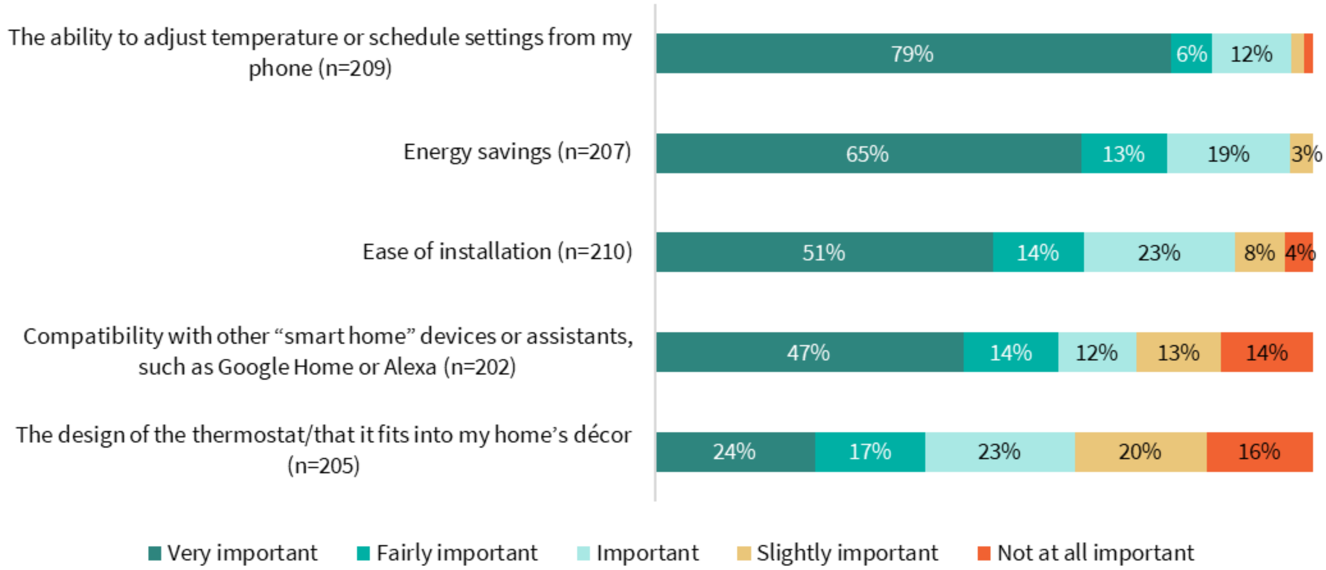
Figure 84. Reasons for Choosing Thermostat Brands



Source: Online Marketplace customer survey. E2. Why did you decide to buy the brand of smart thermostat that you did?

Customers were also asked about the importance of a variety of other factors in their decision to purchase a smart thermostat (Figure 85). Customers reported the ability to adjust temperature or schedule from their phone, energy savings, and ease of installation as the most important factors in their decision-making process. The thermostat design and compatibility with smart home devices were least important to customers.

Figure 85. Factors Influencing Customers' Decision-Making Process



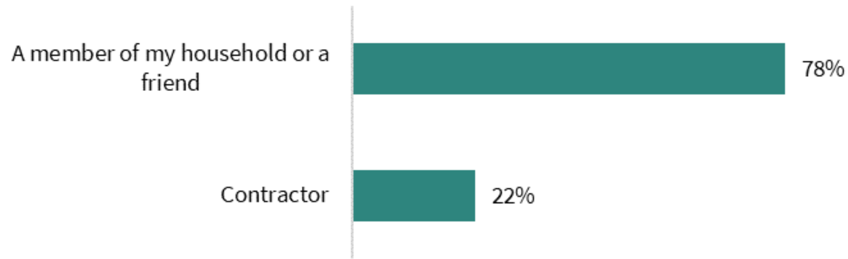
Source: Online Marketplace customer survey. E3. When thinking about purchasing a smart thermostat for your home, how important were each of the following factors in your decision-making process? Please rate on a scale of 1 to 5, where 1 is not at all important and 5 is very important.

Thermostat: Installation and Use

Nearly all customers reported the thermostats they purchased were currently installed (90%).[59] The most common reason that thermostats were not installed in a customer's home was that the thermostat was not compatible with their HVAC system (n=6). Other common reasons were that customers needed help with the installation (n=3), the installation was too expensive (n=3), and that they gave away the thermostat (n=3). Nine out of 19 customers with thermostats that were not installed indicated the thermostat is currently in storage. Of those whose thermostat was installed, over three-fourths of customers (78%) reported a member of their household, or a friend, installed their thermostat, while a smaller proportion indicated that a contractor installed their thermostat (Figure 86).

[59] Note: This is provided for process reasons only; the evaluation team is not calculating and applying an ISR to our impact analysis because it is inherently included in the billing analysis result.

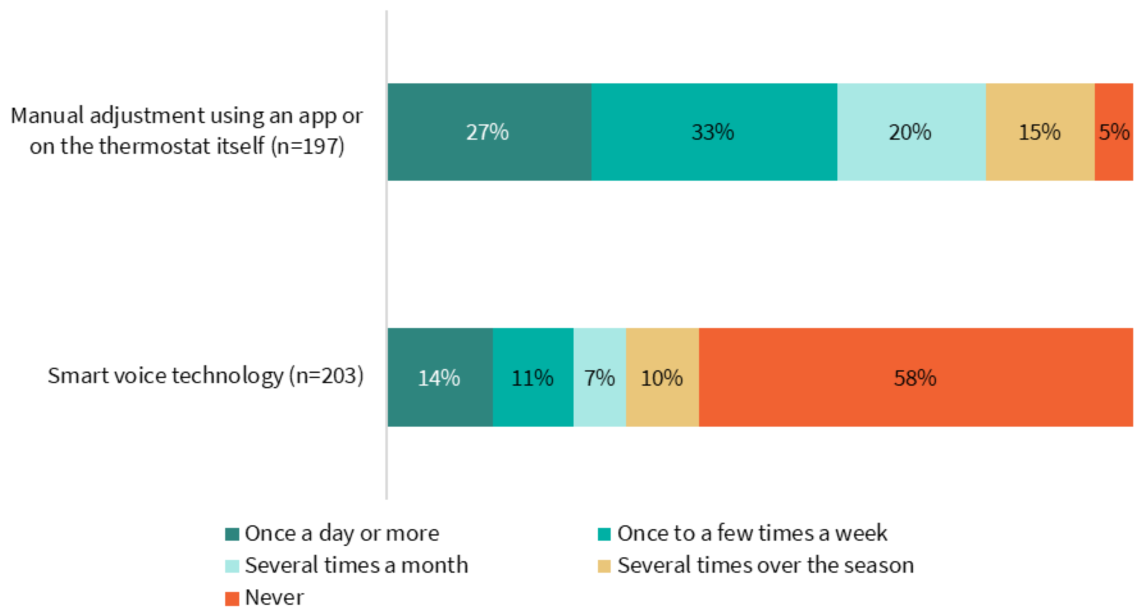
Figure 86. How the Thermostat was Installed (n=213)



Source: Online Marketplace customer survey. G1. Who installed your thermostat?

Three-fourths of survey respondents (76%) programmed their own heating and cooling schedule, while 15% kept the thermostat's default settings. It was more common for customers to control their thermostat from their phone compared to smart voice technology (e.g., Google Home, Alexa, Siri, etc.), with 58% reporting they never use smart voice technology (Figure 87). Over half of customers (60%) reported changing the temperature manually at least once a week and up to once a day or more. One-quarter of customers (25%) make frequent adjustments (at least once a week) using smart voice technology.

Figure 87. Frequency of Temperature Adjustments



Source: Online Marketplace customer survey. G6. How often do you use smart voice technology to control your thermostat? (e.g., Google Home, Alexa, Siri, etc.) G7. How often do you manually adjust the temperature on your thermostat, either using an app or on the thermostat itself?

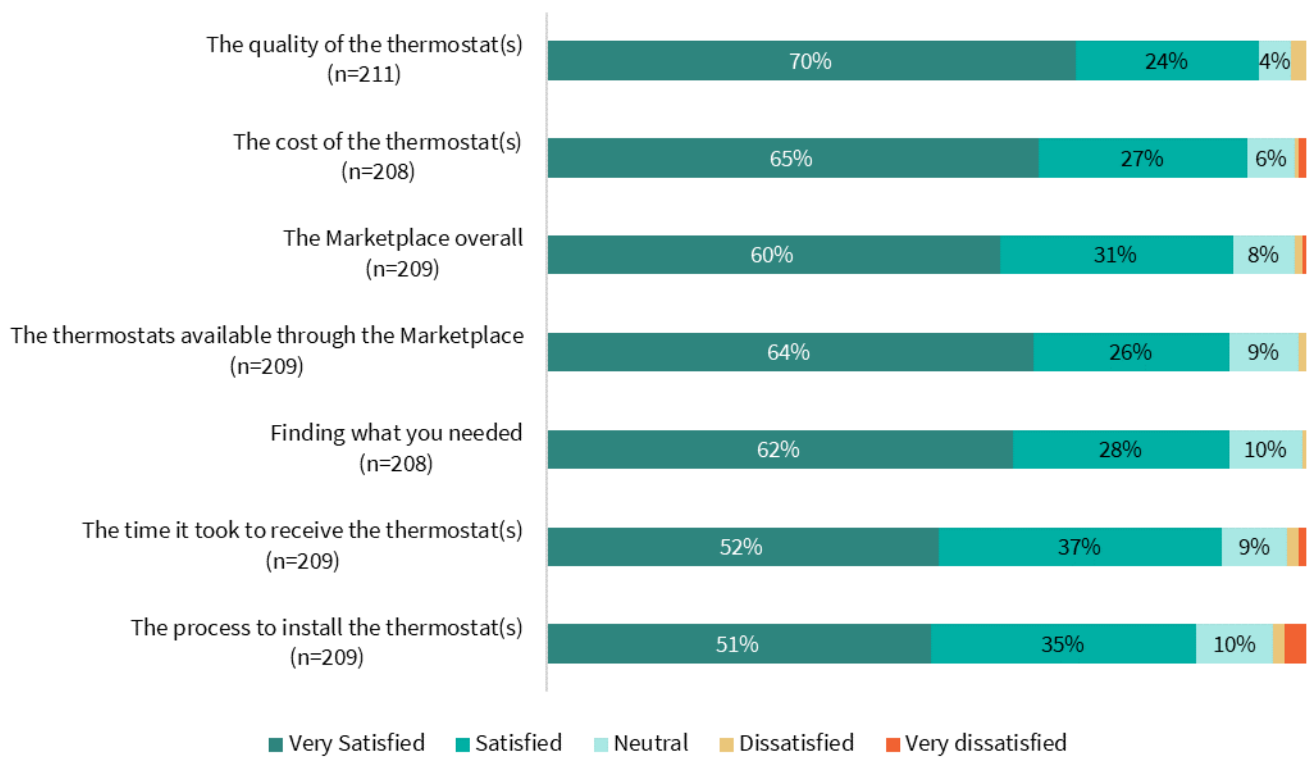
Satisfaction

The following section describes respondents' satisfaction with the Online Marketplace and Georgia Power overall. In both cases, respondents were overall satisfied. The two aspects of the Online Marketplace that respondents were least satisfied with were related to the logistics of receiving and installing their thermostat(s).

Satisfaction with the Online Marketplace

Almost all customers (90%) were either very satisfied or satisfied with the Online Marketplace overall (Figure 88). All aspects of the Online Marketplace were also rated very highly; at least 90% were very satisfied or satisfied with the quality, cost, and types of thermostats available, and with their ability to find what they needed on the Online Marketplace.

Figure 88. Satisfaction with the Online Marketplace



Source: Online Marketplace customer survey. H1. Please rate your satisfaction with each of the following aspects of the Georgia Power Marketplace.

The process to install the thermostats received the lowest satisfaction ratings, but satisfaction was still high with 86% of customers rating themselves as either very satisfied or satisfied. The time it took to receive the thermostat had the second lowest satisfaction ratings, although most customers reported that they received their thermostat within two weeks (79%). A small portion of customers (2%) said it took four weeks or more to receive their thermostat. It should be acknowledged that the advent of many online retailers offering two-day shipping (such as Amazon and Target) may have skewed the general public's perception of acceptable shipping times, and the COVID-19 pandemic impacted shipping time for all carriers in 2020.

When asked how likely they would be to recommend the Online Marketplace to a friend or colleague, almost two-thirds (63%) rated their likelihood as a 9 or 10 on a scale of 1 to 10 where 1 was "not at all likely" and 10 was "extremely likely". Only 12% rated their likelihood as a 6 or below.

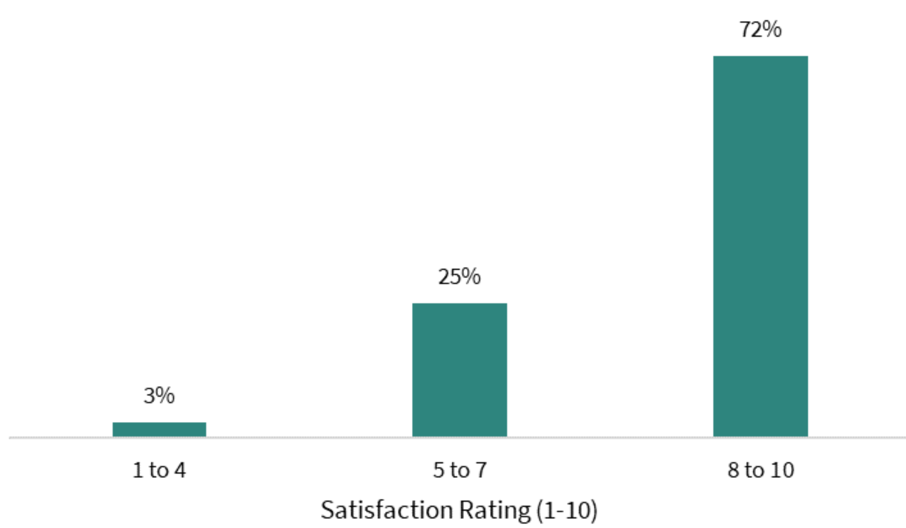
Almost all customers said it was very or somewhat easy to use the Online Marketplace to buy their thermostat (94%). Of the six customers who said the Online Marketplace was difficult to use, two indicated that the Online Marketplace was unable to validate their address. Per program staff, account validation has been improved recently and address validation success rates have increased.

Most customers found that the product descriptions on the website were useful with 84% indicating they were either very or somewhat useful.

Satisfaction with Georgia Power

Overall, Thermostat Marketplace customers were satisfied with Georgia Power (Figure 89). Nearly three-fourths of customers rated their satisfaction as an 8, 9, or 10 on a scale of 1 to 10 where 1 was "not at all satisfied" and 10 was "extremely satisfied" (72%). The mean satisfaction score was 8.3 out of 10.

Figure 89. Satisfaction with Georgia Power (n=209)



Source: Online Marketplace customer survey. H4. Taking into consideration all aspects of your utility service experience, please rate your current *satisfaction with Georgia Power overall.*

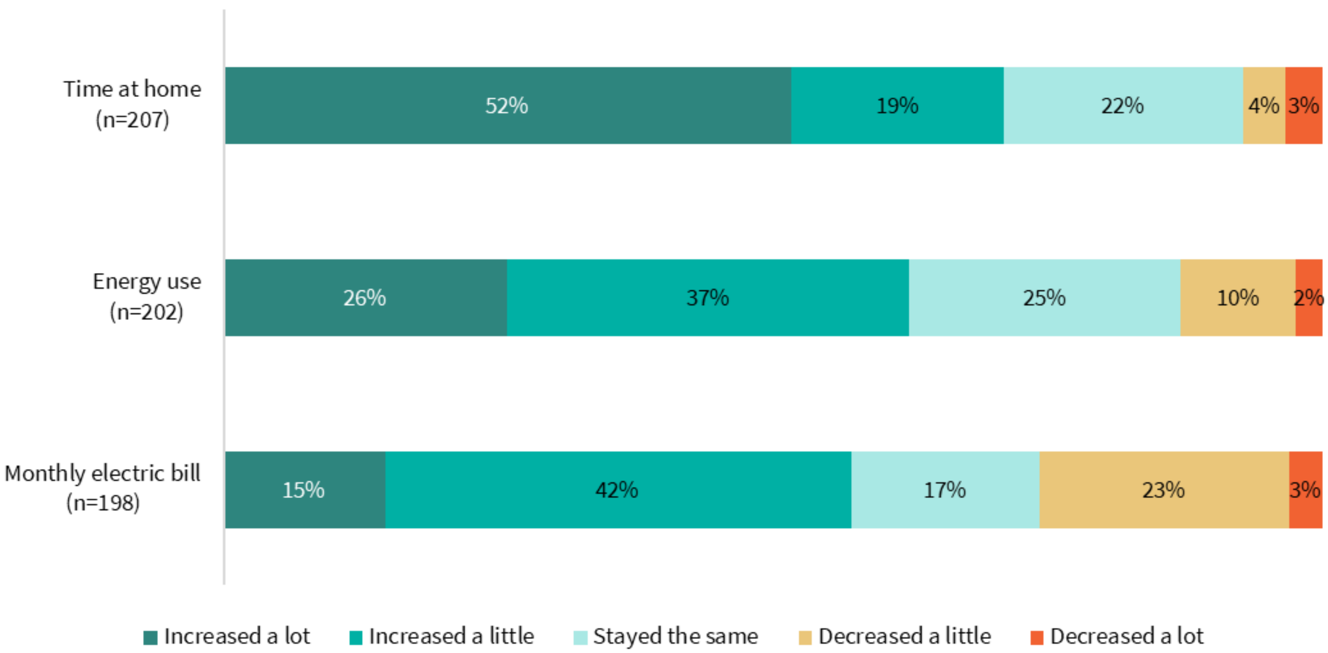
Opportunities for Improvements

Most surveyed customers did not have any suggestions for improving the Online Marketplace. Of those that did (n=10), the most common suggestions were to connect customers to contractors who could install the thermostat quickly and for a low price (n=2), to improve delivery (n=2), and to provide lower prices (n=2). In addition, two customers indicated they did not receive the rebate.

Effects of COVID-19

Given the timing of the Online Marketplace customer survey and evaluation activities, the evaluation team included questions to assess the effects of the COVID-19 pandemic on customers' energy-related behavior in their home (Figure 90). More than half of the surveyed customers indicated that the amount of time they spent at home in 2020 compared to 2019 had increased a lot (52%), and over half reported that their energy use had increased in 2020 (60%). About half of customers reported an increase in their energy bill compared to 2019 (54%), while about 24% said their energy bill had decreased in 2020.

Figure 90. Effects of COVID-19 on Energy-Related Behavior



Source: Online Marketplace customer survey. I1. Please think about the amount of time you spend at your home in a given week. Compared to this time in 2019, would you say the time your household spends at home has…? I2. Please think about the amount of energy your household uses in a given week. Compared to 2019, would you say your household energy use has…? I3. Now, please think about your monthly electric bill. Since 2019, would you say your electricity bill has…?

Less than half of customers reported making improvements to their home since the beginning of 2020 (43%). Of those who made improvements, most reported the cost to be at least $1,000 (75%). The most common improvements made were home remodeling projects (n=48), improvements to the home's envelope (i.e., doors, windows, roof, insulation, air sealing) (n=28), and installing new HVAC equipment (n=15).

Participant Survey Demographics

Finally, customers were asked a series of demographic questions (Appendix 5B: Survey Demographics includes detailed demographic data). Most surveyed customers reported owning their home (93%) and living in single family homes (91%). Most had lived in their homes for three years or less (53%) and most homes were less than 60 years old, with 89% built in 1960 or later. Most customers reported one or two people living in their household (52%) and that their household size stayed the same between 2019 and 2020 (74%).

Nearly half of surveyed customers (47%) were younger than 45 years old. One-fifth of customers declined to report their annual household income, but of those that did, nearly three-fourths reported a total annual household income of $75,000 or more (72%). In addition, almost three-fourths of surveyed customers reported achieving at least a four-year college degree (73%). Most surveyed customers did indicate their employment situation had not changed since 2019 (80%). Most customers identified themselves as White (64%), followed by Black or African American (21%), and reported speaking English in their home (98%).

Conclusions and Recommendations

Conclusion 1: Annual verified net savings were 205 kWh per thermostat, or 5.5% of heating and cooling usage.

Evaluated savings were lower compared to previous evaluations. Several reasons were identified that may help to explain this finding:

- Survey respondents indicated that their smart thermostat more frequently replaced a programmable thermostat than a manual thermostat. The savings over a programmable thermostat baseline is expected to be lower since customers who previously owned a programmable thermostat may have already programmed and used an efficient schedule.

- Different analysis methodologies were used in the 2017 and 2021 thermostat evaluations. The 2021 evaluation used a regression analysis that relied on a matched comparison group to estimate the baseline energy consumption. The matched comparison group theoretically allowed the evaluation team to isolate the change in energy consumption attributed to the thermostat, while excluding other changes between the pre- and post-periods (due to economic trends, occupancy changes, behavioral changes, etc.). The 2017 evaluation leveraged a simpler pre-post analysis that may have captured the general decline in per-household consumption in addition to the thermostat efficiency, and incorrectly attributed it to thermostat savings. For example, if per-home average weather-normalized electric consumption in Georgia is declining at a rate of 1% annually, a pre-post analysis would attribute the 1% reduction to the measure, while an analysis with a matched comparison group would not.

- However, it should also be noted that the post-installation period evaluated for this cycle (February 2019 through March 2021) overlapped with the COVID-19 pandemic, which caused national shutdowns beginning in March of 2020 and influenced customer behavior patterns. Because the study used a matched comparison group rather than a randomized control study, it is impossible to rule out selection bias due to the COVID-19 pandemic, and the magnitude and direction (positive or negative) cannot be quantified. However, it is certainly possible that smart thermostats save less when customers are home more frequently, as fewer thermostats may be set to “away” mode. This should continue to be explored in future research.

- Survey respondents reported frequently taking advantage of their smart thermostat’s ability to be adjusted remotely from their phone. Over half of customers (58%) reported changing the temperature at least once a week and up to once a day or more. These adjustments diverge from the thermostat’s programmed temperature schedule and may lead to less efficient operation of the HVAC system.

Recommendations:

- Provide educational materials encouraging customers to program an efficient schedule on their thermostat and, if available, opt-in to the thermostat's learning and optimization features. Sharing those frequent adjustments to the temperature may lead to less efficient operation of their HVAC system, resulting in lower energy and bill savings, may nudge customers to adjust it less frequently.

- Add information to marketing materials that encourages customers with manual thermostats to upgrade to a smart thermostat. Highlight the higher savings that can be achieved when replacing a manual thermostat. In addition to energy and bill savings, include information in the marketing materials that highlights other features of smart thermostats that participants care most about, such as the ease of installation or "smart" features.

- Evaluate thermostats in the next program cycle using a robust, industry-standard methodology, such as one leveraging a matched comparison group, to determine if savings remain consistent in future years, especially if current economic and customer behavior conditions (such as higher work-from-home rates) persist.

Conclusion 2: Satisfaction was high among program participants.

Almost all survey respondents (90%) were either very satisfied or satisfied with the Online Marketplace overall. Nearly three-fourths of respondents (72%) rated their satisfaction with Georgia Power as an 8, 9, or 10 on a scale of 1 to 10 where 1 was "not at all satisfied" and 10 was "extremely satisfied".

Recommendations:

- Continue to offer rebates for smart thermostats through the Georgia Power Online Marketplace (if cost-effective).

Conclusion 3: There was no statistically significant difference in energy savings between smart thermostats installed in single family and multifamily premises.

The segmented impacts return consistent per-unit savings for both single family and multifamily premises. Reported savings separate the impacts and indicate different savings values for each, while verified net savings show consistent savings of 205 kWh per-unit per year.

Recommendations:

- Combine premise types into a single Thermostat Marketplace measure.

Conclusion 4: Savings are expected to differ between customers with electric and fossil fuel heat.

Thermostat savings are constrained by the HVAC consumption of the home because they are limited to the weather dependent energy use of a home. The heating estimate is diluted by the fact that not all homes are heated with electricity. Homes that use electricity for both cooling and heating will have more opportunity for reduction than homes with fossil fuel heating. We performed a high-level calculation and estimated that thermostat participants with electric heat save about 250 kWh per thermostat annually, compared to 130 kWh per thermostat for customers with gas heat.

Recommendations:

- Explore the viability of splitting the thermostat measure and the savings by heating fuel. Homes with electric heat are expected to save more than homes with fossil fuel heat, all else equal.

- Target electrically heated homes by marketing to customers with high billed consumption during winter months. In addition, consider designing marketing materials to appeal to customers with heat pumps or other types of electric heating equipment.

- Collect and track data on customers' primary heating fuel. From an operational standpoint, Georgia Power would likely need to rely on customer self-reported heating fuel, which customers sometimes report incorrectly. However, in both the Thermostat Marketplace and General Population surveys, 60% and 57%, of customers (respectively) reported having electric heating equipment. This aligns with US Energy Information Administration data, which also reports 60% of Georgia's households using electricity for heating.[60] The fact that these values align may provide more confidence that these self-reported estimates of heating fuel are at least somewhat reliable.

  In addition, since Temp✓ requires electric heat, customers that also enroll in Temp✓ could be confidently assigned a larger "known electric heat" savings value. There may be additional ways to help customers identify their heating fuel, by providing them guidance on how to check themselves, that would increase the accuracy of a self-report.

Conclusion 5: There were diminishing returns from installing a second thermostat in a home.

While homes that purchased two smart thermostats saved more energy on average than homes purchasing a single thermostat, the per-unit savings were lower in multi-device homes. If the program objective is to obtain the highest per-unit savings (rather than as many units as possible), we suggest limiting customers to

[60] https://www.eia.gov/state/analysis.php?sid=GA

a single thermostat. If the goal is to maximize the number of thermostats among Georgia Power customers, then allowing for additional rebated thermostats is a practical method.

Recommendations:

- Consider limiting the Marketplace rebate offering to a single thermostat per customer to maximize the per-thermostat savings. If Georgia Power decides to allow customers to sign up for Temp✓ once again via the marketplace, reconsider this cap.

Conclusion 6: Given the Online Marketplace's perceived ease of use and customers' high satisfaction with it, there is an opportunity for Georgia Power to raise awareness of other energy efficiency offerings, which had lower awareness among survey respondents.

The marketing approach, with manufacturer sale events and email promotions, was successful in drawing customers to the Online Marketplace and promoting smart thermostat purchases. However, over half of the survey respondents indicated they were not aware of any other Georgia Power energy efficiency programs, and only about one-third of customers were aware of HEIP and Temp✓.

Recommendations:

- Encourage participation in other Georgia Power energy efficiency programs when a customer purchases a rebated smart thermostat, as these customers indicated that energy efficiency is a motivator and therefore may be primed for additional retrofits. Most thermostat purchasers were younger homeowners who may be good candidates for Individual Improvements or Whole House projects to maximize the energy saving benefits of their thermostat by ensuring their home's envelope is weatherized.

Conclusion 7: Provide additional resources to ensure customers have a positive experience installing their thermostat.

A small number of customers reported their thermostat had not been installed (n=20). The most common reasons thermostats were not installed were compatibility and installation issues. Some customers noted they discovered after receiving the thermostat that it was not compatible with their HVAC system. In addition, while most customers installed the thermostat on their own, some wanted or needed help. Those customers reported that contractors were hard to find, expensive, and had long wait times for appointments. This may have been an effect of the pandemic.

Continue to monitor installation rates through evaluation and other customer research. If issues persist, consider the recommendations below.

Recommendations:

- Require all customers to complete a compatibility check before they finalize their purchase to ensure their new thermostat will work with their existing HVAC system and electrical wiring. Per program staff, they have added additional language at check out as well as links to check compatibility.
- Provide messaging that lists contractors recommended by Georgia Power who can support smart thermostat installations. An advantage to encouraging contractor installations is that they can provide customers with helpful information regarding the most efficient way to use their smart thermostat.
- Develop materials that list resources for customers who plan to install their thermostat themselves. For example, thermostat manufacturers provide online guides with instructions to install their thermostats. Program staff report that online guides are available on the Marketplace.

Conclusion 8: The program has successfully reached younger customers, such as Millennials.

Nearly half of surveyed participants were younger than 45, meaning they belonged to either the Gen Z or Millennial generations. This indicates the program has been successful in engaging these customers, who can sometimes be considered harder to reach for some energy efficiency programs. Program participants also trended wealthier, with three-quarters indicating their income was above $75,000 per year. Georgia Power currently offers smart thermostats (at no cost to the customer) to income-eligible customers through HEEAP, which is likely a more effective way to reach this demographic than the Marketplace.

Recommendations:

- As noted above, consider if there are additional ways to educate and funnel participants into other Georgia Power energy efficiency programs. There is an opportunity to encourage deeper energy savings for these younger customers who may be less easily reached through other programs.
- Continue to explore ways to serve customers the Online Marketplace may be missing. The program is currently offering thermostats through other programs, such as HEEAP, to reach income-eligible customers. The program could consider targeted marketing channels and messages to continue to engage older generations, who participate in slightly lower proportions to Millennials.

6. HOME ENERGY EFFICIENCY ASSISTANCE PROGRAM (HEEAP)

Program Design and Delivery

Georgia Power's Home Energy Efficiency Assistance Program (HEEAP) works with a network of approved contractors to deliver no-cost home energy improvements to income-qualified residential customers. Households with an income level 200% or less of the current year US Federal Poverty Guidelines submit a self-assessment of their homes' energy efficiency and provide details on the envelope, HVAC, and water heating systems. A Georgia Power representative then assigns a work order to a participating contractor who visits the home, performs an assessment, works with Georgia Power to adjust the work order as appropriate, and completes the upgrades. The measure catalog for HEEAP is like the Home Energy Improvement program (HEIP) Individual Improvements path, sharing measures such as attic insulation, air sealing, duct sealing, and smart thermostats, although HEEAP also includes some additional measures not offered through HEIP Individual Improvements. Table 89 lists the full measure catalog. Many measures have separate savings assumptions by housing type (single family [SF] versus multifamily [MF]) and heating fuel (gas versus electric).

Table 89. HEEAP Measure Catalog

MEASURE CATEGORY	MEASURE NAME
DHW Flow Reduction and Lighting	HEEAP Energy Kit (temporary 2020 offering)
LED.	LED (Standard)
Insulation	MF - Ceiling Insulation - Elec
Insulation	MF - Ceiling Insulation - Gas
Sealing and Infiltration Control	MF - Duct Testing & Sealing - Elec
Sealing and Infiltration Control	MF - Duct Testing & Sealing - Gas
Tune-ups/Services	MF - HVAC Diagnostics and Servicing AC - Gas
Tune-ups/Services	MF - HVAC Diagnostics and Servicing HP - Elec
Equipment	MF - HVAC Replacement - Elec
Equipment	MF - HVAC Replacement - Gas
Sealing and Infiltration Control	MF - Infiltration Reduction Air Sealing - Elec
Sealing and Infiltration Control	MF - Infiltration Reduction Air Sealing - Gas
Equipment	MF - Mini-split HVAC Systems - Elec
Controls	MF - Smart - Wi-Fi-Enabled Thermostat - Elec
Controls	MF - Smart - Wi-Fi-Enabled Thermostat - Gas
DHW Insulation	Pipe Insulation 6-ft - Elec
Insulation	SF - Ceiling Insulation - Elec
Insulation	SF - Ceiling Insulation - Gas

MEASURE CATEGORY	MEASURE NAME
Sealing and Infiltration Control	SF - Duct Testing & Sealing - Elec
Sealing and Infiltration Control	SF - Duct Testing & Sealing - Gas
Tune-ups/Services	SF - HVAC Diagnostics and Servicing AC - Gas
Tune-ups/Services	SF - HVAC Diagnostics and Servicing HP - Elec
Equipment	SF - HVAC Replacement - Elec
Equipment	SF - HVAC Replacement - Gas
Sealing and Infiltration Control	SF - Infiltration Reduction Air Sealing - Elec
Sealing and Infiltration Control	SF - Infiltration Reduction Air Sealing - Gas
Equipment	SF - Mini-split HVAC Systems - Elec
Controls	SF - Smart - Wi-Fi-Enabled Thermostat - Elec
Controls	SF - Smart - Wi-Fi-Enabled Thermostat - Gas
DHW Insulation	Water Heater Insulation Jacket - Elec

Changes from Previous Cycle Design

HEEAP is a new offering in the 2020 – 2022 cycle.

Implications of the COVID-19 Pandemic

The evaluation team recognizes that this evaluation occurred during a timeframe in which the COVID-19 pandemic impacted daily life for residential customers in Georgia. As described below, HEEAP did not operate as designed in 2020 due to safety precautions related to COVID-19. This program, a new program design for Georgia Power and the industry, was still in the early preparation stages when the pandemic began in March of 2020. Because this program design requires considerable face-to-face interaction, the program was put on hold for the remainder of the year. The program began to ramp up in earnest in early 2021 and the first participants completed their projects in Q2 of 2021.

However, in the interim, Georgia Power was able to identify a no-contact way to provide energy savings for income-qualified customers, sending nearly 8,000 energy savings kits in the fall of 2020. This was a limited offering that provided no-contact energy savings to income-qualified customers while HEEAP (as designed) was on pause. As such, the kits measures were not included in the evaluation as they are not expected to be included in the program in the future.

Due to the limited participation to-date, the findings in this report should be considered directional. In terms of impact evaluation, the primary goal of this evaluation was to review program deemed savings to determine if they are reasonable and if assumptions are appropriate. Therefore, per-measure analysis should be the primary focus of key impact findings in this report; the combined summative program-level realization rate is only reflective of the current sample of projects this cycle and should not be used for future planning. However, despite the limited participation in HEEAP, several measures overlap with HEIP, a program that did have significant participation. Where appropriate, the evaluation team leveraged the approach and data collection efforts from our evaluation of HEIP to inform evaluation outcomes for HEEAP. Greater confidence is justified in the verified savings for overlapping measures, because the evaluation team's recommendations for HEEAP air sealing, attic insulation, smart thermostats, and duct sealing are informed by the results of the HEIP evaluation.

Program Performance

Table 90 summarizes reported and verified savings for the program and compares them to goals. The evaluation team did not evaluate the energy savings kits measures, as this is not a component of the program design, so the verified gross and verified net savings for 2020 are set equal to the reported savings.

Table 90. HEEAP Savings Summary

METRIC	TIME PERIOD	GROSS SAVINGS GOAL	REPORTED SAVINGS	VERIFIED GROSS SAVINGS	VERIFIED NET SAVINGS	REALIZATION RATE
Electric Energy Savings (kWh/yr.)	2020	6,722,253	4,787,807	4,787,807 [a]	4,787,807 [a]	N/A
	Q1 – Q2 2021	3,361,127	72,162	36,089	36,089	50%
Summer Peak Demand Reduction (kW)	2020	3,569	799	799 [a]	799 [a]	N/A
	Q1 – Q2 2021	1,785	35	11	11	31%

[a] *The energy and demand savings generated in 2020 by the energy saving kits were passed through by the evaluation team and not directly evaluated.*

Table 91 outlines the realization rates and net-to-gross (NTG) adjustment factors. Energy and demand realization rates varied by measure, so the program-level realization rate is a function of the mix of measures observed in the evaluation period. As noted above, the evaluation was conducted on a small population size; these realization rates are only reflective of the projects analyzed and caution should be taken when applying or extrapolating to future planning efforts. Additionally, these values exclude the energy saving kits as these were not evaluated. Consistent with industry-standard practice, NTG is set at 100% because HEEAP is an income-qualified offering.

Table 91. HEEAP Adjustment Factors

METRIC	REALIZATION RATE (%) [a]	FREERIDERSHIP	SPILLOVER	NTG (%) [b]
Electric Energy Savings (kWh/yr.)	50%	0%	0%	100%
Peak Demand Reduction (kW)	31%	0%	0%	100%

[a] *Realization Rate is defined as **verified** Gross savings divided by **reported** savings.*
[b] *NTG is defined as **verified** net savings divided by **verified** gross savings.*

Research Questions

Due to the timing of program launch, which was delayed due to the COVID-19 pandemic, the evaluation team conducted a limited evaluation scope to provide directional feedback to Georgia Power on early program performance. The evaluation team conducted qualitative and quantitative research activities to answer the following key research questions for the program:

- Are the reported savings for the program reasonable? What changes are recommended to the per-unit savings based on the characteristics of the homes serviced, equipment properties, and engineering calculations?
- What was the customer experience with the program, from sign-up through completion?
- How did customers become aware of the program? What were their motivations for participation?
- How satisfied were customers with the program, including the participation process, interactions with contractors, and satisfaction with each piece of equipment received?
- What do contractors recommend for program improvement?

Impact Evaluation

This section details each step of the impact evaluation and its associated electric energy savings and summer and winter peak demand reduction. As noted above, the evaluation approach was limited this cycle due to low participation caused by delays in program ramp up due to safety concerns and restrictions caused by the COVID-19 pandemic. The evaluation team focused on providing directional feedback to Georgia Power based on preliminary program participation.

The impact evaluation primarily focused on a reasonableness check and verifying measure-level savings using industry-standard algorithms. The evaluation team evaluated a census of the twenty completed HEEAP projects through Q2 2021; the limited sample size should be considered when interpreting any results in this report. As best practice, another review of program data should be completed again once the program has been running for at least 6 to 12 months, to better understand the composition of program participants and projects. At a minimum, program participation data should be reviewed to assess whether project and participant characteristics (such as home size, measure mix, etc.) have changed as participation increases. However, HEEAP measures that are also offered in HEIP can benefit immediately from the robust evaluation conducted for the Individual Improvements program. Additional information on those overlapping measures is presented in Table 92 and discussed in the following sections.

Verified Gross Savings Approach

The calculation of verified gross savings for HEEAP measures relied on a combination of algorithms from technical reference manuals (TRMs) from various jurisdictions, including, but not limited to, Georgia Power's 2019 TRM. This approach was used, in part, because the reported gross per-unit savings come from various sources, including results from prior cycle evaluations, building simulation models, and algorithms. Where appropriate, the same algorithms used to determine reported savings were used to calculate verified savings. However, in cases where reported savings were determined through prior evaluations or building simulations, the evaluation team used algorithms and approaches from alternative sources. Georgia Power did not claim winter peak demand savings for HEEAP but requested that the evaluation team estimate winter peak demand savings for each measure.

Table 92 lists the approach and the source for the reported deemed savings for each HEEAP measure, showing which measures relied on prior evaluations, which relied on simulation modeling, and which were based on algorithms outlined in the Georgia Power 2019 TRM. The table also shows that verified savings for two HEEAP domestic hot water measures were calculated using the same approach used to determine per-unit reported energy savings. Table 93 and

Table 94, presented later in this section, provide additional details on the approaches used to calculate verified savings.

Table 92. HEEAP Measure Overlap with HEIP and Reported Deemed Savings Approach

MEASURE	MEASURE OVERLAP WITH HEIP INDIVIDUAL IMPROVEMENTS	REPORTED DEEMED SAVINGS TYPE	REPORTED DEEMED SAVINGS SOURCE	REPORTED SAVINGS APPROACH USED FOR VERIFIED SAVINGS
LED		Evaluation result	Results from Evaluation of Georgia Power Company's 2017 DSM Programs. Nexant, August 2018.	
Ceiling Insulation	X	Evaluation result	Results from Evaluation of Georgia Power Company's 2014 DSM Programs. Nexant, July 2015.	
Duct Sealing	X	Evaluation result	Results from Evaluation of Georgia Power Company's 2010 Residential DSM Programs. Nexant, July 2011.	
HVAC Servicing		Simulation	EnerSim building simulation modeling.	

MEASURE	MEASURE OVERLAP WITH HEIP INDIVIDUAL IMPROVEMENTS	REPORTED DEEMED SAVINGS TYPE	REPORTED DEEMED SAVINGS SOURCE	REPORTED SAVINGS APPROACH USED FOR VERIFIED SAVINGS
Air Sealing	X	Evaluation result	Results from Evaluation of Georgia Power Company's 2010 Residential DSM Programs. Nexant, July 2011.	
Smart Thermostat	X	Evaluation result	Results from Evaluation of Georgia Power Company's 2017 DSM Programs. Nexant, August 2018.	
Pipe Insulation		Algorithm	Savings algorithm with deemed inputs for pre- and post- R-values, pipe diameter, entering and leaving water temperature, and recovery efficiency.	X
Water Heater Insulation Jacket		Algorithm	Savings algorithm with deemed inputs primarily from PA TRM, June 2016, errata update February 2017.	X

Figure 91 shows an example of the source for one of the applicable measures in the Georgia Power TRM. The figure shows that the energy savings for the air sealing measure is characterized solely based on the results of a prior evaluation, and not on a specified savings algorithm. While the Georgia Power TRM does not document the algorithm or assumptions, the 2010 evaluation report does provide the energy savings algorithms and most inputs. The evaluation team's approach to the air sealing measure for HEEAP and HEIP in this evaluation uses the same underlying equations.

Figure 91. Georgia Power TRM Infiltration Reduction Air Sealing Measure Modeling Details

Measure Modeling Details

Savings Algorithm
kWh = Kwh_eval

Value		Description	Value	Units	Reference
kWh_eval	=	Verified energy savings for air sealing treatment	3,037.00	kWh	1

References	
1	Evaluation of Georgia Power Company's 2010 Residential DSM Programs. Nexant, July 2011.

HEEAP shares four measure types with the HEIP Individual Improvements program path: ceiling insulation, duct sealing, air sealing, and smart thermostats. This measure overlap is also shown in Table 92.

HEEAP reported per-unit savings for these four measures are the same as their single family counterparts in HEIP, and similarly the evaluation team used the same algorithms and approaches for both programs to determine verified savings for the measures. Because project participation was limited in HEEAP, several inputs to the algorithms came from the evaluation team's analysis of HEIP Individual Improvements measures, which had much greater participation. Table 93 and

Table 94, presented later in this section, provide additional details on which inputs were taken from analysis of HEIP Individual Improvements measures.

Document Review

The program had a total of twenty completed projects that closed in the second quarter of 2021. The evaluation team reviewed the tracking database for comprehensiveness and compared the tracking data to project files including invoices, work orders, photos, and customer preliminary reviews (i.e., self-assessments). Invoices and work orders contained information applicable to each project that is not contained within the tracking database. Information included pre- and post-retrofit blower door test results, LED quantity, insulation R-value, and smart thermostat quantity.

Customer preliminary reviews also contained additional details about each project, including:

- Home construction type (single family versus multifamily)
- Year built
- Square footage
- Existing attic insulation condition
- Primary heating fuel type

- Presence of central AC cooling versus window AC
- Presence of space heaters
- Model information, size, age, and efficiency of the cooling system
- Duct location
- Presence of duct sealing
- Water heating fuel type, age, and model information
- Cooking fuel type

Review of the program tracking database and additional documents showed that most relevant information was collected for each project. All but one of the 20 projects included a self-assessment document. Of the 17 projects that received air infiltration reduction, most had information on pre- and post-improvement blower door tests. Fifteen project invoices and work orders contained pre-improvement blower door test results and 13 contained post-improvement blower door test results. In contrast, very few projects had information on existing or installed attic insulation levels. Of the 13 projects that received attic insulation, none had information from invoices or work orders stating the existing insulation thickness, R-value, or condition, while only two of the 13 provided the improved insulation R-value.

Engineering Reviews

The evaluation team's selection of algorithms and inputs for verified energy and peak demand savings was based on a variety of factors including:

- The home and equipment parameters available in the program tracking data or supporting documentation. For example, if blower door test-in and test-out results are available for each completed project, we want to use an algorithm that uses $CFM50_{pre}$ and $CFM50_{post}$ as inputs to the savings algorithm.
    - Conversely if the algorithm used to determine reported per-unit savings relies on input parameters that are not available, we want to use an algorithm that includes only the available information instead.
- Consistency with the approach used to characterize reported per-unit savings – either in the Georgia Power TRM or in prior impact evaluations.
- Reputable and regionally appropriate TRMs (where possible).
- The ability to estimate summer and winter peak demand impacts in addition to annual energy savings.

Using the data from desk reviews where possible, the team performed engineering reviews of each measure type and calculated verified gross savings for each HEEAP project. Appendix 6A: Algorithms and Assumptions describes which site-specific data points, from either the tracking database or desk review effort, were utilized in the calculation of verified savings. That appendix provides a detailed description of the formulas and assumptions used to calculate verified savings. Table 93 provides an overview of the method used for each measure type.

Table 93. 2020 + Q1 & Q2 2021 HEEAP Engineering Review Methods by Measure

MEASURE	ENGINEERING REVIEW METHOD
LED	LED energy and demand savings for HEEAP were drawn from the results of the concurrent 2020 Specialty Lighting impact evaluation. The evaluation team set the in-service rate to 100% and set the cross-sector sales rate equal to 0% for HEEAP.
Ceiling Insulation	Savings were calculated based on pre- and post-improvement R-values, attic square footage, TMY3 cooling and heating degree hours/days for Atlanta, and heating and cooling system efficiencies. Site-specific pre- and post-improvement R-values were used when available. When those values were not available, average values from the 2020-2021 HEIP Individual Improvements impact evaluation were utilized. Attic square footage was taken from desk reviews of project documents, when available. Otherwise, inspection of the project site in Google Earth was used to estimate attic area.
Duct Sealing	Duct sealing savings was calculated as a function of the duct leakage reduction, equivalent full load heating and cooling hours, and heating and cooling system characteristics in the home. An average duct leakage reduction was calculated from the results of the 2020-2021 HEIP Individual Improvements impact evaluation. Duct blaster test-in and test-out are required for each project in HEIP and the values are stored in the program tracking data. The duct leakage reduction was used in energy savings algorithms from the Minnesota TRM v3.2 – which uses “pre” and “post” duct leakage values in CFM25 as the central inputs.
HVAC Servicing	The Pennsylvania TRM (2019) and the Illinois TRM (v9.0) both use a 5% savings factor for HVAC servicing measures. [61] The percent savings was applied to Georgia-specific average residential cooling and heating energy

[61] Both PA and IL TRMs cite Energy Center of Wisconsin, “Central Air Conditioning in Wisconsin, A Compilation of Recent Field Research”, May 2008 as source for 5% factor.

MEASURE	ENGINEERING REVIEW METHOD
	consumption. Summer and winter demand savings were calculated based on cooling and heating load shapes' coincidence with Georgia Power's seasonal system peak definitions.
Air Sealing	Site-specific pre- and post-improvement blower door test results were used to calculate savings from air sealing. When blower door test results were unavailable (only for one project), the average pre- and post-improvement values from the other projects were used. The savings method incorporates the CFM reduction with TMY3 climate characteristics, heating and cooling system efficiencies, and factors to adjust for latent cooling and to adjust from the 50-Pascal test level to natural air flow.
Smart Thermostat	Smart thermostat energy and demand savings for HEEAP were drawn from the results of the concurrent 2021 Thermostat Marketplace impact evaluation. The Thermostat Marketplace billing analysis used whole house AMI data and segmented results based on the number of rebated thermostats per home and found higher per-thermostat savings for homes with one thermostat than homes that purchased multiple thermostats from the Marketplace. This finding is consistent with other smart thermostat evaluations and likely a function of the fact the second thermostat is typically applied to a secondary system or a single system with zoning. Since the number of thermostats installed is recorded for each HEEAP participant, the evaluation team utilized the segmented results to estimate verified savings. Only one HEEAP participant received two smart thermostats, so this approach leads to higher per-thermostat savings in HEEAP compared to HEIP, where participants frequently purchased two Marketplace thermostats. The number of thermostats installed by future participants should be monitored to ensure this assumption remains appropriate. The evaluation team also backed out an assumed 77% NTGR from the Thermostat Marketplace results because the matched comparison group billing analysis directly estimates net savings. Consistent with industry standard practice, NTGR is assumed to be 100% for HEEAP due the income-qualified nature of the program.
Pipe Insulation	Verified savings for pipe insulation is based on an assumed R-value of 1 for uninsulated pipe and an

MEASURE	ENGINEERING REVIEW METHOD
	assumed addition of R-3.5 insulation. The pipe is assumed to be a ¾” pipe and the difference in the hot water temperature and the ambient temperature is assumed to be 65°F. Savings is calculated for six feet of pipe length to match the reported deemed savings estimate. The assumed baseline R-value is consistent with the input assumption from the Georgia Power TRM. The assumed R-value of the added pipe insulation is 0.5 less than what is assumed in the Georgia Power TRM to reflect typical pipe insulation levels more accurately.
Water Heater Insulation Jacket	An algorithmic approach is used, as documented in the Georgia Power TRM, which relies on the surface area and heat transfer coefficient of the tank water heater before wrapping and assumptions about difference in temperature between the tank and ambient temperature in the room where the water heater is located.

Verified Gross Savings Results

Table 94 shows the *reported* deemed savings and *verified* gross per-unit savings for 2020 + Q1 & Q2 2021 HEEAP measures. For most measures, a primary driver of the difference between reported and verified gross savings is the prevalence of smaller house sizes participating in the program. The smaller size of houses in the program led to reduced impacts from envelope measures as compared to the deemed values that make up the reported savings. Additional details on the drivers of differences in verified versus reported savings are shown in Table 95.

The air sealing results show a counterintuitive pattern across electrically heated and gas heated homes with larger electric savings in the homes with gas heat. There are two factors that explain this result. First, homes with electric heating happened to experience substantially less infiltration reduction (average 853 CFM50 reduction, n=9) than those homes with gas heating (average 1,158 CFM50 reduction, n=8). Second, even though heating and cooling effective full load hours are similar in Georgia (816 $EFLH_{cool}$, 729 $EFLH_{heat}$), air infiltration reduction tends to provide greater cooling savings than heating savings. This is due to the need for a home’s HVAC system to dehumidify infiltration air during the summer months in addition to the need to remove the added sensible heat. This effect is particularly pronounced in Georgia where the “latent multiplier” is 7.9, reflecting the ratio of total heat from infiltration (sensible plus latent) to sensible heat from infiltration.

The smaller impact from heating season savings, coupled with the asymmetry of the magnitude of infiltration reduction, led to the counterintuitive pattern in savings between electrically heated and gas heated homes.

The evaluation team expects that with additional participation, Georgia Power will see the average CFM reductions stabilize across heating fuels and air sealing in electrically heated homes will return larger savings than air sealing in gas heated homes, on average.

Table 94. 2020 + Q1 & Q2 2021 HEEAP Program Reported & Verified Gross Per-Unit Savings Values

MEASURE	UNIT OF MEASURE	REPORTED PER-UNIT SAVINGS			VERIFIED GROSS PER-UNIT SAVINGS		
		KWH	SUMMER KW	WINTER KW	KWH	SUMMER KW	WINTER KW
LED	Lamp	33	0.004	n/a	32	0.004	0.005
Ceiling Insulation (Gas Heat)	Home	222	0.169	n/a	46	0.026	0.000
Ceiling Insulation (Electric Heat)	Home	672	0.220	n/a	549	0.038	0.297
Duct Sealing (Gas Heat)	Home	1,011	1.201	n/a	441	0.253	0.000
Duct Sealing (Electric Heat)	Home	1,920	0.540	n/a	1,005	0.253	0.348
HVAC Servicing (Gas Heat)	Home	717	0.657	n/a	169	0.097	0.000
HVAC Servicing (Electric Heat)	Home	1,193	0.660	n/a	293	0.097	0.077
Air Sealing (Gas Heat)	Home	1,443	1.677	n/a	778	0.446	0.000
Air Sealing (Electric Heat)	Home	3,037	0.786	n/a	762	0.329	0.116
Smart Thermostat	Thermostat	424	0.147	n/a	328	0.089	0.071
Pipe Insulation	6 feet of pipe	160	0.300	n/a	156	0.018	0.018
Water Heater Insulation Jacket	Water Heater	227	0.000	n/a	226	0.027	0.039

Annual energy savings and summer peak demand reduction are both reported for HEEAP. Verified savings was calculated for annual energy savings as well as both summer and winter peak demand reduction. Wherever possible, peak demand reduction was calculated using Georgia Power's summer and winter peak definition by applying 8,760-hour load shapes to determine coincidence with each peak. Additional details on verified demand savings calculations are provided in Appendix 6A: Algorithms and Assumptions.

Table 95 highlights notable differences between *reported* and *verified* gross estimates.

Table 95. 2020 + Q1 & Q2 2021 HEEAP Notable Differences Between Reported & Verified Gross

MEASURE	REPORTED SOURCES AND ASSUMPTIONS	VERIFIED GROSS SOURCES AND ASSUMPTIONS	PRIMARY REASONS FOR DIFFERENCES
LED	Georgia Power TRM v2.0	2021 Specialty Lighting impact evaluation	Updated HVAC interactive factors developed by the evaluation team
Ceiling Insulation	Deemed from July 2015 evaluation results, which used BEopt energy simulation models	Mid-Atlantic TRM v9.0 drives primary calculation; site-specific R-values where available and average baseline from HEIP Individual Improvements when site-specific not available; ceiling square footage estimated for each site, when data unavailable, using Google Earth	Attic square footage may be smaller (~1,658 sq ft) for HEEAP than the sample in the 2014 evaluation; baseline R-value averaged approximately R-13; verified savings cooling and heating system efficiencies of 13 SEER and 8.2 HSPF
Duct Sealing	Georgia Power TRM v2.0; deemed from July 2011 evaluation results	Algorithms based on Minnesota TRM v3.2; duct leakage reduction based on average reduction from 2020-2021 HEIP Individual Improvements	Average leakage reduction from HEIP Individual Improvements dataset
HVAC Servicing	EnerSIM modeling outputs documented in the Georgia Power TRM v2.0; ~3-ton capacity with pre-SEER of 7.7 and post-SEER of 9.2	PA and IL TRM's "maintenance factor" percent savings, 5%; Georgia-specific average heating and cooling consumption	Georgia Power TRM assumes a 2,200 square foot home that uses 21.5 MWh/year (heat pump with electric DHW) or 11.5 MWh/year (gas heat and DHW). HEEAP homes are smaller, on average, with smaller HVAC systems than the TRM characterization. Verified savings calculations assume higher test-in and test-out efficiencies
Air Sealing	Georgia Power TRM v2.0; deemed from 2011 evaluation results	Same algorithmic approach as the 2011 Nexant evaluation; Site-specific pre- and post-improvement blower door test results	Average CFM50 reduction of approximately 1,000 CFM50; Average home size of approximately 1,500 sq ft
Smart Thermostat	2017 Evaluation results	2021 Thermostat Marketplace impact evaluation. For HEEAP participants receiving one thermostat (n=9) we assign the Marketplace result for a single thermostat household. For HEEAP participants receiving two thermostats (n=1), we assign the per-unit impacts for a two-thermostat home. We reference the HEIP thermostat results to determine gross energy savings after NTG (77%) has been backed out	Billing analysis uses a matched comparison group and AMI data rather than a pre-post analysis of monthly bills. The matched comparison group with nonparticipants method estimates net savings
Pipe Insulation	Georgia Power TRM v2.0; deemed by increments of 6-feet of pipe	Georgia Power TRM v2.0; calculated for 6 feet of pipe; R-3.5 added insulation, instead of R-4.	Energy realization rate is near 1, but demand realization rate is low. Georgia Power TRM uses R-4 added insulation, verified savings uses R-3.5, a more

MEASURE	REPORTED SOURCES AND ASSUMPTIONS	VERIFIED GROSS SOURCES AND ASSUMPTIONS	PRIMARY REASONS FOR DIFFERENCES
			reasonable value. Reported kW savings of 0.3 kW per 6-feet of pipe is high. That level of demand savings requires complete removal of the electric water heater, not insulating a section of supply piping
Water Heater Insulation Jacket	Georgia Power TRM v2.0; R-value of baseline case = 8.3; R-value after jacket = 20	Georgia Power TRM v2.0	Rounding

Realization Rates

The next tables (Table 96 and Table 97) show the program's reported savings and verified gross savings, as well as the resulting program-level realization rates. As noted previously, these results are for a limited number of initial projects. We provide an overall program-level realization rate below, but we do not recommend that Georgia Power uses this for planning purposes, as the overall composition of measures may change once participation increases. The per-unit savings values (and corresponding per-unit realization rates) should be relied on for future planning purposes as current best-estimates of savings.

Table 96. 2020 + Q1 & Q2 2021 HEEAP Program Level Reported & Verified Gross Electric Energy Savings

MEASURE	MEASURE QUANTITY	REPORTED ELECTRIC ENERGY SAVINGS (KWH/YR.)	VERIFIED GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)	REALIZATION RATE
LED	266	8,760	8,458	97%
Ceiling Insulation	13	6,036	4,117	68%
Duct Sealing	4	5,862	2,892	49%
HVAC Servicing	6	5,254	1,260	24%
Air Sealing	17	38,877	13,079	34%
Smart Thermostat	11	4,664	3,612	77%
Pipe Insulation	7	1,120	1,090	97%
Water Heater Insulation Jacket	7	1,589	1,580	99%
Total Savings	331	72,162	36,089	
Total HEEAP Realization Rate		50%		

Note: Totals may not sum properly due to rounding.

Table 97. 2020 + Q1 & Q2 2021 HEEAP Program Level Reported & Verified Gross Summer Peak Demand Reduction

MEASURE	REPORTED PEAK DEMAND REDUCTION (KW)	VERIFIED GROSS PEAK DEMAND REDUCTION (KW)	REALIZATION RATE
LED	1.09	1.14	104%
Ceiling Insulation	2.55	0.42	17%
Duct Sealing	3.48	1.01	29%
HVAC Servicing	3.95	0.58	15%
Air Sealing	20.48	6.53	32%
Smart Thermostat	1.61	0.98	61%
Pipe Insulation	2.10	0.12	6%
Water Heater Insulation Jacket	0.00	0.19	N/A
Total Savings	35.26	10.97	
Total HEEAP Realization Rate			31%

Note: Totals may not sum properly due to rounding.

Verified Net Savings

Consistent with industry-standard practice, NTG is set at 100% because HEEAP is an income-qualified offering. Therefore, the verified net savings are equal to the verified gross savings. For smart thermostats, as discussed above, the team referenced the billing analysis performed for HEIP. Because that billing analysis resulted in net savings, the team used the estimated gross savings value from that evaluation.

Process Evaluation

The evaluation team conducted interviews with five contractors and four early participants in the program. The evaluation team sought to answer the following research questions:

- How do customers hear about the program, and why did they choose to participate? Are program marketing initiatives resonating with customers?
- Do customers understand the process for participation? What participation elements met their expectations? And which were a surprise to them?
- How accessible did participants find the program staff for asking questions?
- How satisfied are customers with the program overall as well as individual program components?
- Is the program meeting the needs of income-qualified customers?

- How, if at all, should the program model be adjusted based on experiences learned in this program cycle?
- What are the challenges and benefits of transitioning this program to in-house administration within Georgia Power, including from a cost perspective?
- Are there other potentially cost-effective measures that could be added to this program to get deeper savings?

At the time the interviews were conducted, only 11 participants had completed projects. These 11 participants included:

- Two customers who had applications created in 2020, but were previously waitlisted
- Nine customers who had applications created in 2021

The evaluation team contacted each of these participants via email and phone and completed four total interviews; two of the interviews were with customers who had been previously waitlisted, and two interviews were with those who applied in 2021. The evaluation team also interviewed five of the six contractors who have been active with HEEAP to date. Our interviews with program contractors probed for insights into program processes that can help improve program design and delivery, as well as whether there are additional measures that contractors believe would be beneficial and potentially cost-effective to include in the program.

Given the limited amount of program participation to date, both from the customer and contractor perspective, the interviews were qualitative in nature, and are intended to provide early directional findings for program staff, rather than definitive examples of the current program experience.

Process Synopsis

Below we present a high-level synopsis of the program process, as experienced by participants and contractors. **Bolded** items indicate that the step in the process is a temporary process implemented in adaptation to COVID-19 restrictions.

1. Customer gains awareness of the program
2. Customer applies for the program
    a. **Customer submits pictures of household systems and condition**
3. Program staff reviews the application
    a. Third-party verifies participant's income
4. **Program staff conduct follow-up interview with applicant to verify application and photos**

5. Program staff conduct assessment of participant's home[62]
6. Program staff assigns application to a participating contractor
    a. Program staff send tentative project scope to contractor with an opportunity to accept/reject the project
    b. Contractor has 24 hours to evaluate the proposal and accept/reject the project
7. If accepted - contractor communicates with the homeowner and schedules the work/assessment
8. Contractor conducts assessment and either:
    a. Confirms the initial application was accurate and sufficient
    b. Provides additional feedback regarding what improvements would help the energy efficiency of the home
9. Contractor sends accepted/revised scope to program staff
10. Program staff authorize select measures and send back to contractor
11. Contractor accepts/rejects revised proposal
12. If approved, contractor schedules authorized work with the customer
13. Contractor performs the work
14. Program staff release payment to the contractor within in seven to ten days

Customer Awareness and Marketing

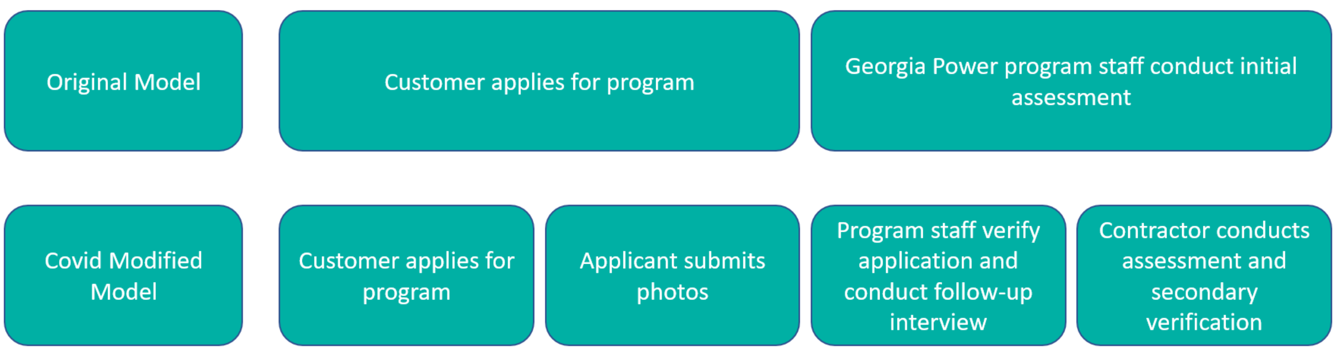
To date, Georgia Power has primarily relied on follow-up with participants who attempted to enroll in the previous iteration of HEEAP but were unable to due to the program cycle ending and were later added to the HEEAP wait list. The interviewed participants indicated various sources of primary program awareness, including through the previous iteration of HEEAP (n=1), through a local community resource center (n=1), through their own direct outreach to Georgia Power (n=1), or through the news (n=1). The participants who indicated they heard of the program through the county assistance program, or the local resource center (senior center) are similar in their experience in that they were both already utilizing a resource they previously relied on for some form of financial support. As Georgia Power considers increasing the marketing presence of HEEAP, community resources are important pathways to engage future participants, as those resources are already engaged with the same communities that HEEAP seeks to engage.

[62] This part of the process was not in effect at the time of the interviews due to the ongoing COVID-19 pandemic.

Program Process

Due to the ongoing COVID-19 pandemic, the application and home assessment aspects of HEEAP operated differently during the assessment period compared to the program's original design. Originally, upon completion and acceptance of a customers' application and a successful income verification, Georgia Power program staff were to conduct an initial home assessment themselves (not participating contractors), including direct installation of energy saving measures. During the evaluation study period, the assessment was simultaneously both a piece of the application process, as well as its own stand-alone aspect that occurred *after* a contractor accepted a tentative job scope. During the assessment period, the first piece of the assessment occurred as part of the application process, where applicants were asked to submit pictures of certain household systems and household conditions if they were able. The second piece of the assessment was then delivered by program contractors, who provided additional verification of the original application and household conditions and conducted the direct installation of energy saving measures at their initial visit.[63] Figure 92 depicts the application and assessment processes as originally scoped, and as implemented during the evaluation period given the COVID-19 pandemic.[64]

Figure 92. Original and Covid Modified Application and Assessment Procedures



The contractors interviewed indicated they were more satisfied with the current model compared to the original model, as it allows them to be more prepared to complete the full scope of the approved project when that time comes. Contractors indicated this model sometimes results in them needing to return to a job at another date (conduct the on-site assessment one day, complete the scoped work another day), but that to date this has not created any issues.

[63] Some contractors indicated that they could complete the assessment and the advanced measure installations at the same visit.

[64] As of October 21, 2021, Georgia Power is employing a hybrid model of this approach, where some assessments are conducted by program staff, and others are conducted by program contractors.

> *"I like Georgia Power's administration; it leaves a lot up to the contractors which is nice because before we were prescribed everything and not given a lot of information as far as knowing what to come with and how to be prepared. I like the Georgia Power version where we're the ones doing the assessment. It's helpful knowing what to do because we do the assessments."*
>
> – HEEAP contractor

Application Process

Applicants in 2020 were not originally required to submit photos or other supplementary application details when they first applied; program staff have since requested these additional details as part of the follow-up outreach and intake process. As such, each of participants we interviewed conveyed similar experiences with the application process, even though the program used different processes when the customers originally applied.

Two of the four interviewed participants indicated they relied on help from a family member with their application, while two indicated they completed it themselves. None of the respondents indicated any difficulty with the application process or dissatisfaction with the level of information required. However, one respondent who did not complete the application themself indicated they encountered difficulties when scheduling their work because the program was attempting to communicate with them directly, rather than with their family member who completed the application.

Contractors likewise indicated that elderly customers are common participants in the program, and often their children (or someone else) help to facilitate the application process for them. Contractors indicated that this can often make communication and scheduling challenging, but that it has not proven to be a significant problem yet. Moving forward, it will be important for Georgia Power to consider program participants, or potential program participants, who may need additional assistance with the application or scheduling processes.

> *"It's been difficult on occasion trying to coordinate with customers because they can be elderly and having a family member communicate them. One I have right now, Georgia Power had only given me the contact info of the homeowner but not the daughter who I really needed to be in touch with."*
>
> – HEEAP contractor

Participant Expectations & Experience

Contractors noted, and two participants agreed, that participants do not have clear expectations regarding the measures or services that will be provided through the program. Despite this, participants overall were very satisfied with the measures installed, and cited noticeable differences in the comfort of their homes after participating in the program.

"It is more comfortable. The whole house now gets cool. Now it is cool in the whole house and not just in a few rooms like before."

– HEEAP participant

"Since they sealed the doors, it is much cooler. It was energy efficient, but they put the strips on the outside to help the doors be more energy efficient. And the (energy) went down a bit. It is more comfortable now and not drafty."

– HEEAP participant

"It's much cooler in the house now, and I think the energy bill went down a little bit."

– HEEAP participant

Two of the interviewed participants, however, noted they did have specific hopes from the program, which were not met, with each stating that they had hoped for new windows and one also expecting additional insulation that was never received.

"I was hoping that I would get something fixed that didn't get fixed. I had two windows that needed to be fixed. The program said it would do stuff like that but then Georgia Power said that they don't do windows. I have a cracked window that's the only thing I thought that didn't get done."

– HEEAP participant

"I had a lot of little things – they did what they could do. I was hoping they'd put in some windows, but they said they didn't do that. I was just hoping for the windows and maybe doors.

–HEEAP participant

"I thought they would do insulation under the house, but they didn't. He said someone was going to come back and do the stuff under the house, but no one called back. I haven't heard back from Georgia Power. The number I have doesn't work."

– HEEAP participant

The concern expressed related to the customer not receiving insulation under their home was primarily a communication issue. This was the only instance in which a program participant noted they attempted to contact program staff for any reason and had trouble doing so. As it is important for Georgia Power to consider program participants, or potential program participants, who may need additional assistance with the application or scheduling processes, it is similarly important to consider ensuring clear communication channels are available for participants to follow up with any questions, and to ensure that these channels are easy to navigate for all participants.

Contractor Experience

Each of the contractors interviewed indicated that they were involved with Georgia Power programs for a long time. Each worked with other Georgia Power programs prior to their participation in HEEAP, indicated experience with previous iterations of both the HEEAP and HEIP programs, and to a certain extent had incorporated the program offerings into their business models. Each contractor thus either had a working knowledge of how the program would work, or simply had an informal lunch with program staff to bring themselves up to speed.

> *"I was able to speak to program staff directly – that's how I was able to understand the program. We worked with the programs in the past, so between working with them before, they gave me the complete run down with a small interview before we started. I haven't needed anything extra since then."*
>
> \- HEEAP contractor

Because of the low volume of the program to date, contractors did not yet have much first-hand experience, but noted that they see the potential future benefit of the program. Each contractor spoke highly of HEEAP staff and gave considerable praise to the Georgia Power team for their ability to implement the program themselves while simultaneously contending with COVID-19 restrictions. Furthermore, contractors indicated the current program model, whereby they verify the initial assessment prior to conducting the work, allows them to be more prepared to complete the work when the time comes, as they are aware of the specific needs of the home and the work that needs to be done before they arrive.

> *"It's seamless and it's getting better every day. The hiccups on a scale from 1 to 10, everything's pretty much a 1 - Georgia Power does a great job. If there's any situation that's an issue, they're like a swarm of bees; they get on it and fix it right away. If I have any questions or situations that arise, I can always get somebody on the phone - I can get 3 to 4 people on the line - I'm never sitting somewhere saying 'What do I do here?' I can always call from the house or the job site. The training is always ongoing. I was talking to program staff the other night at 9:30 at night. You always get an email returned you always get a phone call returned. With Georgia Power you always can count on somebody and that's important when you're in the field."*
>
> – HEEAP contractor

"Because we just started back working with Georgia Power and we don't have that many work orders coming in it hasn't really brought in more business. But I can see that it can potentially bring in more business because once we go to the home and they're familiar with our name we'll be the ones to call so I think that will help business in the future."

– HEEAP contractor

Additional Suggested Measures and Markets

Contractors indicated the program's preliminary progress is successful at addressing the needs of the income-qualified population that the program serves. However, two contractors noted a need among moderate-income customers, who are excluded from HEEAP, but are unable to afford measures through HEIP or without a program at all.

"I think with the service that we provide through Georgia Power, not just low-income but maybe medium income families? HVAC services could really become expensive and what we provide with this service is something that would help prevent future damages to their HVAC system. A step above low-income would benefit from this program, and especially during these times it could be hard to pay for a full-service program."

- HEEAP contractor

Likewise, contractors noted additional measures they would like the program to consider adding, including floor insulation, HVAC repairs or replacements for participants using window ACs, and windows.

"If we could get rebates for floor insulation, that should qualify. I don't have a sense for the energy savings from that, but that's something that Georgia Power could figure out. They'd have to know that we were doing these jobs and right now they don't know that. They don't know that I've gone to their customer's house and pulled out soggy fiberglass from the floor and sprayed in foam, so they don't know to look for that."

- HEEAP Contractor

“Adding on to the HVAC measures. A lot of the homes have HVAC, but they don’t work, so something to get those HVAC systems up and running would be great. You might not get the air sealing or weatherization, but your HVAC system is up and running, so that’s three or four window units you don’t have to use anymore.”

- HEEAP Contractor

“As far as other things – replacement windows, but those are about $800 installed and it takes 20 weeks to get a window – other than that we’re doing so much, weather stripping, caulking, the air sealing, plumbing penetrations, attic penetrations, it’s a pretty thorough weatherization job.”

- HEEAP Contractor

Multifamily Considerations

Two of the interviewed contractors noted they recently conducted work with a multifamily property and offered suggestions for future engagement. Each of these contractors noted that personal relationships with property managers and building owners are the only way they have found to engage with multifamily populations, as it is incredibly difficult to market to them and individual tenants have no autonomy with regards to energy efficiency decisions.

“For this one, I had a relationship with the owners through private connections. From my knowledge of the multifamily world, getting relationships with property owners is the best way to get in. The tenants have very little sway with the owners so going through them is not helpful at all.”

– HEEAP Contractor

Conclusions and Recommendations

Conclusion 1: Claimed savings for the air sealing measure are inconsistent with the home size and level of infiltration reduction observed during the first 15 months of the 2020 – 2022 cycle in both HEEAP and HEIP.

The evaluation team reviewed estimates of savings alongside customer characteristics and usage. If we pair the Georgia Power TRM default $EFLH_{cool}$ value of 816 with a three-ton, 12 SEER air conditioning unit, the estimated average annual cooling consumption of a Georgia home is 816 * 3 *12/12 = 2,448 kWh. The claimed per-unit savings for air sealing in a gas heated home is 1,443 kWh or a 59% reduction. While the homes serviced by HEEAP are presumably leakier than the average Georgia home, the average cooling capacity of HEEAP homes in 2021 was 2.8 tons. Similarly, we estimated pre-retrofit weather-normalized annual HVAC consumption for electrically heated homes at approximately 6,000 kWh, which makes the claimed per-unit air sealing savings of 3,037 kWh also over a 50% reduction. The average CFM reduction in HEEAP was approximately 1,000 CFM – or 25% of the pre-retrofit CFM50. These inconsistent assumptions, coupled with the fact that the homes participating in HEEAP are relatively small at an average of 1,500 square feet, resulted in substantially lower verified gross savings as compared to reported savings.

Recommendations:

- Apply savings per CFM to scale savings more accurately. The evaluation team recommends using 0.9 kWh per CFM reduced for air sealing in electrically heated homes and 0.7 kWh per CFM reduced for air sealing in homes heated with fossil fuel heat, which would allow the program to effectively scale savings with CFM reduction. For peak demand, we recommend 0.4 kW per 1,000 CFM reduced for summer peak demand reduction and 0.1 kW per 1,000 CFM reduced for winter peak demand reduction for homes with electric heat. The average CFM50 reduction in HEEAP among the projects evaluated was 997 so the evaluation team believes a reasonable planning assumption for the 2023 – 2025 cycle is a CFM50 reduction of 1,000.
- Monitor key metrics for program participants once participation has increased. In addition to implementing scalable savings for air sealing measures, once participation has ramped up Georgia Power should monitor key metrics, customer characteristics, and baseline information for customers across all measures to better understand and characterize customers who participate in this program. This will help ensure assumptions are aligned with actual participation.

Conclusion 2: The program should track additional information in Vision to allow for QA/QC and evaluation. Attic insulation levels, pre- and post-improvement, would aid in energy savings estimation.

The HEEAP tracking database did not capture baseline or installed R-values for ceiling insulation projects. Invoices and work orders also did not capture this information for the majority of HEEAP projects. Project characteristics, especially baseline (in-situ) insulation depth and condition, and ultimately R-value, substantially impact ceiling insulation project savings. These characteristics should be captured in the program tracking database, and ideally used to calculate energy and demand savings on a per-project basis.

Recommendations:

- **Capture baseline and installed ceiling insulation R-values.** Utilize these site-specific values to calculate energy savings by project using the savings methodology shown in Appendix 6A: Algorithms and Assumptions.

Conclusion 3: The duct testing and sealing measure is delivered differently in HEEAP compared to HEIP.

While the per-unit savings claims are the same and the type of repairs are similar, HEEAP does not require duct leakage test-in and test-out. Instead, Georgia Power field service technicians complete pressure pan testing to determine if the duct system warrants repair work. Our verified savings estimates and per-unit savings recommendations rely on the duct leakage test-in and test-out results from HEIP Individual Improvements.

Recommendations:

- **The current duct testing approach makes sense for HEEAP from a program delivery standpoint.** The average home size amongst recipients of this measure in HEIP and HEEAP was similar during our evaluation, but Georgia Power should remain mindful of differences in home size when applying results from HEIP duct leakage tests to HEEAP in the future.

Conclusion 4: The reported per-unit savings for the HVAC servicing measure represents a 15% to 20% reduction in end-use consumption. This level of improvement is inconsistent with industry studies and assumptions for this measure.

Where project documentation included a description of the HVAC service, contractors generally listed rinsing the condenser coils and changing air filters. One invoice called out adding 410a refrigerant. This is standard practice for an AC tune-up. Except in cases where significant refrigerant charge issues or airflow issues are corrected, savings from central air conditioner and air source heat pump tune-ups can be expected to be between 1% and 5% of baseline consumption[65]. The deemed savings values for HEEAP likely overstate energy savings.

Recommendations:

- **Collect additional details on level of work performed for HVAC servicing.** HVAC servicing could include a simple tune-up or more comprehensive diagnostics and adjustments. We recommend collecting

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[65] Minnesota TRM v3.0, Central AC/ASHP Tune-Up measure; Illinois TRM v7.0, 5.3.10 HVAC Tune-Up (Central Air Conditioning or Air Source Heat Pump); Texas TRM v7.0, 2.2.1 Air Conditioner or Heat Pump Tune-Ups, PA TRM 2019, 2.2.5 Air Conditioner & Heat Pump Maintenance

the details on the work completed. *Was refrigerant added? If so, how much?* This type of data collection could help justify per-unit savings larger than a typical tune-up.

Conclusion 5: Reported peak demand reduction is significantly overestimated for several HEEAP measures.

Peak demand reduction for ceiling insulation, duct sealing, air sealing, HVAC servicing, and pipe insulation were reported as being between three times (air sealing) and 32 times (HVAC servicing) higher than the verified summer peak demand reduction. Figure 93 shows the parametric energy simulation runs used to characterize peak demand savings for the HVAC servicing measure. Several parameters are worth noting. The homes serviced by HEEAP in 2021 were approximately 1,500 square feet, or 32% smaller than the reference home modeled in EnerSim. The highlighted peak load contribution drops by 0.7 kW or almost 14% of whole house consumption. Conversely, the winter peak load contribution is unchanged despite a 10% improvement in heating efficiency.

Figure 93. Georgia Power TRM Entry – HVAC Diagnostics and Services Heat Pump

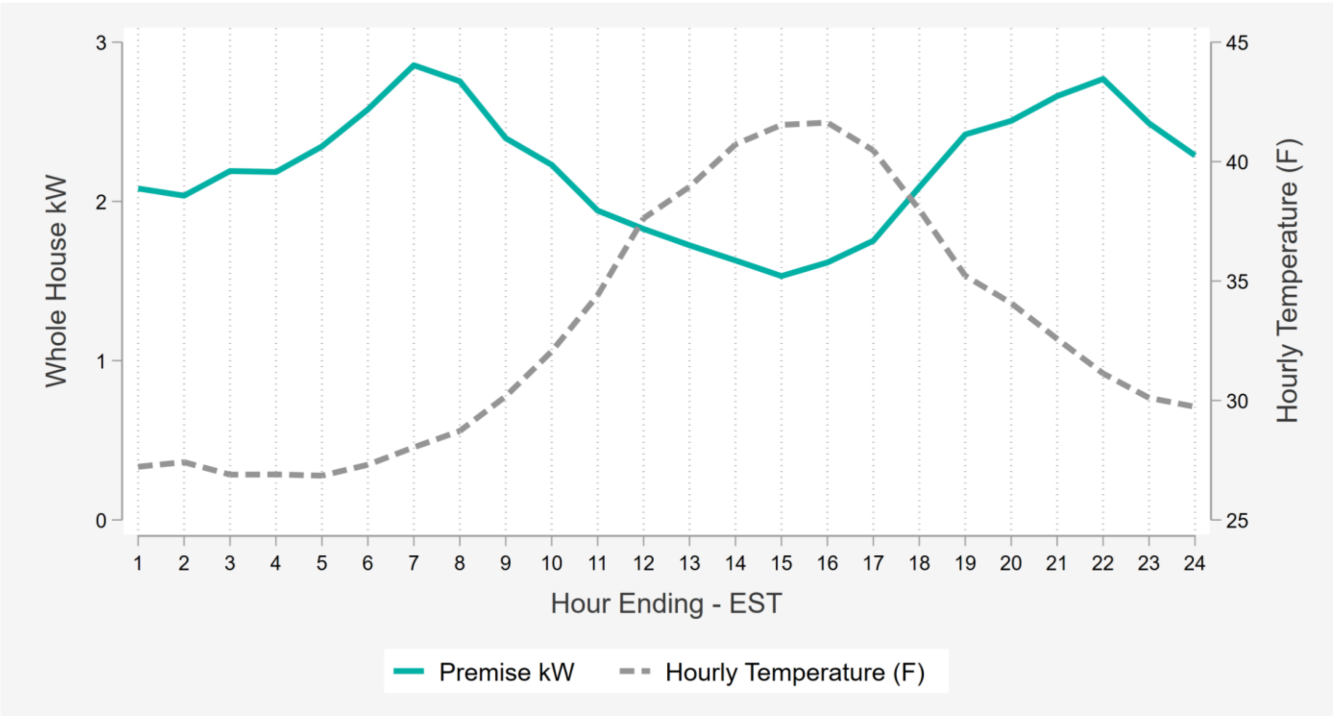
EnerSim Model Inputs	Base Case	Change Case
Loadshape		
Modeling Notes	RB-S-E-HP-EC-HV-BAS05	RC-S-E-HP-EC-HV-OTH06
Home/Facility Square Footage	2,200.00	2,200.00
Weather	GA_Atlanta_Hartsfield_IntTMY3.bin	GA_Atlanta_Hartsfield_IntTMY3.bin
Miscellaneous Details		
Total Energy & Rate Information		
Estimated kWh	21,527.00	20,334.00
Estimated Summer Peak kW	5.10	4.40
Estimated Winter Peak kW	14.20	14.20
Electric Rate Used	R-22__NoFuel&FF	R-22__NoFuel&FF
Base Revenue - Electric (1st year)	1,791.00	1,682.00
Total Therms	0.00	0.00
Total Gallons	51,399.00	51,399.00
HVAC Type		
HVAC Tonnage	3.11	3.11
HVAC SEER	7.70	9.20
Heating Fuel	Electric	Electric
Heating BTU/kW	30,205.00	33,635.00

Recommendations:

- **Review the home size, HVAC system efficiency levels, and other relevant energy simulation parameters used to determine deemed savings.** On average, HEEAP participating homes were approximately 1,500 square feet in size, had under three tons of cooling capacity, and tended to have systems with SEER values in the 10 to 14 range. While these numbers are preliminary, the team expects that homes that participate could be somewhat smaller overall, given home characteristics seen in similar populations from HEIP. This should be monitored in the future as participation continues to increase.

- **Revisit the peak load assumptions in the EnerSim models.** Figure 94 shows average hourly premise load and outdoor air temperature on a cold January weekday in 2020. These homes enrolled in Temp✓ so should all have an air source heat pump. The diversified peak load contribution is approximately 3 kW per household. The 14.2 kW winter peak shown Figure 94 is inconsistent with the residential load data our team studied in this evaluation.

Figure 94. Average Electrically Heated Household Demand – January 21, 2020



Conclusion 6: Elderly customers are common participants in the program, and often their children (or someone else) help to facilitate the application process for them. This can often make communication and scheduling challenging.

Two of the four interviewed participants indicated they relied on help from a family member with their application, while two indicated they completed it themselves. One respondent who received assistance with the application indicated that they encountered difficulty when scheduling their work because the program was attempting to communicate with them directly, rather than their family member who completed the application. Likewise, one contractor referenced a similar and recent situation, where they had trouble scheduling work with a participant whose daughter submitted the application for them.

Recommendations:

- **Consider program participants, or potential program participants, who may need additional assistance with the application or scheduling processes.** Ensure clear communication channels are available for participants to follow up with any questions, and to ensure that these channels are easy to navigate for all participants.

- Provide fields on the application to capture additional contact information of anyone who assisted with the application.

Conclusion 7: Contractors prefer the modified program model that was employed during the evaluation period, where they verify the initial self-assessment prior to conducting the work. They report that this allows them to be more prepared to complete the full project, as they are aware of the specific needs of the home and the work that needs to be done before they arrive.

Due to the ongoing COVID-19 pandemic, the application and home assessment aspects of HEEAP operate differently than the program's original design. Originally, upon completion and acceptance of a customers' application and a successful income verification, Georgia Power program staff conducted an initial home assessment themselves (not participating contractors), including direct installation of energy saving measures. During the evaluation period, the assessment was simultaneously both a piece of the application process, as well as its own stand-alone aspect that occurred *after* a contractor had accepted a tentative job scope. The first piece of the assessment then occurred as part of the application process, where applicants were asked to submit pictures of certain household systems and household conditions if they were able. The second piece of the assessment was then delivered by program contractors, who provided additional verification of the original application and household conditions and conducted the direct installation of energy saving measures at their initial visit. Currently, the program employs a hybrid approach, whereby program staff conduct some assessments, and program contractors conduct others.

Recommendations:

- After COVID-19 restrictions are relaxed, consider whether to continue allowing contractors to conduct the home assessments themselves, depending on program delivery priorities and needs. While contractors prefer this method, there may be additional considerations (such as increased QA/QC of contractor quality and performance) required for this approach.

7. RESIDENTIAL REFRIGERATOR RECYCLING PROGRAM

Program Design and Delivery

Georgia Power's Refrigerator Recycling program offers free pickup and a $35 incentive to single family customers for their secondary, working refrigerators and freezers. By picking up and recycling these units in an environmentally safe manner, the program creates cost-effective, long-term energy and peak demand savings, ensuring the appliances are removed from the grid completely. The program also raises customer awareness of the economic and environmental costs of these older appliances.

To qualify:

- The participant must reside in a single family unit and own their appliance.
- The freezer or refrigerator must be a secondary unit, between 10 to 30 cubic feet.

The program promotes two types of incentives. The first incentive is a $35 check provided directly to customers. The second incentive is the free removal service, which is often as much of a benefit as the monetary incentive. The program is implemented by ARCA, who coordinates the scheduling, pickup, and recycling of appliances through the program. In 2020 and Q1 of 2021, the program recycled a total of 2,168 appliances.

Changes from Previous Cycle Design

In response to the ongoing COVID-19 pandemic, the program was paused from mid-March 2020 through early-November 2020. Participants who applied during this period were placed on a waitlist and contacted once program operation resumed. Once the program resumed, participants were given the option to have appliances picked up from outside their home by program implementation staff (ARCA). There were no other changes to the program's design compared to the previous cycle.

Implications of the COVID-19 Pandemic

The evaluation team recognizes that this evaluation occurred during a timeframe in which the COVID-19 pandemic impacted daily life for residential customers in Georgia. The Refrigerator Recycling program was on hold for the majority of 2020 and ramped back up in late 2020 with outside pickup only. While the program was on hold, some customers were waitlisted until the program was relaunched.

Evaluation, research, and analysis nearly always have the potential for introduced and inherent biases and exogenous factors that may influence results. Ideally, evaluators attempt to control for these factors in analyses, such as through sample design. When controlling for these factors is not possible, evaluators will attempt to identify and characterize the factors that may have influenced evaluation results. For all program evaluations conducted in this cycle, the evaluation team carefully considered possible ways the unprecedented events of the COVID-19 pandemic and related factors may have impacted our results. There is much that is still unknown about how the COVID-19 pandemic has influenced household energy use and behavior in the US, and it is likely that the pandemic has affected households differently depending on household size, location, employment status, and other demographic factors (such as income, race, age, etc.). Additionally, whether and at what speed these factors return to pre-2020 conditions are occurring at varying degrees and speeds across different demographics and populations.

It is possible that the pandemic, and resulting program changes, impacted the type of customer and/or characteristics of appliances that are recycled through the program. For example, because outside only pickup requires that customers have their appliances plugged in outside of their house, customers who could not meet these criteria may have chosen not to participate as the program is currently designed. This theoretically could have impacted this cycle's results, including net-to-gross. However, the evaluation team was unable to compare these two program delivery methods, as nearly all participants in the evaluation period received outside pickup. Ultimately, this cycle's results are relatively consistent and similar with the past cycle's findings; however, as Georgia Power shifts back to in-home pickup, they may want to consider monitoring key program metrics (such as appliance age) and consider reassessing net-to-gross to ensure findings are consistent with future program designs.

Program Performance

The program was paused for a substantial part of the year in 2020. As such, the program fell short of the originally stated goals, achieving only 9% of gross energy savings (kWh) and summer peak demand reduction (kW). Table 98 summarizes savings for the program, including program savings goals.

Table 98. 2020 – Q1 2021 Refrigerator Recycling Program Savings Summary

METRIC	TIME PERIOD	GROSS SAVINGS GOAL	REPORTED SAVINGS	VERIFIED GROSS SAVINGS	VERIFIED NET SAVINGS	REALIZATION RATES
Electric Energy Savings (kWh/yr.)	2020	8,478,877	780,215	675,694	334,013	87%
	Q1 2021	n/a	1,523,809	1,319,673	652,349	
	Total	**n/a**	**2,304,024**	**1,995,367**	**986,362**	
Summer Peak Demand Reduction (kW)	2020	669	62	77	38	125%
	Q1 2021	n/a	120	151	74	
	Total	**n/a**	**182**	**228**	**113**	

Relative to the program's reported savings, the Refrigerator Recycling program achieved 87% of reported electric energy savings (kWh), and 125% of the reported peak demand reduction (kW). Table 99 outlines the *verified* gross and NTG adjustment factors.

Table 99. 2020 – 2021 Refrigerator Recycling Program Adjustment Factors

METRIC	REALIZATION RATE (%) [a]	FREERIDERSHIP	SPILLOVER	NTG (%) [b]
Electric Energy Savings (kWh/yr.)	87%	50%	N/A	50%
Peak Demand Reduction (kW)	125%	50%	N/A	50%

[a.] Realization Rate is defined as *verified* Gross savings divided by *Reported* savings.

[b.] NTG is defined as *verified* net savings divided by *verified* gross savings.

Research Questions

The evaluation team conducted qualitative and quantitative research activities to answer the following key research questions for the program:

Process Questions

- How are customers learning of the program?
- What influences customers' decisions to participate in the program?
- How satisfied are customers with the process, the implementation contractor, and their experiences in general?
- What is the vintage of equipment recycled, and how does that vintage compare with the general population as well as prior years' appliances? Based on these trends, what changes might the program consider for future program years (after 2022)?

Impact Questions

- Are the average savings assumptions accurate, and if not, how, and why should they be adjusted?
- How did the program perform against participation and savings goals?
- How influential was the program in encouraging the removal of their equipment, and what components of the program have the greatest influence on customers' decisions?

Impact Evaluation

Verified Gross Impacts

This section details each step of the impact evaluation and its associated electric energy savings and peak demand reduction.

Approach

Chapter 7 of the Uniform Methods Project (UMP) directs evaluators on approaches for calculating savings resulting from refrigerator and freezer recycling programs. [66] The evaluator has three options: (1) conduct in-situ metering using participants from Georgia Power's program; (2) use meter data or a model derived from meter data collected from another evaluation deemed representative, or (3) apply inputs gathered through primary and secondary sources to the prescribed UMP regression equation to calculate the unit energy consumption (UEC). [67] The evaluation team determined the second option—updating and applying inputs to a regression model derived from meter data collected across a sample of customers—is the optimal and most cost-efficient approach to evaluate the Refrigerator Recycling program. Below, we list the steps taken to determine the regression model and estimate savings.

Overall, to develop estimates of gross impacts, the evaluation team took the following steps:

- Reviewed and cleaned program tracking data. The evaluation team reviewed extracts from VisionDSM that included customer contact information and key appliance characteristics (such as age, size, and configuration) to ensure recycled appliances met program requirements and to calculate inputs to the regression equation.
- Conducted a literature review of peer utility studies. The evaluation team reviewed ten peer utility sources of appliance recycling metering studies (including Georgia Power's 2011 study) to determine the best regression model to use this year to develop impact estimates. Ultimately, the evaluation team used the regression model from Georgia Power's 2011 study to estimate savings.
- Calculated UEC using a regression model. The evaluation team used key appliance inputs from 2020 and 2021 program tracking data to estimate current savings with the 2011 Georgia Power regression model.

[66] Kurnik, Charles W., Josh Keeling, and Doug Bruchs. "Chapter 7: Refrigerator Recycling Evaluation Protocol. The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures." National Renewable Energy Lab. (NREL), Golden, CO (United States), October 4, 2017. https://doi.org/10.2172/1398879.

[67] Average Annual Energy Consumption of participating appliances.

- **Conducted participant and nonparticipant surveys.** These surveys provided key appliance information, such as how often appliances were used prior to being recycled, in addition to other data that fed into the net-to-gross and process evaluations. More details on how these surveys were sampled and fielded are included in Appendix 7A: Algorithms, Assumptions, and Additional Background.

- **Developed estimates of part use factor.** The evaluation team utilized the participant surveys to calculate a self-reported estimate of how often appliances were used annually.

The 2011 impact evaluation of Georgia Power's Residential Refrigerator Recycling program included an appliance metering study and developed a regression model for this specific purpose (as specified in Section 9 of the 2012 report).[68] Given the high cost of metering, the UMP recommends this approach where reliable and territory specific data exist. Gross savings are calculated as such:

$$Gross\_kWh = N * Existing\_UEC * Part\_use$$

Where:

Gross_kWh	=	*Annual electricity savings*
N	=	*Number of appliances recycled*
Existing_UEC	=	*Average Annual Energy Consumption of participating appliances*
Part_use	=	*Portion of year the average appliance would likely be plugged in and operating*

The calculations and additional details on the approaches used to develop the existing UEC and part use factors can be found in Appendix 7A: Algorithms, Assumptions.

Verified Gross Savings Results

Table 100 shows the *reported* deemed savings and *verified* gross per-unit savings for the 2020 Refrigerator Recycling program measures. The reported deemed savings values were taken from the program scorecards, while the verified gross per-unit savings values were calculated using the program tracking and participant survey data.[69] The verified gross per-unit energy savings were slightly lower than the reported values, while the per-unit demand savings were higher. Lower energy values are in part driven by younger appliances being recycled through the program, as these appliances are more energy efficient than older appliances.

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[68] Nexant, December 21, 2012. 'Impact Evaluation of Georgia Power Company's 2011 DSM Programs'

[69] A full discussion of these calculations is presented in Appendix 7A: Algorithms, Assumptions, and Additional Background

Table 100. 2020 & Q1 2021 Refrigerator Recycling Program Reported & Verified Gross Per-Unit Savings Values

MEASURE	UNIT OF MEASURE	REPORTED DEEMED SAVINGS			VERIFIED GROSS PER-UNIT SAVINGS		
		KWH	SUMMER KW	WINTER KW	KWH	SUMMER KW	WINTER KW
Refrigerator	1 Refrigerator	1,070	0.084	n/a	927	0.106	0.106
Freezer	1 Freezer	1,011	0.080	n/a	885	0.101	0.101

The deemed energy savings values currently used by the program were derived from the 2017 program evaluation, while the values used for this evaluation were calculated using the most recent program tracking data. As the per-unit energy savings value is comprised of both the average annual energy consumption of participating appliances (existing UEC) and the portion of the year that the average appliance would likely have been plugged in and operating (part use factor), changes in these values (the attributes of the appliances recycled each year) result in corresponding changes to the per-unit savings value. The evaluation team found slightly lower energy savings for this cycle.

Conversely, the evaluation team found somewhat higher demand values than were used for deemed savings. However, the deemed savings used for reporting in this cycle do not align with what was found in the 2017 report (approximately 0.12 kW per unit for both refrigerators and freezers in 2017). Compared to 2017's findings, this evaluation's demand results trend consistently along with the energy results.

The specific values from the previous evaluation that were used for existing UEC, and part use factor were not readily available. However, participant inputs to those values were available - namely the average age of recycled appliances and the relative percentage of appliances that were recycled and manufactured prior to the 1993 efficiency standard change. Both factors trended younger this cycle, which resulted in slightly lower overall savings. Table 101 highlights notable differences between *reported* and *verified* gross estimates.

Table 101. 2020 & Q1 2021 Refrigerator Recycling Program Notable Differences Between Reported & Verified Gross

MEASURE	REPORTED SOURCES AND ASSUMPTIONS	VERIFIED GROSS SOURCES AND ASSUMPTIONS	PRIMARY REASONS FOR DIFFERENCES
Refrigerator	*Reported* energy (kWh) savings align with the gross verified savings values attained from the previous evaluation conducted in 2017 of 1,070 kWh. The demand savings used for planning estimates this cycle are somewhat lower than the 2017 EM&V results.	UMP Chapter 7 and information in program tracking data.	The appliances recycled through the program in 2020 were both built more recently and were younger when they were recycled, compared to those recycled in the 2017 program year. Related to this, the percentage of appliances recycled that were built after the increased 1993 efficiency standard

MEASURE	REPORTED SOURCES AND ASSUMPTIONS	VERIFIED GROSS SOURCES AND ASSUMPTIONS	PRIMARY REASONS FOR DIFFERENCES
			increased as well. Lower demand assumptions used for this cycle than were reported in the 2017 EM&V report are likely driving the higher realization rate.
Freezer	*Reported* energy (kWh) savings align with the gross verified savings values attained from the previous evaluation conducted in 2017 of 1,011 kWh. The demand savings used for planning estimates this cycle are somewhat lower than the 2017 EM&V results.	UMP Chapter 7 and information in program tracking data.	The appliances recycled through the program in 2020 were both built more recently and were younger when they were recycled, compared to those recycled in the 2017 program year. Related to this, the percentage of appliances recycled that were built after the increased 1993 efficiency standard increased as well. Lower demand assumptions used for this cycle than were reported in the 2017 EM&V report are likely driving the higher realization rate.

As described above, the vintage of appliances as well as their actual age are both key inputs to estimating gross impacts for appliance recycling programs and have a considerable impact on the overall per-unit savings estimate. Below we provide a comparison of average vintage of appliances for the past three evaluation cycles. As time passes, the proportion of appliances manufactured after 1993 (when higher appliance standards were put in place) continues to increase. Additionally, the average age of appliances continues to decrease as the market for old and inefficient appliances is depleted. In 2017, the average age of refrigerators and freezers recycled through the program was 19 and 22 years old, respectively. In 2020 and 2021, the average age of refrigerators was 16 years old, and freezers was 18 years old. Both factors are the main drivers of the slight downward trend in overall gross savings for both freezers and refrigerators.

Table 102. Average Appliance Vintage Over Time

MEASURE	REFRIGERATORS	FREEZERS
2020/2021	2005	2003
2017	1998	1995

MEASURE	REFRIGERATORS	FREEZERS
2014	1994	1987

Realization Rates

Table 103 and includes reported and verified demand savings. These were developed by applying a flat 8,760 load shape to the gross verified energy savings. As discussed in the 2017 evaluation, it is likely that the actual load shape for refrigerators and freezers fluctuates slightly, but these differences are negligible when compared to a flat load shape.

Table 104 show the program's reported savings, verified savings, and verified gross savings. Verified gross savings achieved 87% of the program's reported electric savings, due to the verified gross per-unit savings value (927 kWh/year for refrigerators, 885 kWh/year for freezers) being slightly lower than the deemed savings values used for planning (1,068 kWh/year for refrigerators, 1,019 kWh/year for freezers, developed for the 2017 evaluation). As a note, to evaluate the largest sample possible for future planning given program launch delays, the evaluation team included all available data points using the date the appliance was *picked up/recycled*. This means that the values reported here will not exactly match what was reported in Georgia Power's savings report documentation, as those rely on the timing of when the projects are *finalized and invoiced.*

Table 103. 2020 & Q1 2021 Refrigerator Recycling Program Reported Tracking Data & Verified Gross Electric Energy Savings

MEASURE	REPORTED TRACKING DATA ELECTRIC ENERGY SAVINGS (KWH/YR.)	VERIFIED GROSS ELECTRIC ENERGY SAVINGS (KWH/YR.)
Refrigerators	2,477,538	2,145,661
Freezers	342,495	296,874
Total Savings	2,820,032	2,442,536
Total Program Realization Rate [a]		87%

[a] *Realization Rate is defined as verified Gross savings divided by Reported savings.*

Note: Totals may not sum properly due to rounding.

includes reported and verified demand savings. These were developed by applying a flat 8,760 load shape to the gross verified energy savings. As discussed in the 2017 evaluation, it is likely that the actual load shape for refrigerators and freezers fluctuates slightly, but these differences are negligible when compared to a flat load shape.

Table 104 includes reported and verified demand savings. These were developed by applying a flat 8,760 load shape to the gross verified energy savings. As discussed in the 2017 evaluation, it is likely that the actual load shape for refrigerators and freezers fluctuates slightly, but these differences are negligible when compared to a flat load shape.

Table 104. 2020 & Q1 2021 Refrigerator Recycling Program Reported Tracking Data & Verified Gross Peak Demand Reduction

MEASURE	REPORTED TRACKING DATA PEAK DEMAND REDUCTION (KW)	VERIFIED GROSS PEAK DEMAND REDUCTION (KW)
Refrigerators	196	245
Freezers	27	34
Total Savings	223	279
Total Program Realization Rate [a]		125%

[a] Realization Rate is defined as verified Gross savings divided by Reported savings.

Verified Net Savings

The evaluation team again followed Chapter 7 of the UMP for assessing net savings to ensure we applied standard methods. The NTG method in the UMP protocol focuses on assessing freeridership and does not recommend assessing participant spillover for appliance recycling programs.

To assess freeridership, the evaluation team conducted surveys with participants, and asked them a series of questions intended to identify what would have happened to the appliance if the program had not existed. The UMP categorizes all responses into three major scenarios, described below. In absence of the program, the appliance would have been:

- **Kept** by the household
- Discarded by a method that **transfers** it to another customer for continued use
- Discarded by a method leading to it being **destroyed** or permanently removed from service

These three scenarios comprise the freeridership component of the NTG calculation (the proportion of appliances that would have been removed from the grid in the absence of the program). In addition to participants, the evaluation team surveyed nonparticipating customers (as recommended by the UMP) to gather information on customers who recently transferred or discarded an appliance.[70]

Table 105. RRP Survey – Transferred, Destroyed, and Kept Distribution

APPLIANCE TYPE	SCENARIO	COMBINED AND WEIGHTED PROPORTION BY SCENARIO
Refrigerator	Kept	35%
	Transferred	29%
	Destroyed	36%
Freezer	Kept	34%
	Transferred	31%
	Destroyed	35%

Table 106 shows the NTG ratios by measure, and Table 107 provides the program's reported and verified net electric energy savings. Appendix 7A: Algorithms, Assumptions provides comprehensive inputs and calculations for each of these values.

Table 106. 2020 & Q1 2021 Refrigerator Recycling Program Net-to-Gross Ratios by Measure

MEASURE	NTG
Refrigerators	50%
Freezers	48%
Program Average	50%

Table 107. 2020 & Q1 2021 Refrigerator Recycling Program Reported & Verified Net Electric Energy Savings

MEASURE	REPORTED ELECTRIC ENERGY SAVINGS (KWH/YR.)	VERIFIED NET ELECTRIC ENERGY SAVINGS (KWH/YR.)	REPORTED PEAK DEMAND REDUCTION (KW/YR.)	VERIFIED NET PEAK DEMAND REDUCTION (KW/YR.)
Refrigerators	2,145,661	1,064,594	196	245
Freezers	296,874	142,992	27	34
Total Savings	2,442,536	1,207,587	223	279

[70] As a sensitivity analysis, we analyzed how these theoretical behaviors of participants differed between those who indicated they had been on a waitlist before participating in the program, against those who indicated they had not. We found that the waitlist had a positive impact on program NTG values, as participants who had been required to wait were more likely to indicate that they would have kept their appliance in the absence of the program, resulting in higher NTG values. The results from this analysis can be found under NTG Sensitivity Analysis in Appendix 7A: Algorithms, Assumptions, and Additional Background

Table 108 highlights the yearly differences in the program freeridership and NTG values of the RRP program. The relatively higher percentage of participants who indicated that they would have been likely to dispose of their appliance in absence of the program contributed to the lower NTG values found in this year's evaluation. It should be noted that in previous cycles, net-to-gross results included nonparticipant spillover (not shown here) which considerably increased overall net savings. This is no longer claimed in the current cycle, which has the biggest overall impact on net savings comparatively.

Table 108. Refrigerator Recycling NTG Benchmarks

YEAR	PERCENTAGE LIKELY TO HAVE DISPOSED IN ABSENCE OF PROGRAM		NTG	
	REFRIGERATOR	FREEZER	REFRIGERATOR	FREEZER
2020/2021	65%	66%	50%	48%
2017	51%	48%	65%	57%
2014	62%	67%	56%	57%

Process Evaluation

Participant Feedback

The evaluation team surveyed 216 customers who participated in the program: 117 of which recycled refrigerators, 82 who recycled freezers, and 17 who recycled one of each.[71] The survey was administered as a mixed-mode survey (phone and online). Responses were analyzed by participant type (refrigerator or freezer), but no statistically significant differences were found in the responses of these two groups. Therefore, all responses are representative of the survey population. The following sections describe the results related to source of awareness, reasons for participation, satisfaction with the program, and program impacts on customers.

Table 109. Participant Survey Sample Distribution

MEASURES RECYCLED	SAMPLE	
	REFRIGERATOR	FREEZER
One refrigerator	114	-
Two refrigerators	3	-
One freezer	-	81
Two freezers	-	1

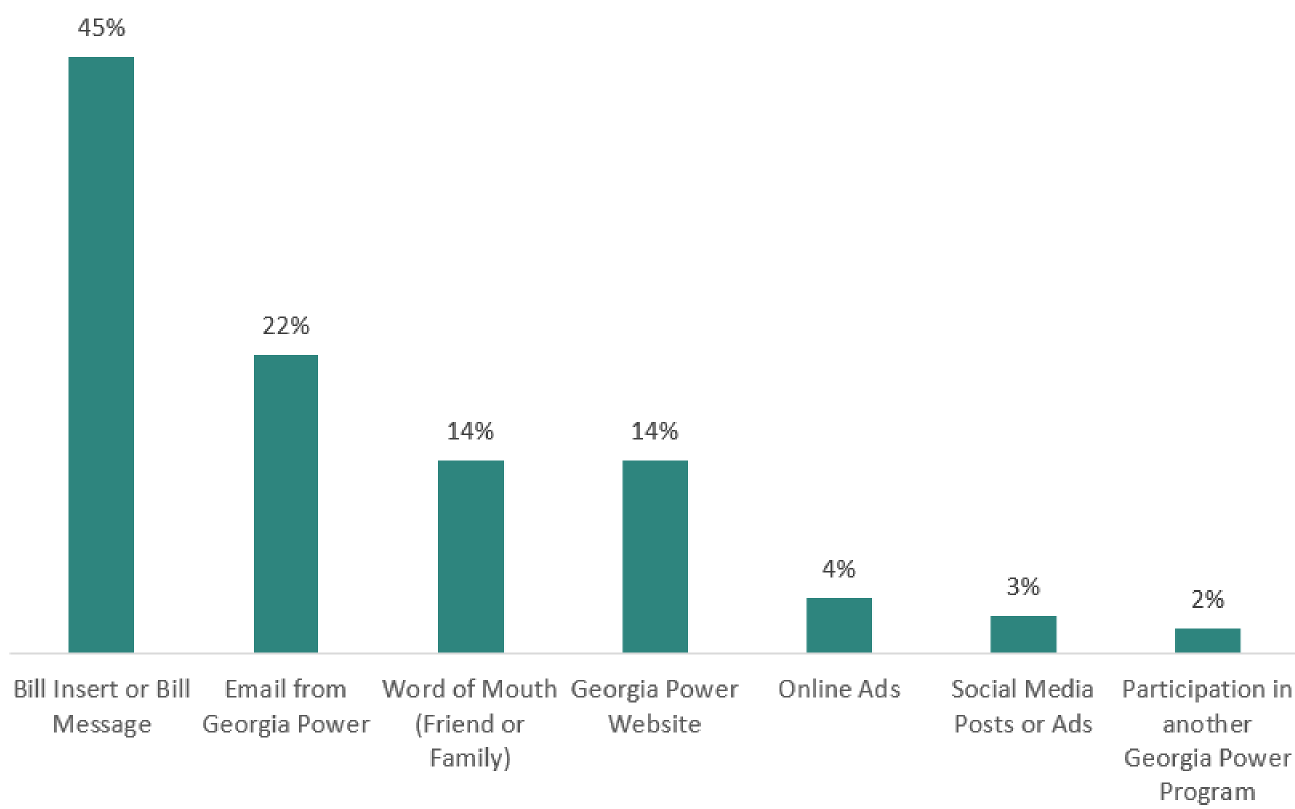
[71] Participants who recycled one of each appliance type were placed in the "freezer" sample group, and asked questions primarily focused on the disposal of their freezer.

MEASURES RECYCLED	SAMPLE	
	REFRIGERATOR	FREEZER
One refrigerator and one freezer	-	17
Total Sample	117	99

Program Awareness

Bill inserts and bill messages are the primary drivers of program awareness (45%, Figure 95). Emails from Georgia Power were the second most cited source of awareness (22%), while word of mouth and the Georgia Power website each accounted for 14% of program awareness. Throughout the COVID 19 pandemic, Georgia Power indicated that they had limited social and digital media in the market advertising programs. As such, other mediums like online advertisements, social media posts, and advertisements of participation through another Georgia Power program each accounted for less than 5% of program awareness. The general population survey identified similarly low levels of engagement with social media posts or ads.

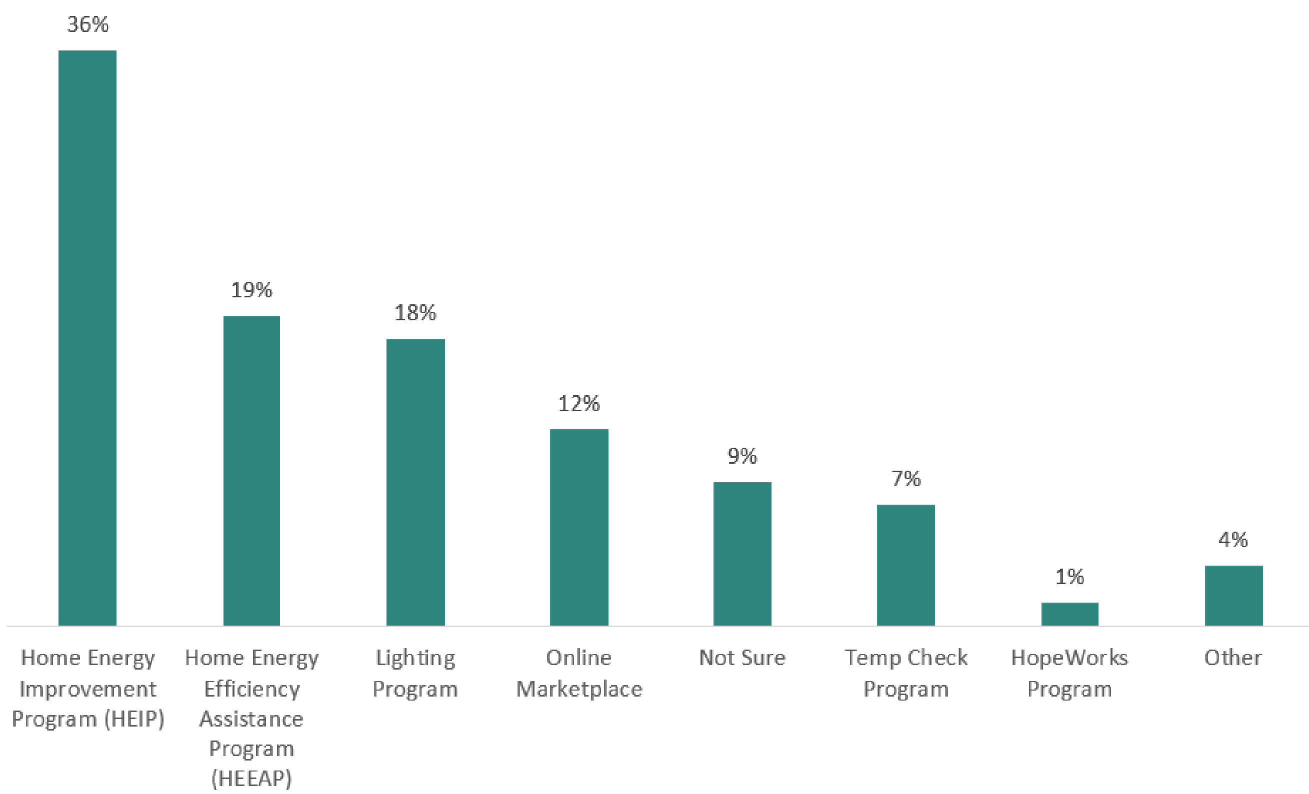
Figure 95. Sources of Program Awareness



Source: Participant Survey. E1. How did you learn about Georgia Power's Refrigerator Recycling Program? Allowed for multiple responses.

Most respondents (64%) indicated they were aware of another Georgia Power energy efficiency program aside from the Refrigerator Recycling program. Among those who indicated awareness of another program (n=136), the Home Energy Improvement Program (HEIP) was the most cited (36%, Figure 96), followed by the Home Energy Efficiency Assistance Program (HEEAP, 19%), the Lighting Program (18%), and the Online Marketplace (12%).[72] Just 9% of respondents indicated they were aware Georgia Power offered other programs but were unable to provide any information concerning the structure of the offerings of those programs. “Other” responses include customers who referenced specific measures (air conditioners, windows, etc.) but were unable to provide any further details.

Figure 96. Awareness of Other Georgia Power Programs



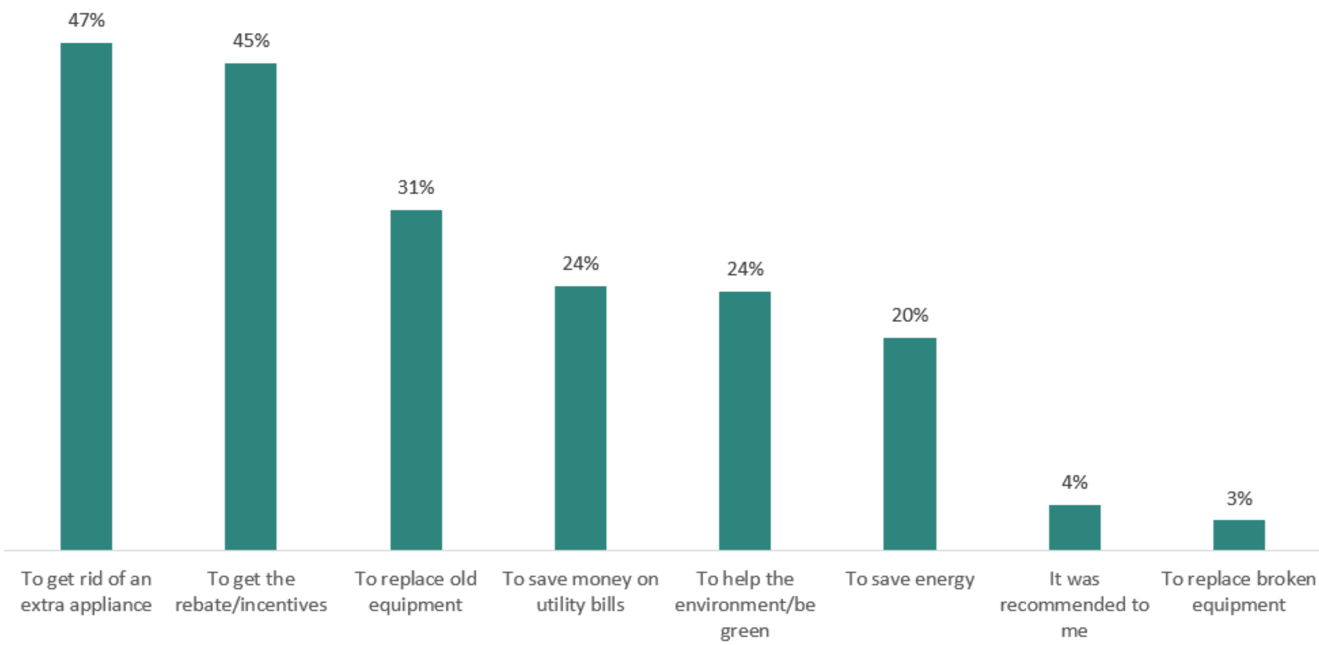
Source: Participant Survey. E3. What energy efficiency programs are you aware of? Allowed for multiple responses.

[72] The HEEAP Program is a brand-new offering to Georgia power in 2020. As such, this number includes respondents who cited awareness in “the low-income program”, as many survey respondents were better able to describe the general nature of the program, rather than the specific name. It is possible they are also confusing this offering with other low-income services offered by Georgia Power.

Participation Drivers

The desire to remove an extra appliance (47%, Figure 97) along with a desire to obtain the incentive (45%) were the primary motivations for customers who participated in the Refrigerator Recycling program. Conservation based motivations such as helping the environment and being green (24%), saving money on utility bills (24%), and saving energy (20%) substantially influenced program participation. Roughly one-third of respondents indicated they had participated to replace either old (31%) or broken (3%) equipment, indicating that for most participants the program is successful in completely removing an appliance from the grid.

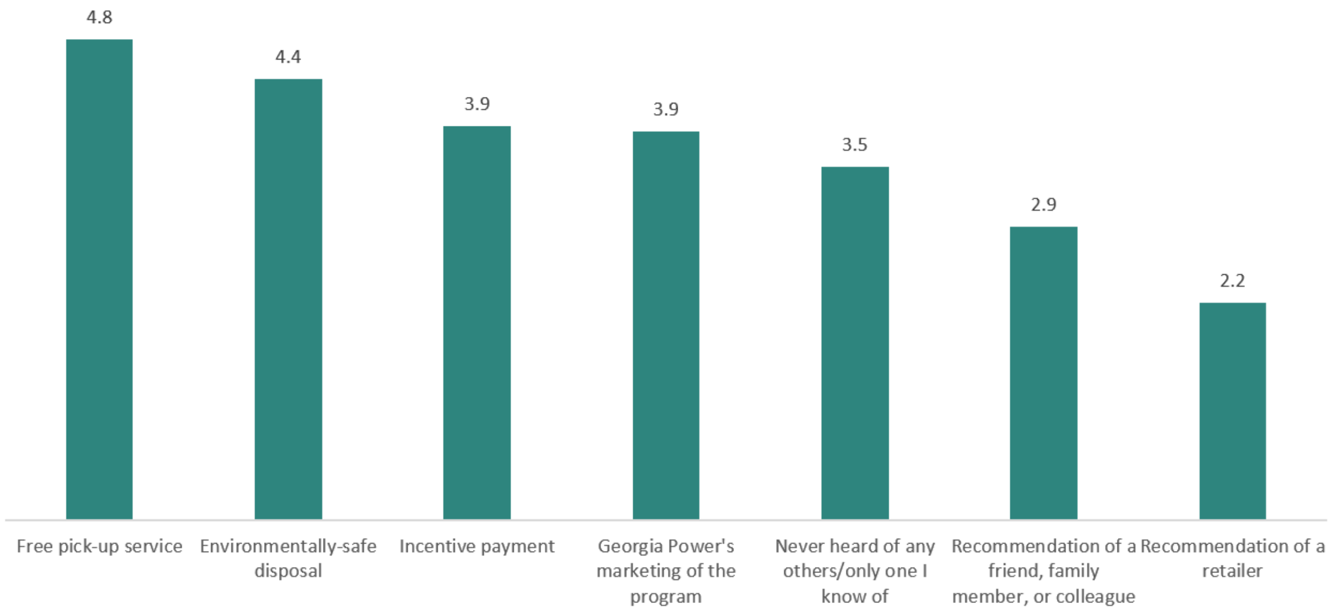
Figure 97. Participation Motivation



Source: Participant Survey. G1. Why did you decide to participate in Georgia Power's Refrigerator Recycling Program?

The specific aspects of the Refrigerator Recycling program that influenced participant behavior largely aligned with participants' primary motivations to participate in the program – that is the free pickup service (4.8 out of 5), the environmentally safe disposal (4.4 out of 5), and the incentive payment (3.9 out of 5) (Figure 98). Additionally, respondents noted that Georgia Power's marketing of the program (3.9 out of 5) was as important as the incentive itself. This alignment between participants' motivations (such as a desire to get rid of an extra appliance), and specific program aspects (such as free pickup service) is a strong indicator that the Refrigerator Recycling program is successfully meeting the needs of Georgia Power customers.

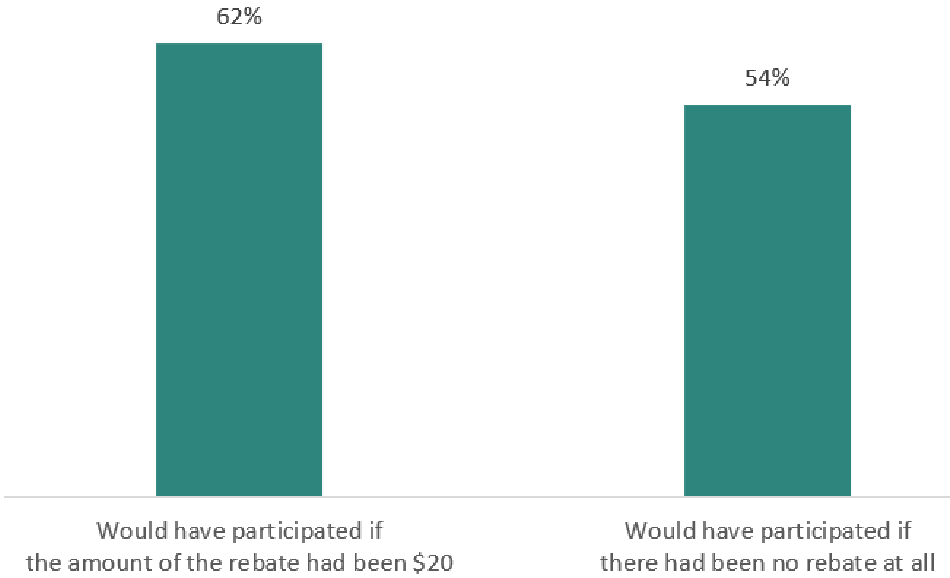
Figure 98. Participation Influences



Source: Participant Survey. H15. Rate how important each one was to your decision to recycle your appliance through Georgia Power's program. Rate each statement any number from 1 to 5, with 1 meaning "not at all important" and 5 meaning "very important".

Survey respondents were somewhat split in the value that they place on the program incentive: most respondents (62%) indicated they would have participated if the rebate had only been $20, and 54% indicated they would have participated if there had been no rebate at all. Conversely, recall that 45% of respondents indicated that the incentive was a primary motivation of their participation (Figure 99). This dichotomy emphasizes the value of the incentive for certain customers, while it also highlights that for many customers, the free pickup and disposal of the appliance is most important.

Figure 99. Incentive Levels



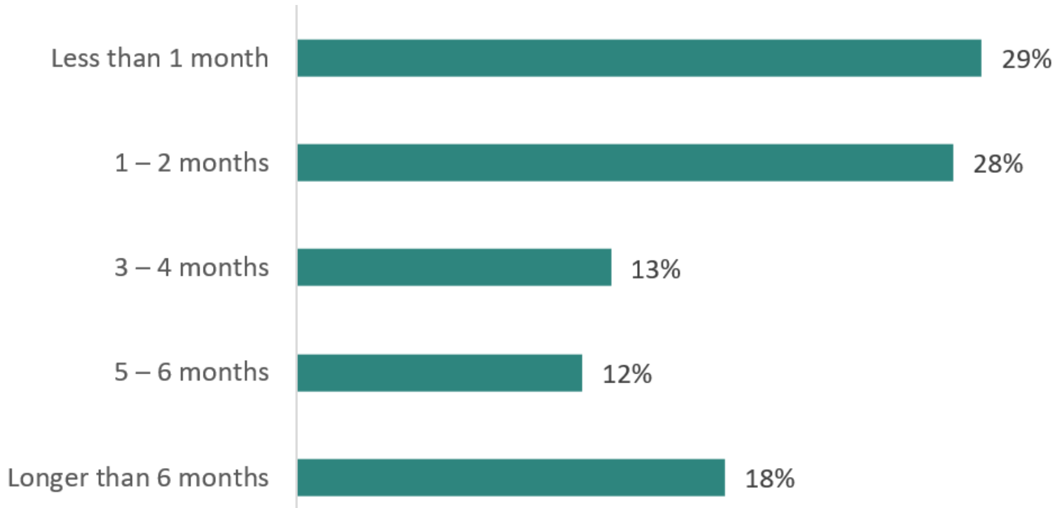
Source: Participant Survey. H17. Would you have participated in the program if the amount of the rebate had been $20? Source: Participant Survey. H18. Would you have participated in the program with no rebate at all?

As described in Appendix 7. – Residential Refrigerator Recycling Program, the evaluation team did conduct additional analysis on the net-to-gross results to determine if any groups may be more likely to keep their appliance in the absence of the program. One group who said they were more likely to keep their appliance were those who said they would not have participated without the current $35 incentive. While the free pickup is important to all customers, this indicates that the rebate is an important component in mitigating freeridership as it is working to encourage customers to recycle appliances who would otherwise have kept it on the grid.

Participant Experience

The program was paused from mid-March 2020 through early November 2020, and participants who applied during this period were placed on a waitlist and contacted once program operations resumed. Forty-two percent of survey respondents indicated they had been placed on a waitlist prior to their appliance being recycled. Of those who indicated they had been placed on a waitlist (n=89), the majority (57%) indicated that the wait was less than three months, while 18% indicated they were required to wait longer than six months. We explore further implications of the waitlist on participant behavior in the NTG Sensitivity Analysis section of Appendix 7A: Algorithms, Assumptions, and Additional Background

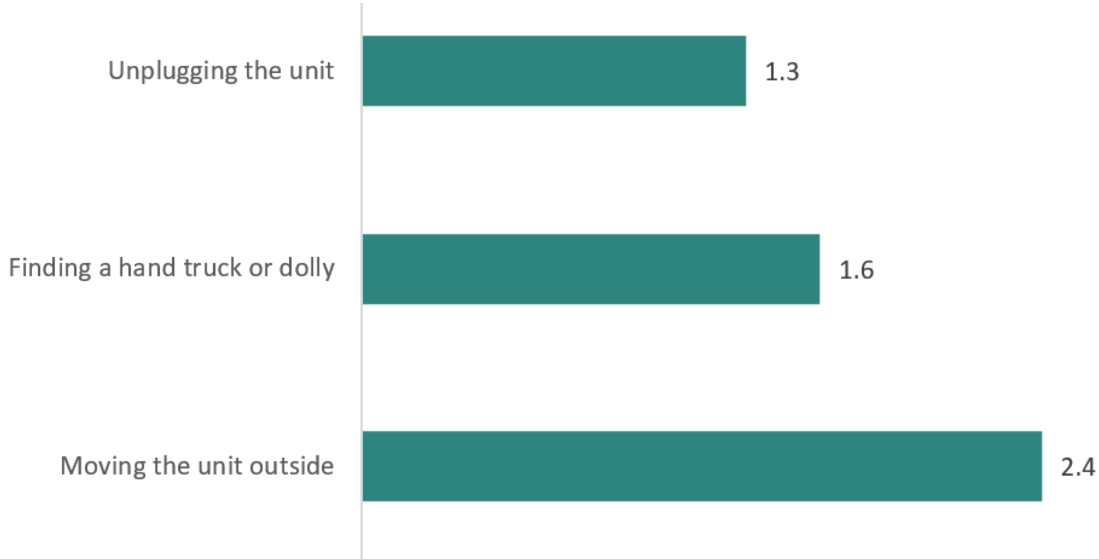
Figure 100. Amount of Time Spent on Waitlist



Source: Participant Survey. H6. Roughly how long were you on the waitlist before you were able to participate?

An additional response to the COVID-19 pandemic was a requirement that appliances needed to be in the garage with a clear path to the unit, or in the driveway, prior to the appliance being picked up. This represented a notable change in the amount of work required from participants in the program, as 60% of all survey respondents indicated that their appliance had to be moved before it was picked up. The majority of those who moved their appliance prior to pick up cited little difficulty with the process though, as only "moving the unit outside" was rated above a 2 in terms of difficulty, on a scale from 1 to 5. While participants on average indicated little difficulty moving their appliance outside, roughly one-quarter (27%) of those who had to move their appliance rated their difficulty with that process as a 4 or a 5.

Figure 101. Participant Difficulty with Moving the Appliance

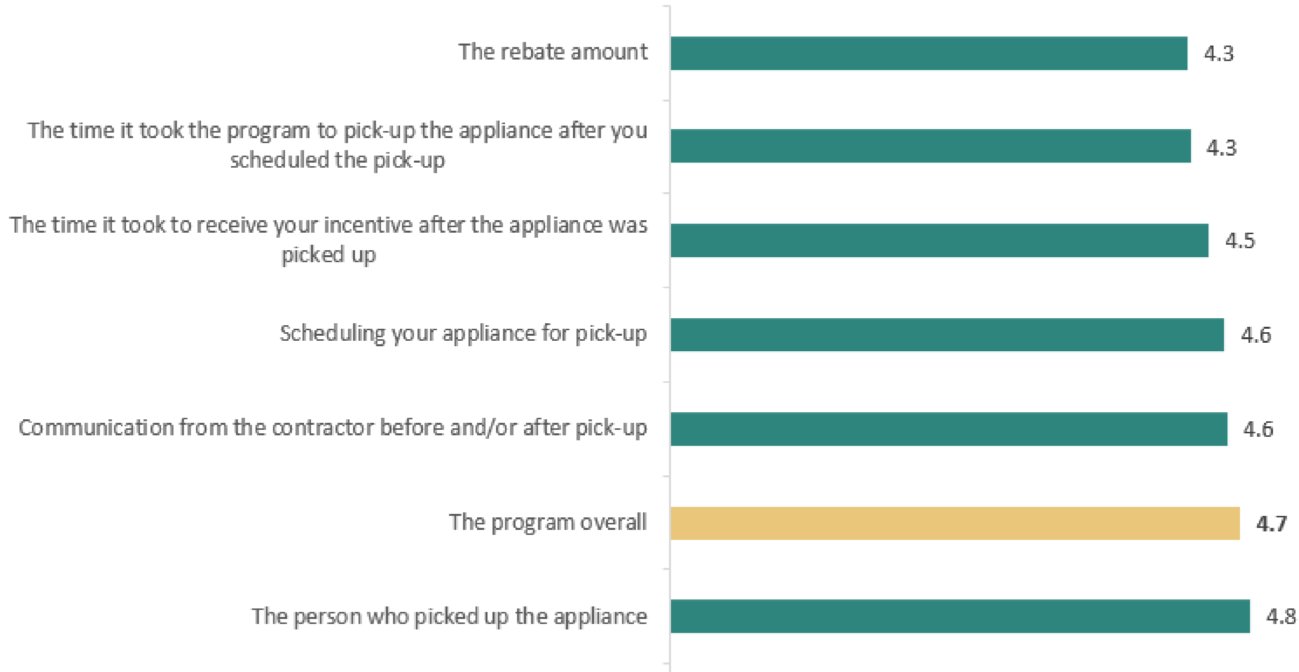


Source: Participant Survey. H4. H4. How difficult was it to complete the following actions? Please rate each of the following on a 1 to 5 scale, with 1 being very easy and 5 being very difficult.

Satisfaction with the Program

Survey respondents reported high levels of satisfaction with the program overall and with the program's various components (Figure 102) with all aspects achieving a minimum of a 4.3 (using a scale from 1 to 5 where one meant not at all satisfied, and 5 meant very satisfied). Program participa nts rated their satisfaction with the program overall a 4.7 and expressed they were most satisfied with the person who picked up their appliance (4.8), and comparatively the least satisfied with the rebate amount (4.3).

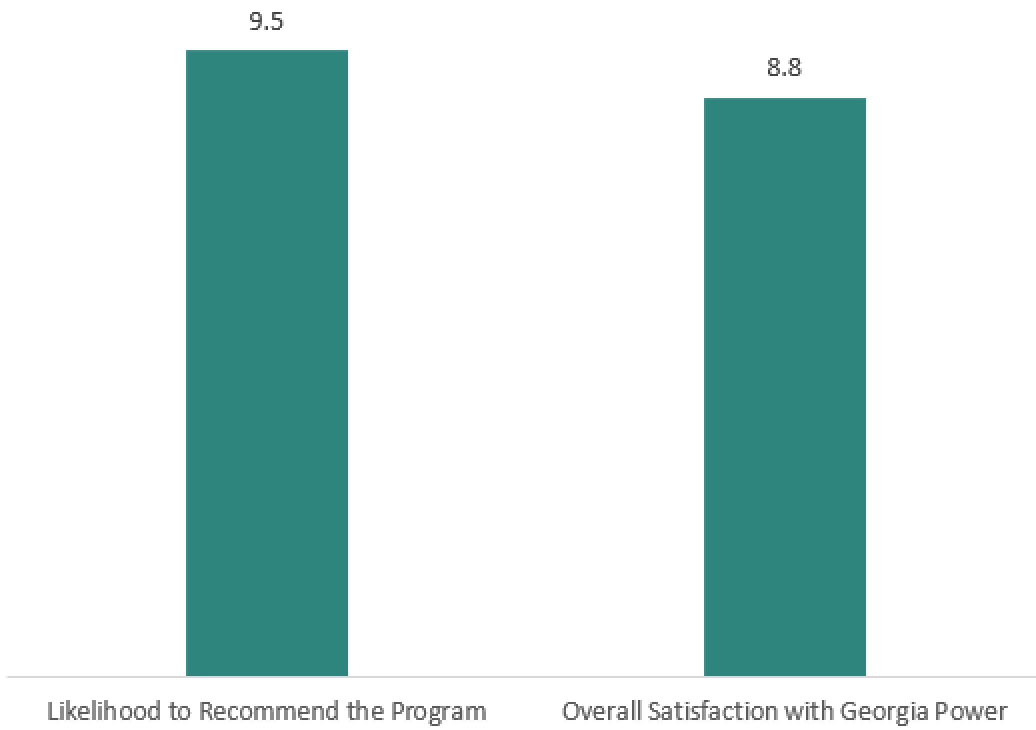
Figure 102. Program Satisfaction



Source: Participant Survey. I1. How satisfied are you with the following components of Georgia Power's Refrigerator Recycling Program?

Coinciding with the overall high levels of program satisfaction, respondents similarly indicated they were highly likely to recommend the program to a friend or colleague, providing an average score of 9.5 (on a scale of one to ten with one being not at all likely and 10 being extremely likely) (Figure 103). Respondents also indicated high levels of satisfaction with Georgia Power as their utility provider overall, providing an overall score of 8.8 (on a scale of one to ten with one being not at all satisfied, and 10 being extremely satisfied).

Figure 103. Likelihood to Recommend and Satisfaction with Georgia Power



Source: Participant Survey. I5. How likely is it that you would recommend the Refrigerator Recycling Program to a friend or colleague? Please select the rating scale point that best describes how you feel on a 1 to 10 scale with 1 being not at all likely and 10 being extremely likely. I6. Taking into consideration all aspects of your utility service experience, please rate your current satisfaction with Georgia Power overall on a 1 to 10 scale with 1 being not at all satisfied and 10 being extremely satisfied?

Among those who expressed low satisfaction with the program overall (providing a rating of less than four out of 10, n=11), seven respondents provided reasoning for their relatively low satisfaction. Drivers of dissatisfaction included:

- Had to pay movers to take appliance outside because of COVID-19 restriction (n=2)
- Issues with the appliance pickup (n=2)
- The website was poorly designed (n=1)
- Pickup person was not friendly (n=1)
- Never received rebate (n=1)

Respondents were asked to consider what, if anything, the person picking up the appliance could have done to improve their experience. Responses included:

- Picked up the appliance from inside (n=9)
- Communicated a specific pickup time (n=5)

- Provided more information (n=1)
- Improved the scheduling process (n=1)
- Picked up appliance at a different time (n=1)
- Provided a receipt (n=1)
- Provided the incentive at the time of pickup (n=1)
- Picked up appliance faster (shorter waitlist) (n=1)

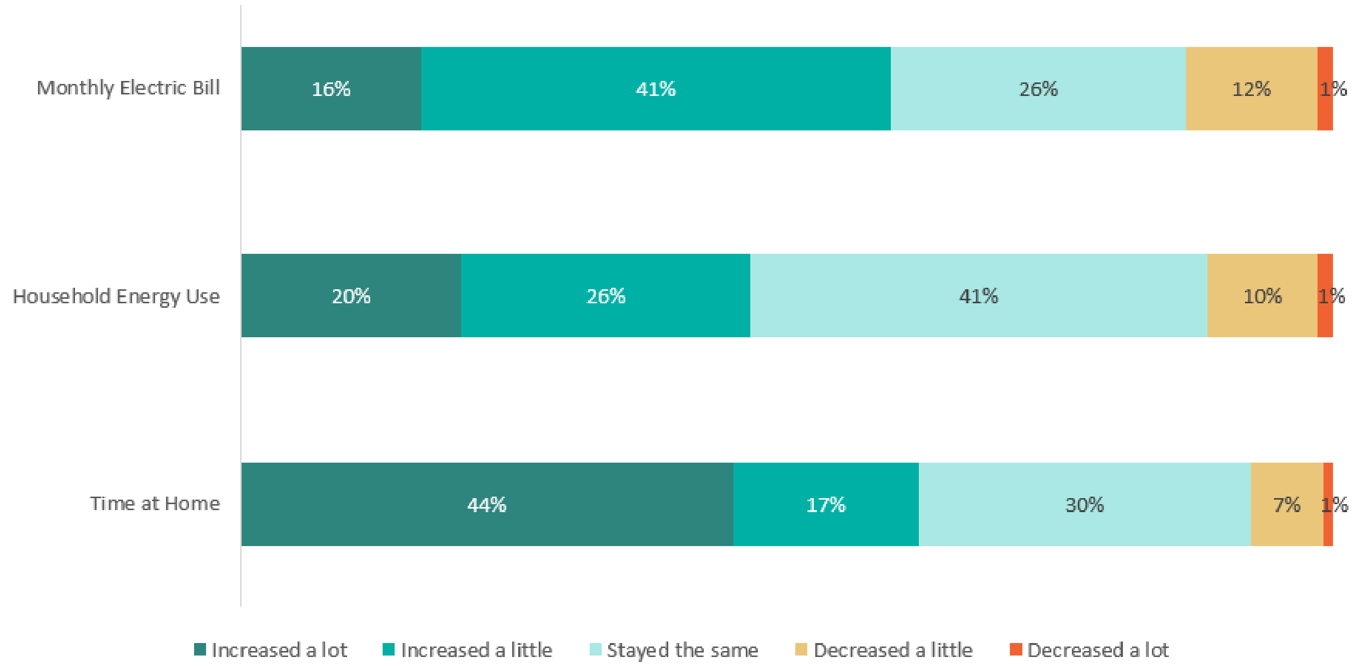
Respondents were asked to consider what, if anything, Georgia Power could have done to improve their experience. Sixty respondents provided suggestions, including:

- Increase the incentive (n=24)
- Reduce the waitlist time (n=9)
- Provide better marketing/program information (n=8)
- Offer pickup of more appliances and/or non-functioning units (n=7)
- Improve the scheduling process (n=3)
- Improve customer service/communication (n=3)
- Remove the requirement for the unit be plugged in if it is outside (n=2)
- Provide the incentives faster (n=2)
- Subcontract to a local company (n=1)
- Provide referral incentives (n=1)

COVID-19 Related Questions

Participant behaviors and their associated energy consumption changed dramatically since the onset of the COVID-19 pandemic. Compared to the same time in 2019, 61% of respondents indicated that their time at home had increased (Figure 104), while 46% of respondents indicated experiencing higher household energy use, and 57% reporting higher monthly electric bills. Roughly one-third of respondents indicated little change in their behavior, with 30% indicating their time at home stayed the same, 41% indicating their household energy use stayed the same, and 26% indicating their monthly electric bill stayed the same.

Figure 104. Behavior Changes Due to COVID-19



Source: Participant Survey. J1 – J3. J1. Please think about 1) the amount of time you spend at your home in a typical week; 2) the amount of energy your household uses in a typical week; 3) your monthly electric bill. Compared to this time in 2019, would you say that has.

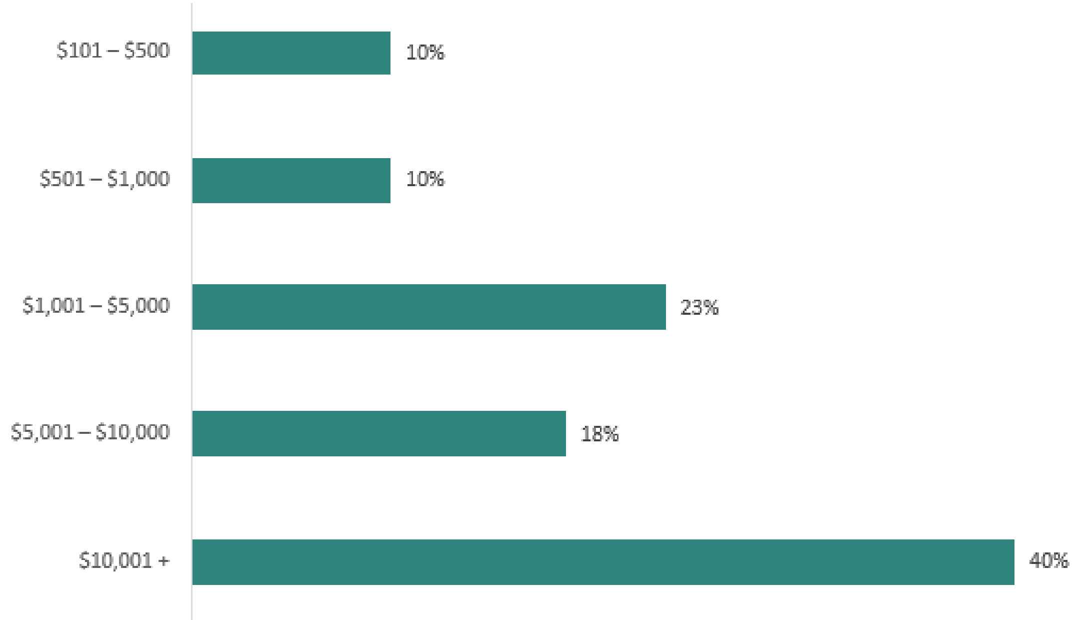
Overall, 42% of all respondents indicated they had made some type of home improvement since the beginning of 2020. However, while most survey respondents indicated they were spending more time at home since the onset of the COVID-19 pandemic, we did not observe any correlation between this behavior change and a respondent's likelihood to have made some type of home improvement since the beginning of 2020. This was corroborated by the fact that more than half (57%) of respondents (n=89) indicated they conducted the home improvement when they did simply because "it was the right time" or "it needed to be done;" only three respondents indicated that the timing of their improvement had anything to do with COVID-19. Without a clear baseline of the percentage of households that conduct home improvements in a typical year, we are unable to attribute any number of the home improvements made to the COVID-19 pandemic.

Figure 105. Home Improvement Status by Relative Time Spent at Home

Source: Participant Survey. J4. Have you made any improvements to your home since the beginning of 2020?

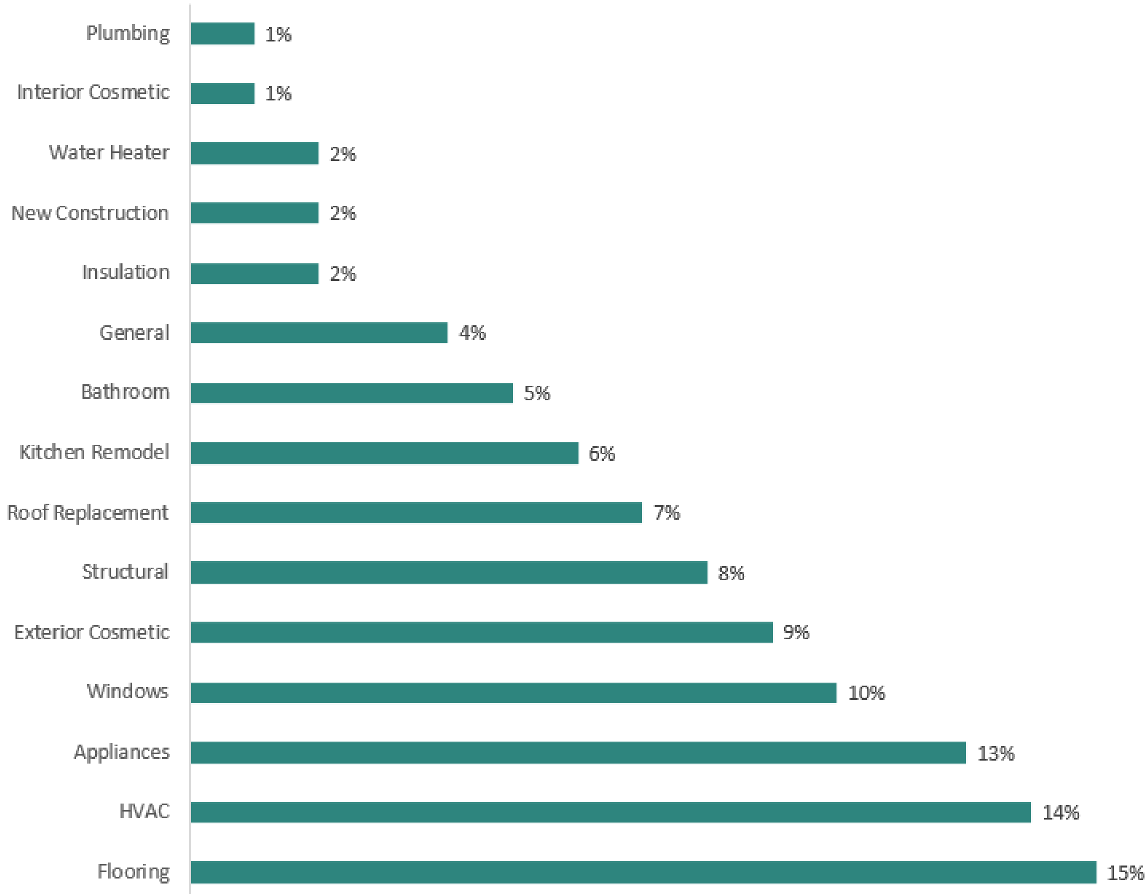
Many of the respondents who reported making a home improvement since the beginning of 2020 (n=89) also indicated the improvements were expensive (Figure 106), with 40% of respondents having spent more than $10,000 on their home improvements. Another 18% of respondents spent between $5,001 and $10,000, while 23% spent between $1,001 and $5,000. The most common home improvements completed were new flooring (15%), HVAC system replacements (14%), and new appliances (13%) (Figure 107).

Figure 106. Amount Spent on Home Improvement*



Source: Participant Survey. J5. What was the cost of the improvement(s)?
** Does not sum to 100% due to rounding.*

Figure 107. Type of Home Improvements Conducted*



Source: Participant Survey. J6. Can you describe the improvements?
**Does not sum to 100% due to rounding.*

Conclusions and Recommendations

Conclusion 1: The Refrigerator Recycling program achieved an 87% realization rate for energy savings. This is largely driven by the age and vintage of appliances recycled through the program trending younger.

The per-unit energy savings applied in the reported gross savings calculation were taken from the previous evaluation in 2017. Appliances recycled during that evaluation period were older than the appliances recycled in this evaluation, both in absolute and relative terms. The age of the appliance recycled is a substantial contributor to the per-unit energy savings calculation, and newer (younger) appliances result in lower program savings. This is not unique to Georgia Power, as customers nationally trend toward owning fewer old and inefficient appliances.

Recommendations:

- Consider additional ways to message to participants with older and less efficient appliances to encourage them to participate in the program. One idea, used by other utilities, is to offer an “oldest refrigerator” contest with a prize for whoever recycles the oldest refrigerator (or freezer).
- Consider reviewing program metrics over time, to determine if there are areas or demographics of customers the program has not saturated. Program participants tended to be older (51% over 60), which is common for appliance recycling programs. However, it is possible there are other pockets of customers, such as younger new homeowners, who also have secondary appliances they no longer want and may be good candidates for targeted marketing. Only 8% of surveyed program participants were under 40 years of age. Additionally, while not explored by this evaluation, it may be useful to work with the program implementer to assess whether there are any geographic pockets of the state with lower participation levels historically, such as more rural areas that may be more difficult to reach.

Conclusion 2: Participants were highly satisfied with the program overall and with all program elements, indicating that the program design change to outside pickup has not negatively impacted customer experience.

Program participants rated their satisfaction with the program overall a 4.7 out of 5 and expressed that they were most satisfied with the person who picked up their appliance (4.8), and comparatively the least satisfied with the rebate amount (4.3). Coinciding with the overall high levels of program satisfaction, respondents similarly indicated they were highly likely to recommend the program to a friend or colleague, providing an average score of 9.5 (on a scale of 1 to 10 with one being not at all likely and 10 being extremely likely).

Recommendations:

- As needed, continue to offer outside pickup, as it does not appear to negatively affect program satisfaction.

Conclusion 3: Refrigerator Recycling participants were more satisfied with Georgia Power as a utility service provider than nonparticipants, indicating that participation in Georgia Power's energy efficiency programs can contribute to higher overall levels of customer satisfaction.

Respondents also indicated high levels of satisfaction with Georgia Power as their utility provider overall, providing an overall score of 8.8 (on a scale of 1 to 10 with one being not at all satisfied and 10 being extremely satisfied). Nonparticipants indicated comparatively lower levels of satisfaction with Georgia Power as a utility provider, with an overall satisfaction score of 8.0, although this is still relatively high.

Conclusion 4: For many customers, the free pickup and disposal of the appliance drove their decision to participate.

Customers noted that the most important driver of program participation was "to get rid of an extra appliance" (47%), while the most influential aspect of the program was the free pickup service (4.8 out of 5). Additionally, respondents rated the environmentally friendly disposal of the appliance as influential as well (4.4 out of 5).

Recommendations:

- Continue to ensure the free pickup aspect of the program is highlighted in all marketing efforts, as well as the fact that the appliances are disposed of in an environmentally friendly manner, as customers value this service as much as the incentive itself. At the time of this report, the Georgia Power program website does highlight the free appliance removal.

Conclusion 5: Net-to-gross results were 50% for refrigerators and 48% for freezers.

Freeridership remained relatively consistent over the past three cycles, although it is slightly lower this cycle compared to previous cycles. The primary driver of lower net savings is that Georgia Power no longer claims nonparticipant spillover, which considerably increased net savings in past cycles. Consistent with past cycles, most respondents said they would have either transferred their appliance to another person or disposed of it if the program had not existed. About one-third of respondents said they would have kept it in the absence of the program. Participants over 70 (n=35) were the most likely to indicate they would have kept their appliance in the absence of the program (51%), compared to any other age group.

Recommendations:

- To maximize net savings, consider ways to target customers who would be most likely to keep their appliance in the absence of the program. Older customers (70+) tended to be more likely to indicate they would have kept the appliance in the absence of the program, compared to customers between the ages of 50 and 69. As noted above, the sample size of younger customers (under 40) was very small, so the team was unable to assess freeridership indicators for this group alone.

- Maintain incentives at current levels and explore whether it is cost-effective to increase them. While customers indicated the free pickup was very important in their decision to participate overall, the incentive appeared to be more important for those customers who said they would have kept their appliance in the absence of the program (i.e., low freeriders). This group was much less likely to say they still would have participated in the program if there was no incentive or a lower incentive. If the program can increase incentives while maintaining cost-effectiveness, this could help reduce freeridership by encouraging more customers to participate who otherwise would have kept their appliance.

APPENDIX 1. – RESIDENTIAL BEHAVIORAL PROGRAM

Appendix 1A: Algorithms and Assumptions

Data Cleaning

We cleaned the raw billing data by removing duplicate reads, negative reads, reads in the top 1% of energy usage, and reads after move-out/inactive date. The following table shows the attrition by wave for treatment and control records and accounts at each cleaning step.

Table 110. Data Cleaning Steps and Rates of Attrition

STEP	WAVE	CONT RECS	TREAT RECS	CONT ACCTS	TREAT ACCTS	CONT PCT RECS REMOVED	TREAT PCT RECS REMOVED	CONT PCT ACCTS REMOVED	TREAT PCT ACCTS REMOVED
Remove data outside of pre and post periods	2014 Legacy Wave	111,506	140,265	5,006	6,290				
	2016 Legacy Income-qualified Wave	102,850	375,137	4,504	16,382				
	2018 Legacy Wave	284,253	1,420,701	12,632	63,190				
	2020 Standard Wave	580,025	1,217,912	25,000	52,578				
	2020 Digital Transformation Wave	570,374	1,712,501	25,000	75,000				
	2020 Digital Only Wave	570,248	571,014	25,000	25,000				
Remove duplicate reads	2014 Legacy Wave	108,904	137,419	5,006	6,290	2.33%	2.03%	0.00%	0.00%
	2016 Legacy Income-qualified Wave	97,331	354,878	4,504	16,382	5.37%	5.40%	0.00%	0.00%
	2018 Legacy Wave	268,718	1,342,769	12,632	63,190	5.47%	5.49%	0.00%	0.00%
	2020 Standard Wave	546,374	1,148,407	25,000	52,578	5.80%	5.71%	0.00%	0.00%
	2020 Digital Transformation Wave	540,786	1,622,430	25,000	75,000	5.19%	5.26%	0.00%	0.00%
	2020 Digital Only Wave	540,228	541,220	25,000	25,000	5.26%	5.22%	0.00%	0.00%
Removing negative reads	2014 Legacy Wave	108,904	137,418	5,006	6,290	0.00%	0.00%	0.00%	0.00%
	2016 Legacy Income-qualified Wave	97,329	354,876	4,504	16,382	0.00%	0.00%	0.00%	0.00%
	2018 Legacy Wave	268,711	1,342,752	12,632	63,190	0.00%	0.00%	0.00%	0.00%
	2020 Standard Wave	546,369	1,148,396	25,000	52,578	0.00%	0.00%	0.00%	0.00%
	2020 Digital Transformation Wave	540,785	1,622,419	25,000	75,000	0.00%	0.00%	0.00%	0.00%
	2020 Digital Only Wave	540,222	541,214	25,000	25,000	0.00%	0.00%	0.00%	0.00%
Removing reads in the top 1% of energy usage	2014 Legacy Wave	108,284	136,635	5,006	6,290	0.56%	0.56%	0.00%	0.00%
	2016 Legacy Income-qualified Wave	97,010	353,886	4,504	16,382	0.31%	0.26%	0.00%	0.00%
	2018 Legacy Wave	263,332	1,315,624	12,630	63,176	1.89%	1.91%	0.02%	0.02%

STEP	WAVE	CONT RECS	TREAT RECS	CONT ACCTS	TREAT ACCTS	CONT PCT RECS REMOVED	TREAT PCT RECS REMOVED	CONT PCT ACCTS REMOVED	TREAT PCT ACCTS REMOVED
	2020 Standard Wave	542,553	1,140,369	24,976	52,544	0.66%	0.66%	0.10%	0.06%
	2020 Digital Transformation Wave	536,426	1,609,629	24,983	74,938	0.76%	0.75%	0.07%	0.08%
	2020 Digital Only Wave	536,134	536,973	24,984	24,983	0.72%	0.74%	0.06%	0.07%
Removing reads after moveout/inactive date	2014 Legacy Wave	108,062	136,213	5,006	6,290	0.20%	0.30%	0.00%	0.00%
	2016 Legacy Income-qualified Wave	96,741	352,798	4,504	16,382	0.26%	0.29%	0.00%	0.00%
	2018 Legacy Wave	262,570	1,309,946	12,630	63,176	0.27%	0.40%	0.00%	0.00%
	2020 Standard Wave	540,100	1,134,214	24,976	52,542	0.42%	0.51%	0.00%	0.00%
	2020 Digital Transformation Wave	533,487	1,598,632	24,983	74,938	0.52%	0.64%	0.00%	0.00%
	2020 Digital Only Wave	533,150	533,478	24,984	24,981	0.52%	0.61%	0.00%	0.01%

Regression Analysis

The evaluation team conducted a regression analysis to determine energy savings for treatment and control respondents using two models: PPR and LFER. Both approaches produced unbiased estimates of program savings. The evaluation team reported the PPR results and used the LFER results as a robustness check. Although structurally different, assuming the RCT is well-balanced with respect to the drivers of energy use, the two models should produce similar program savings estimates. Based on our experience analyzing the impacts of similar programs, the savings estimates produced by the PPR approach tend to be more precisely estimated (smaller standard errors) than those produced from the LFER model. This increase in precision occurs because the PPR accounts for groupwide pre-post consumption differences with a continuous term (ADClag) instead of a categorical term (post). Detailed descriptions of both model types are provided below.

Post-Period Regression

The PPR model controls for anomalous differences in energy usage between treatment and control group respondents by using lagged energy use as an explanatory variable. In other words, the model frames energy use in each calendar month of the post-program period as a function of both the treatment variable and energy use in the same calendar month of the pre-program year. The underlying logic is that any small systematic differences between the control and treatment respondents that remain, despite the randomization, will be reflected in differences in their past energy use, which is highly correlated with their current energy use. Including lagged energy use in the model serves to control for these differences more precisely. The version the evaluation team estimated includes monthly fixed effects interacted with the pre-program energy use variable. These interaction terms allow pre-program usage to have a different effect on post-program usage in each calendar month.

$$\mathrm{ADC_{kt}} = \beta_0 + \beta_1 \mathrm{ADClag_{kt}} + \beta_2 \mathrm{Treatment_k} + \sum_j \beta_{3j} \mathrm{Month_{jt}} + \sum_j \beta_{4j} \mathrm{Month_{jt}} * \mathrm{ADClag_{kt}} + \varepsilon_{kt}$$

Where:

$\mathrm{ADC_{kt}}$ = The average daily usage in kilowatt-hours or therms for respondent *k* during billing cycle *t*. This is the dependent variable in the model.

$\mathrm{ADClag_{kt}}$ = Respondent *k*'s energy use in the same calendar month of the pre-treatment year as calendar month *t.*

$\mathrm{Treatment_k}$ = A binary variable indicating whether respondent *k* is in the participant group (taking a value of 1) or the control group (taking a value of 0).

$\mathrm{Month_{jt}}$ = A binary variable taking a value of 1 when $j = t$ and 0 otherwise.[73]

$\varepsilon_{\mathrm{kt}}$ = The cluster-robust error term for respondent k during billing cycle t that accounts for heteroscedasticity and autocorrelation at the respondent level.

In this model, β_2 is the estimate of average daily energy savings due to the program. Program savings are the product of the average daily savings estimate and the total number of participant-days in the analysis.

Linear Fixed Effects Regression

As with the PPR model, the LFER model combines cross-sectional and time series data. Unlike the PPR model, however, the LFER models the full set of pre- and post-program usage data. The regression essentially compares the pre- and post-program energy usage of participants to those in the control group to identify the effect of the program. The purpose of the respondent-specific fixed effect is to capture all systematic cross-respondent variation in electric energy usage that the model does not capture. Like the lagged usage variable in the PPR model, the fixed effect represents an attempt to control for any small systematic differences between the treatment and control respondents that might occur in the data despite the randomization.

$$\mathrm{ADC_{kt}} = \beta_{0\mathrm{kt}} + \beta_1 \mathrm{Post_t} + \beta_2 \mathrm{Treatment_k Post_t} + \varepsilon_{\mathrm{kt}}$$

Where:

$\mathrm{ADC_{kt}}$ = The average daily usage in kilowatt-hours or therms for respondent k during billing cycle t. This is the dependent variable in the model.

β_{0kt} = The respondent-specific fixed effect at month-year t.

β_1 = The effect of being in the post-period on energy use to account for non-program effects that impact both the treatment and control groups.

$\mathrm{Post_t}$ = A binary variable indicating whether bill cycle t is in the post-program period (taking a value of 1) or in the pre-program period (taking a value of 0).

[73] If there are post-program months, the model has monthly dummy variables, with the dummy variable "month" being the only one to take a value of 1 at time t. These are, in other words, monthly fixed effects.

β_2 = The estimate of treatment effects: the average daily energy savings per household due to behavioral program treatment.

$\mathbf{Treatment_k}$ = A binary variable indicating whether respondent *k* is in the participant group (taking a value of 1) or in the control group (taking a value of 0).

$\boldsymbol{\varepsilon_{kt}}$ = The cluster-robust error term for respondent *k* during billing cycle *t*. Cluster-robust errors account for heteroscedasticity and autocorrelation at the respondent level.

Cross-Program Participation Analysis

The HERs sent to treatment respondents included energy saving tips and marketing modules, some of which encouraged respondents to participate in other Georgia Power energy efficiency programs. To assess the interactions between these programs, the evaluation team analyzed both the HER program and the Residential Behavioral program data for participation overlap to address two factors:

- Participation lift: Does the Behavioral program treatment influence participation in other energy efficiency programs?
- Savings lift and adjustment: What portion of savings from the Behavioral program was obtained through Georgia Power's other energy efficiency efforts?

As with the energy savings calculations, the control group acts as the counterfactual, for both participation and savings from other programs, to address the above questions and provide unbiased estimates through the RCT model.

First, the evaluation team assessed whether the Residential Behavioral program increased participation in Georgia Power's other energy efficiency programs by comparing participation rates between control and treatment groups. If participation rates in other residential energy efficiency programs were the same across HER treatment and control groups, the savings estimates for HERs from the regression analysis were already net of savings from the other programs and indicates that the Residential Behavioral program had no effect on participation in other energy efficiency programs.

However, if the Residential Behavioral program channeled participants into other energy efficiency programs, then savings detected in the HER billing analysis would include savings that are also counted by those other energy efficiency programs. For instance, if the Residential Behavioral program increased participation in the Refrigerator Recycling program (RRP), the increase in savings could be allocated to either the HER program or to RRP provided through the Residential Behavioral program (or some portion to each), but it could not be fully allocated to both programs simultaneously.

The evaluation team then calculated participant lift and savings lift and adjustment:

- Participant lift: Using participation flags, the evaluation team calculated a participation rate based on the number of accounts (either by individual or by household) that initiated participation in other tracked energy efficiency programs after the first report date. The difference in treatment and control participation in the post-treatment period is participation lift.

- Savings lift and adjustment: The evaluation team estimated the energy savings associated with participation lift in other Georgia Power energy efficiency programs:

    - First the evaluation team calculated annual savings for all measures installed in the post-period.

    - Then we adjusted annual savings for each measure installation by the number of days per year in the post-period in which the measure was installed while the account was active; this step is necessary to most accurately estimate the savings that would be captured by the billing analysis.

    - Next, we determined the average household net savings per participant day (the number of days a household was active in each period) from other programs in the post-period for both the treatment and control groups.

    - Last, the evaluation team multiplied the average savings per participant day by the number of treatment group participant days in the post-period to identify the incremental savings attributable to other energy efficiency programs.

To remove the double-counted saving calculated in the Savings Lift Adjustment, we subtracted the results where the treatment had higher savings than the control group from the wave-level model results. For example, when the report channeled treatment customers into the HEIP program at a higher rate than the control group (who participated without the report), we subtract the HEIP program savings from the total Residential Behavioral program savings. We did this for four of the six waves: 2016 Legacy Income-qualified Wave, 2018 Legacy Wave, 2020 Standard Wave, and the 2020 Digital Only Wave. For the 2014 Legacy Wave and the 2020 Digital Transformation Wave we found that a higher number of the control group participated in other Georgia Power energy efficiency programs. In this case, we do not need to remove the double counted savings.

Appendix 1B: Survey Demographics

Below is a detailed table of the survey respondent demographics by treatment and control status.

Table 111. Survey Demographics by Treatment Status

CATEGORY		CONTROL [a]	TREATMENT [a]
Age of Respondents	56 or older	49%	49%
	45 to 55	19%	22%
	36 to 45	22%	22%
	26 to 35	10%	7%
		CONTROL [a]	TREATMENT [a]
Household Income	Under $25,000	4%	12%
	$25,000 to $35,000	16%	8%
	$35,000 to $50,000	9%	9%
	$50,000 to $75,000	17%	18%
	$75,000 to $100,000	16%	11%
	$100,000 to $150,000	16%	21%
	Over $150,000	21%	22%
		CONTROL [a]	TREATMENT [a]
Homeownership	Rent	17%	14%
	Own	83%	86%
		CONTROL [a]	TREATMENT [a]
Square Footage of Home	0 to 1500	30%	20%
	1500 to 3000	50%	54%
	3000 to 4500	12%	14%
	4500 or larger	8%	12%
		CONTROL [a]	TREATMENT [a]
Year Home Built	Before 1900	0%	1%
	1900 to 1939	5%	2%
	1940 to 1959	7%	5%
	1960 to 1979	24%	21%
	1980 to 1989	14%	13%
	1990 to 1999	20%	27%
	2000 to 2004	16%	14%
	2005 or later	14%	18%
		CONTROL [a]	TREATMENT [a]
Number of Occupants	1	7%	6%

CATEGORY		CONTROL [a]	TREATMENT [a]
	2	35%	34%
	3	22%	22%
	4	17%	23%
	5	14%	11%
	6	3%	3%
	7	1%	0%
	8	0%	1%
	9	1%	0%

[a.] Note totals may not add up due to rounding

APPENDIX 2. -TEMP✔ - DEMAND RESPONSE PROGRAM

Appendix 2A: Impact Analysis Methodology

The evaluation team estimated the demand reduction achieved during the DR events using hourly AMI data for participating homes. We conducted the impact analysis through data cleaning and preparation, identifying baseline or counterfactual days, checking equivalency between the treatment and control groups, and regression modeling. We describe each activity in detail below.

In addition to estimated peak demand reduction during the event period, the team also estimated the overall "event-related" impact on energy use, defined as the overall energy impact in the preconditioning, shed, and snapback periods together.

Data Cleaning and Preparation

The evaluation team collected and prepared data from Georgia Power, Georgia Power's implementation database VisionDSM, the implementer, and publicly available weather data. Georgia Power provided our team AMI data as hourly, cumulative values. We converted cumulative values to hourly interval power draw and removed hours with duplicate-yet-conflicting readings. We compared regression results with minimum filtering to those with additional cleaning, which corroborated the findings presented in this report. The evaluation team downloaded data from VisionDSM, which included customer identifiers (e.g., premise number), thermostat brand, enrollment date, and removal date. The implementer provided data on the event details (e.g., event start and stop times), control and treatment assignments for each event, HVAC type data when available, and data on connectivity and opt outs for each event. Lastly, we identified the nearest weather stations for each enrolled customer and downloaded historical weather from two weeks prior to two weeks following the evaluated events.

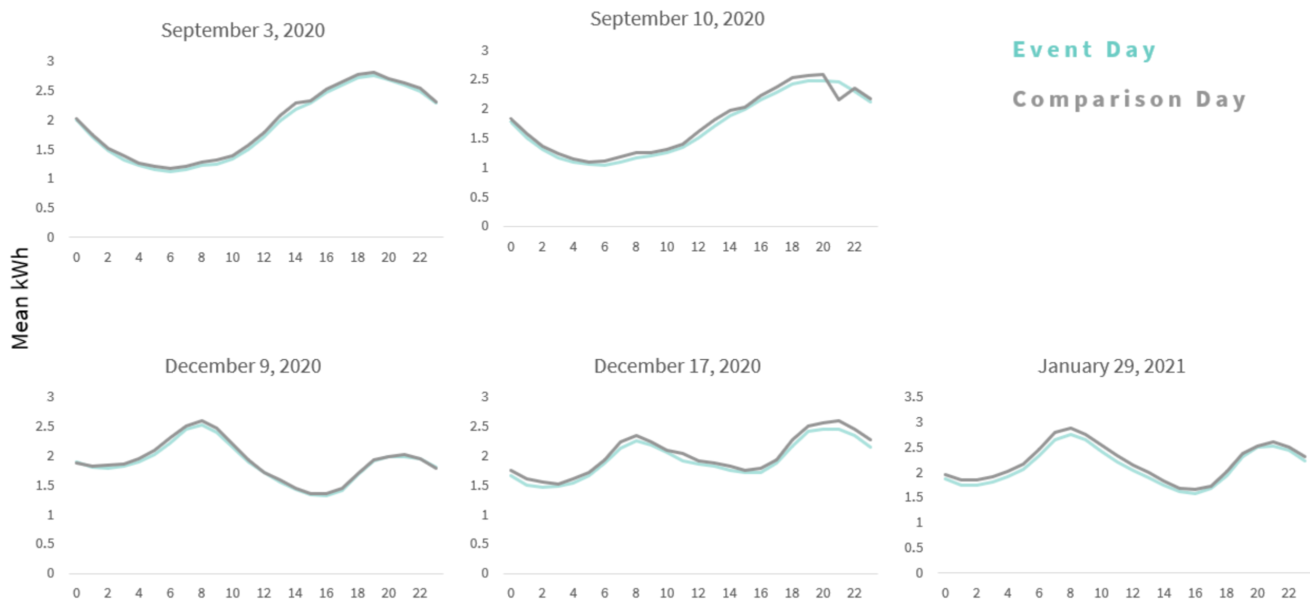
Baseline Days

The evaluation team used historical weather data to find three baseline days for each event. We identified baseline days as the three weekdays within two weeks of the event with the least squared error difference in hourly temperature to the event day. We used the baseline days to assess the equivalency between the control and treatment groups, and to control for any differences between the two groups in the regression model.

Equivalency Check

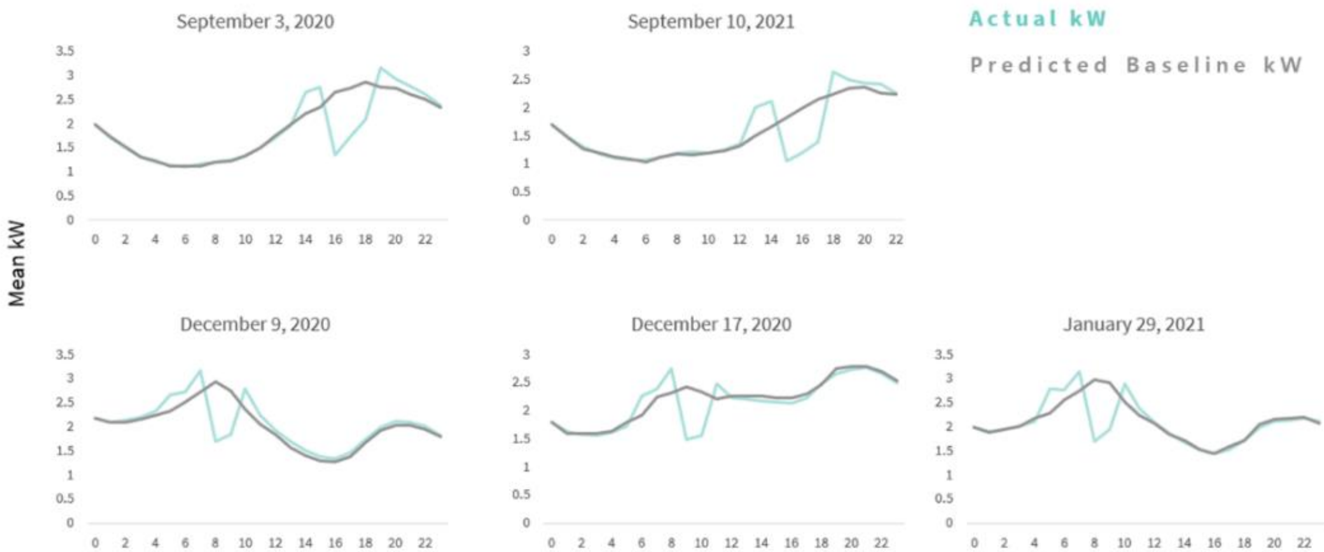
The evaluation team assessed the reasonableness of the control group with two analyses. First, we compared the average usage between the treatment and control groups during each event's baseline days. The closer the usage between the two groups, the more equivalent and reasonable the control group. However, some difference is common, and evaluators use regression models to further control for any minor differences between the two groups (Figure 108).

Figure 108. Equivalency Between Event and Comparison Days



In the second analysis, we tested the ability of the model to address any differences between the treatment and control groups. More specifically, the evaluation team compared the modeled baseline to the treatment group's usage for each event. With this test, the more closely the modeled baseline matches the treatment group's average usage prior to preconditioning, the better the model is estimating the counterfactual based on the control group quality, baseline days, and weather conditions (Figure 109).

Figure 109. Actual Versus Predicted Baseline kWh



Regression Specification

The evaluation team used data from treatment and control groups on the selected non-event days and event days in a linear fixed effects regression model to estimate a treatment effect for each event period. The final model specification included terms that account for weather (as heating degree hours with a base temperature of 65°F and cooling degree hours with a base of 70°F) and time of day. We estimated peak demand reduction and energy savings during an event day by including variables in the model to identify treatment (i.e., taking the value of one for days, hours, and sites where treatment occurred and 0 otherwise).

The evaluation team followed our typical process for consumption analysis evaluation, by implementing different models for each of the following:

- Primary Evaluation Model: a regression that best aligns with typical evaluation analysis.
- Robustness Checks: multiple regressions with minor changes to the model specification to provide an indication as to the sensitivity of the results.
- Exploratory Analysis: multiple regressions where impacts are separated by various characteristics (e.g., event-level results and results by thermostat brand).

For this evaluation, we used the model specification in the equation below as the primary evaluation model. This model provides hourly impacts for each event separately. We chose this model as the primary evaluation model because it aligned with all other results, yielded statistical significance even at this granular-level, and provided additional flexibility for understanding preconditioning and snapback, which appeared to vary in duration between events.

$$kW_{i,h,d} = \alpha_i + \sum \beta_{1,h} * Hr_h + \beta_2 * Trt.Day_d + \beta_3 * HDH.65_{i,h,d} + \beta_4 * CDH.70_{i,h,d}$$
$$+ \sum \beta_{5,h} * Treatment_i * Hr_h + \sum \beta_{6,h} * Trt.Day_d * Hr_h + \beta_7 * Treatment_i * Trt.Day_d$$
$$+ \sum \beta_{8,h} * Treatment_i * Trt.Day_d * Hr_h + \varepsilon$$

$kW_{i,h,d}$	Hourly demand for site *i* at hour *h* during day *d*.
α_i	Site fixed effect for site *i*. This field captures site specific conditions that do not vary over time.
Hr_h	Hourly dummy variables for hours 1 – 24, where for example Hr_1 takes a value of 1 for observations where the hour is 1 and 0 otherwise.
$Trt.Day_d$	Dummy variable for days where shed was delivered, where this field takes a value of 1 during days where the shed signal was sent and 0 otherwise.
$HDH.65$	Heating degree hours at base 65°F for site *i* at hour *h* during day *d*.
$CDH.70$	Cooling degree hours at base 70°F for site *i* at hour *h* during day *d*.
$Treatment_i$	Site treatment dummy variable, where this field takes a value of 1 for treatment sites and 0 for control group sites.

Robustness Checks

To understand the robustness of the results, the evaluation team estimated program impacts for eight alternate and reasonable model specifications.

To understand the robustness of these results, the evaluation team estimated program impacts for eight alternate and reasonable model specifications. We used similar model specifications to the primary evaluation model as robustness checks, as well as other models based on the following specification. These models are used at both the event-specific level and when estimating savings across all events. All robustness checks provided savings within 0.06 kW per customer of the primary evaluation model.

$$kW_{i,h,d} = \alpha_i + \sum \beta_{1,h} * Hr_h + \sum \beta_{2,d} * Event_d + \beta_3 * HDH.65_{i,h,d} + \beta_4 * CDH.70_{i,h,d}$$
$$+ \sum \beta_{5,d} * Event_d * HDH.65_{i,h,d} + \sum \beta_{6,d} * Event_d * CDH.70_{i,h,d} + \beta_7 * Trt.Day_d + \beta_8$$
$$* Treatment_i + \beta_9 * Trt.Shift_{h,d} + \beta_{10} * Trt.Shed_{h,d} + \beta_{11} * Trt.Post_{h,d} + \varepsilon$$

$kW_{i,h,d}$	Hourly demand for site *i* at hour *h* during day *d*.
α_i	Site fixed effect for site *i*. This field captures site specific conditions that do not vary over time.
Hr_h	Hourly dummy variables for hours 1 – 24, where for example Hr_1 takes a value of 1 for observations where the hour is 1 and 0 otherwise.
$Event_d$	Event dummy variables, where for example $Event_1$ takes a value of 1 for the day of event 1 and its counterfactual days and 0 otherwise.
$HDH.65$	Heating degree hours at base 65°F for site *i* at hour *h* during day *d*.

$CDH.70$	Cooling degree hours at base 70°F for site *i* at hour *h* during day *d*.
$Trt.Day_d$	Dummy variable for days where shed was delivered, where this field takes a value of 1 during days where the shed signal was sent and 0 otherwise.
$Treatment_i$	Site treatment dummy variable, where this field takes a value of 1 for treatment sites and 0 for control group sites.
$Trt.Shift_{h,d}$	Load shift treatment dummy variable, where this field takes a value of 1 for days, sites and hours where preconditioning was delivered and 0 otherwise. This field captures preconditioning impacts.
$Trt.Shed_{h,d}$	Shed treatment dummy variable, where this field takes a value of 1 for days, sites and hours where shed was delivered and 0 otherwise. This field captures shed impacts.
$Trt.Post_{h,d}$	Post-shed treatment dummy variable, where this field takes a value of 1 for days, sites and during the 4 hours after shed was delivered and 0 otherwise. This field captures snapback.

Appendix 2B: Survey Demographics

Table 112 provides the full demographic breakdown of survey respondents.

Table 112. Temp✓ Survey Demographic Data

VARIABLE	PROPORTION
HOUSEHOLD INCOME	
Less than $25,000	3%
$25,000 to less than $50,000	11%
$50,000 to less than $75,000	18%
$75,000 to less than $100,000	20%
$100,000 to less than $150,000	25%
$150,000 to less than $200,000	12%
$200,000 or over	12%
AGE	
Less than 30	12%
30 - 39	39%
40 - 49	22%
50 - 59	15%
60 - 69	8%
70+	4%
EDUCATION	
Some high school or less	0%
High school graduate or equivalent	4%
Some college, no degree	11%
Technical college degree or certificate	4%
Two-year college degree	5%
Four-year college degree	39%
Graduate or professional degree	36%
RACE/ETHNICITY	
American Indian or Alaska Native	1%
Asian	11%
Black or African American	16%
Hispanic, Latino, or Spanish origin	7%
Native Hawaiian or Other Pacific Islander	0%
Middle Eastern or North African	1%
White	67%
Some other race, ethnicity, or origin	1%
OWNERSHIP STATUS	
Own	81%
Rent	19%
HOUSE TYPE	

VARIABLE	PROPORTION
Single Family	89%
Multifamily	11%
HOME TENURE	
3 years or less	61%
4 - 10 years	25%
More than 10 years	14%
HOUSING AGE	
Before 1980	23%
After 1980	77%
HOUSEHOLD SIZE	
1 person	22%
2 people	38%
3 people	17%
4 people	14%
5+ people	10%

APPENDIX 3. – RESIDENTIAL SPECIALTY LIGHTING

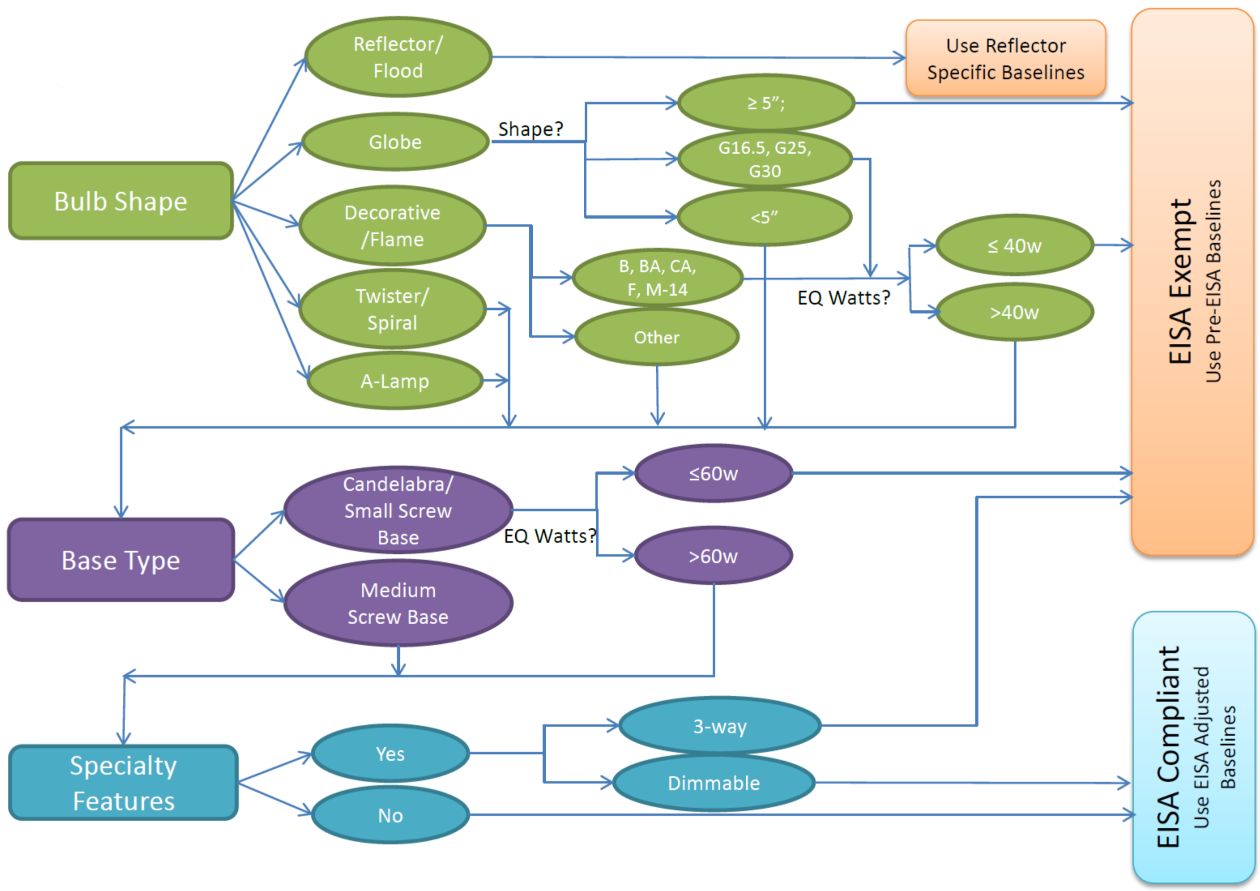
Appendix 3A: Detailed Methodology

Verified Gross Savings

Baseline Wattage

A key component of the savings calculation is the delta between the wattage of the LED bulb and the federal standard baseline wattage of halogen/incandescent bulb (otherwise known as “delta Watts”). Figure 110 depicts how baseline wattages were assigned. Relevant factors in the mapping include bulb shape, equivalent wattage, and specialty features. For each bulb, we collected this information from the ENERGY STAR qualified products list.

Figure 110. Baseline Wattage Map

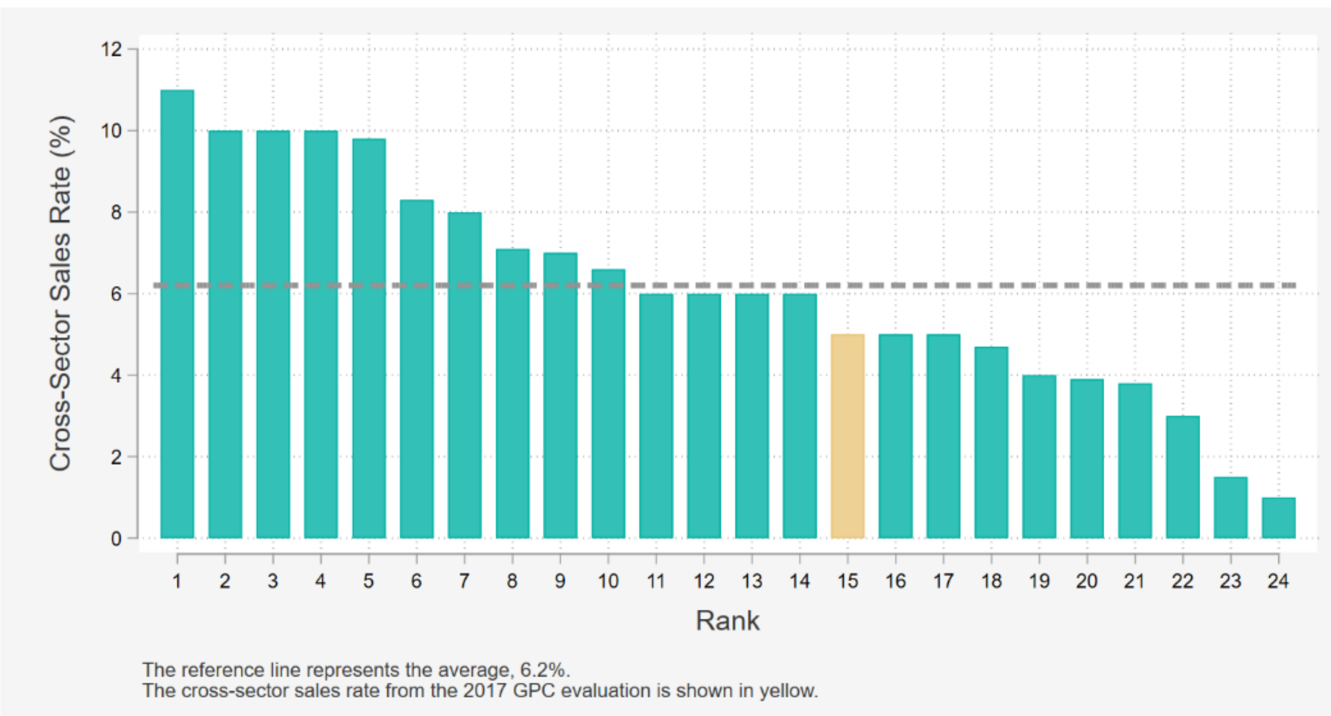


Cross-Sector Sales Rate

Our cross-sector sales assumption of 6.2% is the average cross-sector sales values published in twenty-four different studies, all of which relied on primary research to develop a cross-sector sales value. The studies cover multiple geographic regions and the research period of 2010 to 2019. The studies used several different measurement methods, including in-store intercept surveys and customer-facing surveys conducted after the lightbulbs were purchased via phone or internet. Several studies reported different values for different types of bulbs (e.g., specialty versus standard); for these studies, we use the weighted average of all bulbs sold. Finally, the values for three studies (covering the 2010 – 2013 period) were taken from a 2015 memo prepared by The Cadmus Group and NMR Group for the Massachusetts Program Administrators and Energy Efficiency Advisory Council.[74]

Figure 111 shows the distribution of cross-sector sales values across all 24 studies, with the 6.2% average value shown as a horizontal blue line. Table 113 shows the distribution of cross-sector sales values by study type. Finally, Table 114 provides the full list of studies used in our analysis.

Figure 111. Distribution of Cross-Sector Sales Values



[74] Available here: http://ma-eeac.org/wordpress/wp-content/uploads/Residential-Lighting-Cross-Sector-Sales-Research-Memo.pdf.

Table 113. Distribution and Average Cross-Sector Sales Value by Study Type

SUB-SEGMENTS	AVERAGE	COUNT
Phone Survey	6.6%	5
Intercept Survey	6.0%	11
Multiple	7.1%	5
Mobile Device Survey	3.5%	2
Online Survey	7.1%	1
Average of All 24 Studies	**6.2%**	**24**

Table 114. List of Studies Used in Literature Review

ORGANIZATION	STATE	EVALUATION/PROGRAM NAME	STUDY TYPE	RESEARCH TIME PERIOD	CROSS-SECTOR SALES RATE
PG&E	CA	Upstream and Residential Downstream Lighting Impact Evaluation Report	Multiple	2010-2012	7.0%
SCE	CA	Upstream and Residential Downstream Lighting Impact Evaluation Report	Multiple	2010-2012	6.0%
SDG&E	CA	Upstream and Residential Downstream Lighting Impact Evaluation Report	Multiple	2010-2012	6.0%
Efficiency Maine	ME	Residential Lighting Program	Phone Survey	2011	4.0%
PECO	PA	Residential Upstream Lighting Program	Intercept Survey	2016-2017	1.5%
PPL	PA	Residential Upstream Lighting Program	Phone Survey	2018-2019	6.0%
PPL	PA	Residential Upstream Lighting Program	Phone Survey	2016-2017	10.0%
Duquesne Light	PA	Residential	Intercept Survey	2017-2018	3.8%

ORGANIZATION	STATE	EVALUATION/PROGRAM NAME	STUDY TYPE	RESEARCH TIME PERIOD	CROSS-SECTOR SALES RATE
		Upstream Lighting Program			
FirstEnergy Companies	PA	Residential Upstream Lighting Program	Online Survey	2018-2019	7.1%
FirstEnergy Companies	PA	Residential Upstream Lighting Program	Phone Survey	2016-2017	8.3%
IL	IL	ENERGY STAR Compact Fluorescent Lamp	Intercept Survey	2014-2016	5.0%
Ameren	MO	Residential Upstream Lighting Program	Intercept Survey	2015	9.8%
PSE	WA	Residential Lighting Market Characterization Study	Intercept Survey	2015	8.0%
WI Focus on Energy	WI	Retail Lighting and Appliance Program	Multiple	2014-2015	6.6%
PacifiCorp (RMP)	UT	Utah Home Energy Savings Program Evaluation	Intercept Survey	2013-2014	3.9%
MA EEAC	MA	Lighting Decision Making	Mobile device survey	2016-2017	6.0%
MA EEAC	NY	Lighting Decision Making	Mobile device survey	2016-2018	1.0%
DC SEU	DC	District of Columbia FY2013 Annual Evaluation Report	Intercept Survey, Phone Survey Follow-Up	2013	10.0%
Duke	NC	Energy Efficient Lighting Program	Intercept Survey	2011-2012	10.0%
Consumers Energy	MI	Residential Lighting Program	Phone Survey	2013	4.7%
Midwest Utility	MO	Upstream	Intercept Survey	2010	3.0%

ORGANIZATION	STATE	EVALUATION/PROGRAM NAME	STUDY TYPE	RESEARCH TIME PERIOD	CROSS-SECTOR SALES RATE
		Lighting Program			
EmPOWER	MD	Residential Lighting and Appliance Program	Intercept Survey	2011	5.0%
Midwest Utility	MO	Upstream Lighting Program	Intercept Survey	2013	11.0%
Georgia Power	GA	Residential Lighting Program	Intercept Survey	2017	5.0%

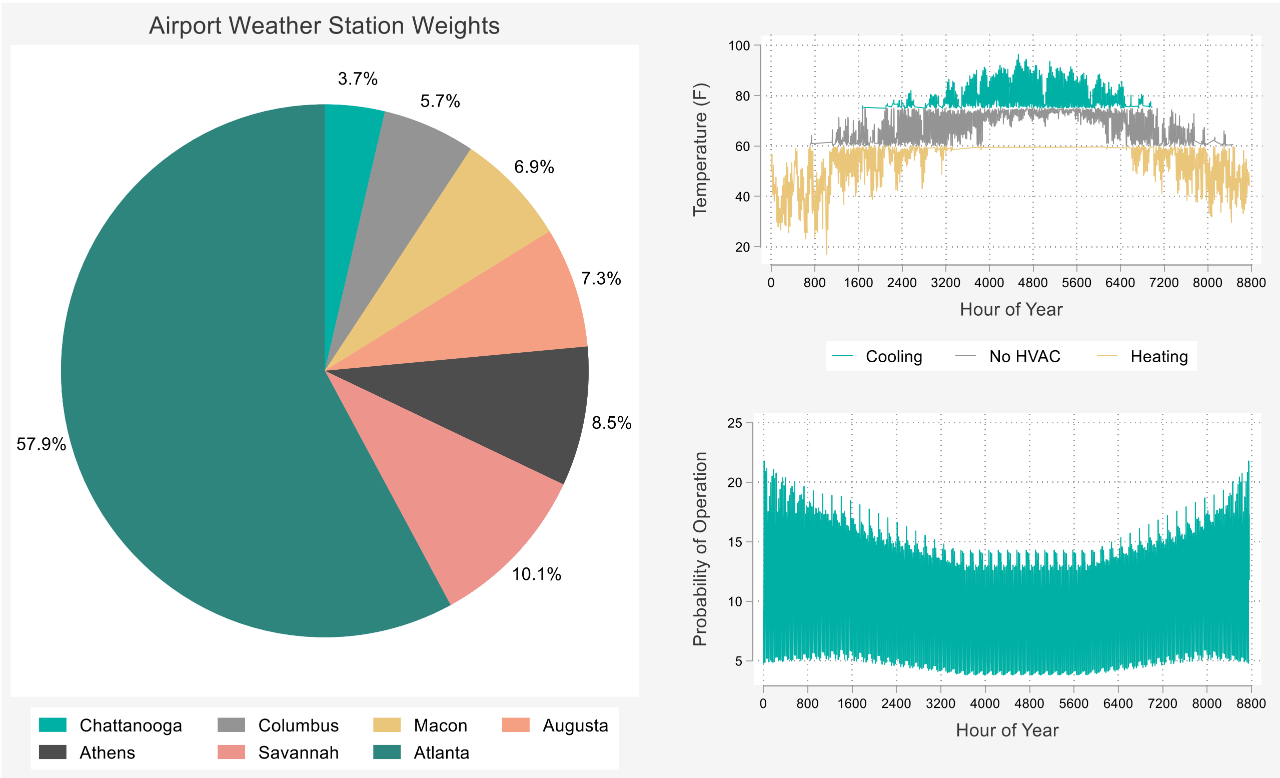
Interactive Effects

The premise behind interactive effects modeling is relatively straightforward. Lightbulbs emit heat as a byproduct. LEDs produce far less waste heat than halogen and incandescent lamps. When replacing an inefficient bulb with an efficient one, the change in waste heat affects HVAC loads for lamps in conditioned spaces. In the summer, air conditioning load is reduced because there is less waste heat to reject. In the winter, the heating system must make up for the heat not supplied by lightbulbs. "Interactive effects" account for the interaction between lighting waste heat and HVAC loads and are included as multipliers in savings algorithms.

To estimate the interactive effects multipliers, we relied on four key data sources:

- Population-weighted normalized weather. We downloaded TMY3 hourly weather data from seven different weather stations across Georgia. A weighted average weather file was calculated using the populations of the cities from which the weather data was pulled. Figure 112 shows the city weights and the annual weather profile.
- 8760 Residential Lighting Profile from GDS Associates Pennsylvania logger study (scaled to 2.62 hours/day). This 8760-load shape represents the expected diversified "on" time for each hour of the year.
- Georgia Power Residential Appliance Saturation Survey (2017). With this data, we estimated the percent of residential premises with electric heat and the percent of premises with air conditioning.
- Georgia Power Lighting Logger Report (2013). With this data, we estimated what percentage of residential lightbulbs in Georgia are in air-conditioned spaces.

Figure 112. City Weights and Hourly Temperature Profile



There are four key components to the interactive effects modeling framework. These components are:

- Internal Gain Contribution: What % of waste heat remains in the building envelope?
- Concurrency: Are the lights and HVAC systems operating at the same time?
- Applicability: Are lights installed in conditioned spaces?
- Efficiency: What is the change in kW associated with waste heat in conditioned spaces?

To estimate the interactive effects multipliers, we first calculated the waste heat associated with the efficient bulb change in each hour of the year. Next, we calculated the effect on the HVAC system, considering the fuel mix and efficiency of heating and cooling systems. Table 115 provides a full list of parameter assumptions). Finally, we applied the effects only in hours when heating or cooling systems were operating.

Table 115. Interactive Effects Parameter Assumptions

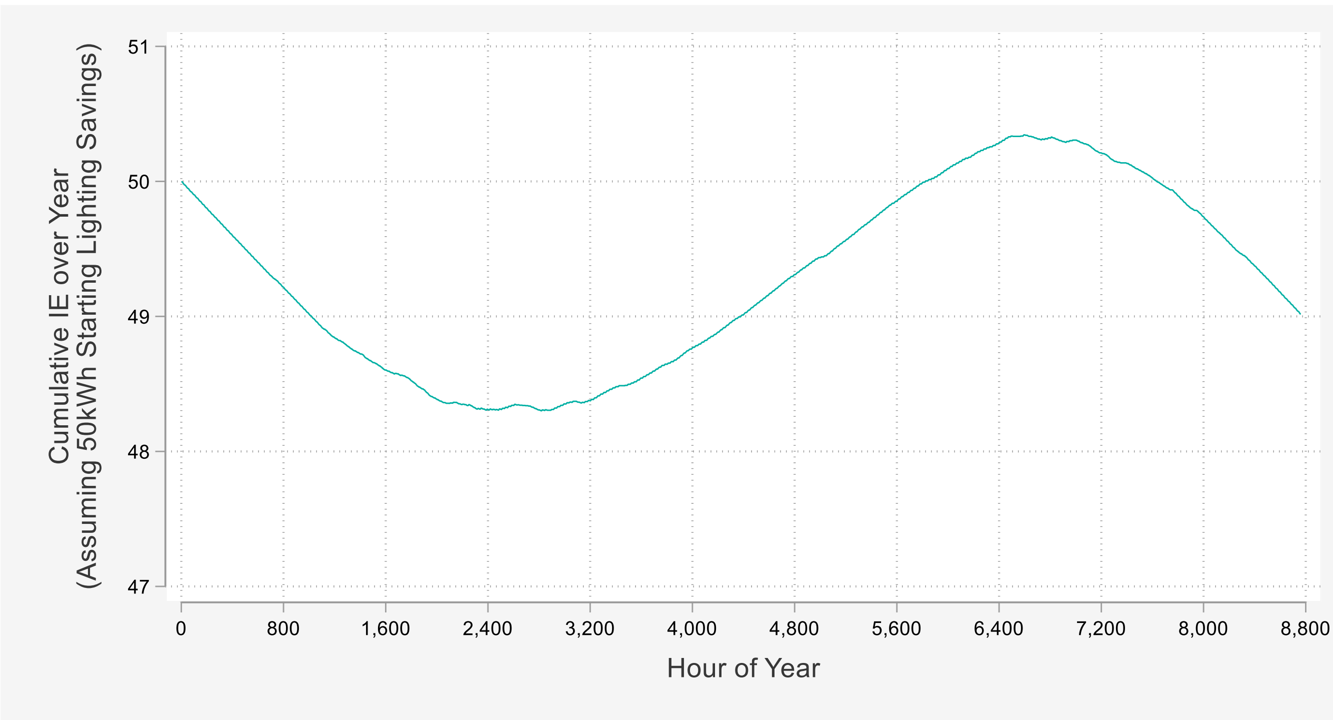
PARAMETER	VALUE	SOURCE	APPLIES TO
% of Heat Remaining in Envelope	60%	Assumption	Internal Gain Contribution
% Electric Heat	54% (23% Heat Pump, 31% Electric, 46% Gas)	Georgia Power RASS p62	Efficiency
% of Bulbs in Conditioned Spaces	86.4%	Lighting Logger Report (Table 3-4)	Applicability
% of Buildings with AC	99%	Georgia Power RASS p73	Applicability
Efficiency of Heating Systems	300% HP 100% Electric Furnace 80% Gas	Assumption	Efficiency
Efficiency of Cooling Systems	300% HP 293% Electric AC (SEER 10)	Assumption	Efficiency
Heating and Cooling Periods	Heating: Temp < 60F Cooling: Temp > 75F	Assumption	Concurrency
Peak Periods	Winter: HE9 January weekdays Summer: HE17, July weekdays	Georgia Power Peak Definition	Concurrency

The modeled multipliers are as follows:

- Annual Energy Savings: 0.980
- Cooling Demand: 1.175
- Heating Demand: 0.849

Figure 113 shows the cumulative interactive effect over the course of one year for a hypothetical bulb that saves 50 kWh. In the first portion of the year (winter), the HVAC system needs to do extra work to make up for the lost waste heat. As summer settles in, the HVAC system does less work, as there is less waste heat to reject. Upon the return of winter, the HVAC system again needs to do extra work. After one full year, we estimated this hypothetical bulb will save 49 kWh rather than 50 kWh due to HVAC interactions.

Figure 113. Cumulative Interactive Effects over the Year



In-Service Rate

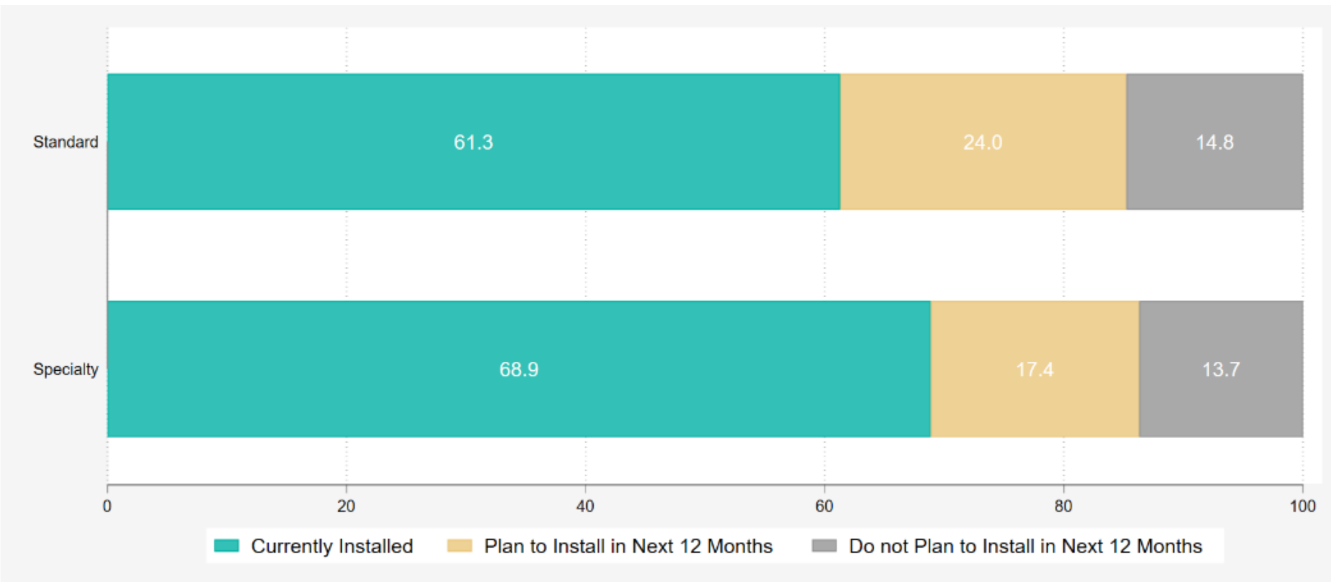
To estimate ISR, we conducted a web survey of Georgia Power customers who purchased standard or specialty lighting from the Georgia Power Online Marketplace between January and September 2020. For this component of the evaluation, note globes, candelabras, and reflectors are grouped together under the "specialty lighting" bin. A total of 254 customers completed the survey (84 who purchased only standard lighting, 84 who purchased only specialty lighting, and 86 who purchased both types of lighting). Per the evaluation plan, we used survey responses to estimate a year-one ISR instead of a multi-year trajectory, since the baseline for delayed installations is uncertain.

Based on survey responses, we categorized lightbulb purchases into one of three buckets: currently installed, will be installed in the next 12 months, and will not be installed in the next 12 months. By bulb type, Table 116 shows the distribution of bulbs into these three bins. Figure 114 shows the relative shares of each bin. The in-service rate combines the "installed" and "plan to install" bins and divides by the total number of bulbs purchased.

Table 116. Distribution of Lighting Purchases by Installation Bin and Bulb Type

CATEGORY	STANDARD	SPECIALTY + REFLECTOR
Number Installed	872	810
Plan to Install in Next 12 Months	341	205
Do not Plan to Install in Next 12 Months	210	161
Total	1,423	1,176
ISR	85.2%	86.3%

Figure 114. Relative Shares by Installation Bin and Bulb Type



Verified Net Savings – Additional Background

Lighting Sales

The LightTracker POS dataset includes lighting sales data for grocery, drug, dollar, selected club, and mass market distribution channels. These data represent actual sales scanned at the cash register for retailers such as Walmart, Kroger, Sam's Club, and Walgreens.

The NCP represents a panel of approximately 100,000 residential households who are provided a handheld scanner for their homes and instructed to scan every purchase they make that has a bar code. For Georgia, the NCP collected data from approximately 3,300 households in 2020. The use of a scanner avoids potential "recall bias," which is prevalent in self-report methods that ask about lighting purchases.

Although the dataset included detailed records of lighting data purchases, the evaluation team spent considerable time ensuring data integrity and inclusion of all the necessary bulb attributes. For example, not all records were populated with some of the more critical variables such as bulb type, style, and wattage or the data had clearly erroneous values (e.g., 60-watt LEDs). After thorough review and quality control of the dataset, the evaluation team reclassified, standardized, and populated missing records, created additional variables, and cleaned the data prior to analysis.

To populate missing records, validate existing records, and include additional bulb attributes, CREED created a Universal Product Code (UPC) database from the following sources:

- Product catalogs downloaded from manufacturer and retailer web sites via web scraping, a technique used to collect large amounts of data from the internet
- Automated lookups of online UPC databases, such as www.upcitemdb.com
- Bulb attributes entered as part of shelf-stocking studies like the one described in this section

CREED then merged the UPC database with the POS data, populating fields based on a hierarchy of data sources believed to be most reliable. Prioritization was typically based in the following order: manufacturer specifications, UPC lookups, and original POS-based database values. The team also conducted manual web-lookups on over 200 high-volume bulbs to verify final assignments.

Additionally, CREED investigated the bulb assignment and the quantity of bulbs per package by examining the average price per unit and identifying outliers in terms of per bulb prices. This process helped identify misclassification of certain bulb types (e.g., bulbs that were flagged as low-cost LEDs but were really LED nightlights and needed to be moved to the "other" lamp type bin), bulb counts that sometimes represented box shipments (e.g., a package identified as having 36 bulbs was really a six-pack of LEDs that was shipped with six packages per box), or high-cost LEDs that were really Wi-Fi-enabled smart LEDs. The CREED team also used lumens per watt (LPW) as a check on bulb assignments (efficient bulbs should have higher LPW values than inefficient bulbs). The sales model is restricted to screw-based bulbs, so any bulbs classified as type "other" were not included in the model.

CREED estimated missing lumen values and missing lamp styles. Regarding lumens, CREED leveraged ordinary least squares (OLS) regression models that predicted lumens based on the type of light and the wattage of the bulb. Regarding style (e.g., standard, reflector, globe, candelabra), CREED leveraged classification and regression trees (CART), a method commonly used for classification problems, to populate the style attribute for lamps that were missing data.

After accounting for the smaller states that lacked sufficient sample size from the panel data or had incomplete program data available, the final model contained 43 states.[75] The lighting dataset included the following key aspects:

- 2020 sales volume and pricing for CFLs, LEDs, halogens, and incandescent bulbs for all channels combined, and broken out by the POS and non-POS channels
- Data reporting by state (with 43 states included in both POS and non-POS) and bulb type
- Inclusion of all bulb styles (standards, reflectors, globes, and candelabras) and controls (e.g., three-way, dimmers, etc.)

As detailed in the following section, the dependent variable of the model was the percentage of LED sales, rather than total LED sales, to normalize for differences in population across states.

Program Activity

To research lighting program activity in the 43 states, CREED contacted program administrators and conducted a literature review of publicly available reports found on the internet or provided by program administrators or their evaluators. The CREED team contacted local utilities in areas where reports with relevant information were not available.

The CREED team collected the following program data for each program administrator in the US:

- Total number of claimed LED upstream program bulbs reported by each program, broken out by style (standard, globe, candelabra, reflector) if possible
- Upstream LED incentives
- Total upstream program budget

The evaluation team used actual program expenditures and, where unavailable, used ENERGY STAR reported expenditures as a proxy.[76,77] After accounting for the states with incomplete program data, the final model included 43 states (detailed below).

To determine Residential Specialty Lighting program activity in Georgia for calendar year 2020, the evaluation team pulled tracking data records from VisionDSM. Table 117 shows the incentives, program expenditures, and the number of program-supported bulbs sold in Georgia during 2020. The difference between the incentives amount and total program expenses is non-incentive expenditures such as marketing,

[75] The seven states that were not included were Alaska, Hawaii, Iowa, Montana, New Jersey, North Dakota, and Vermont.
[76] ENERGY STAR. "ENERGY STAR Summary of Lighting Programs: September 2020 Update." 2020. Available online: https://www.energystar.gov/productfinder/downloads/2020/2020%20ENERGY%20STAR%20Summary%20of%20Lighting%20Programs.pdf
[77] Note that because the ENERGY STAR report included only expenditure ranges, the evaluation team used the midpoints of the ranges to represent the expenditures.

implementation contractor fees, Georgia Power staff labor, and EM&V. The totals in Table 117 do not include food bank distributions as those lamps are not sold and not part of the net impact evaluation.

Table 117. Residential Specialty Lighting Program Statistics, PY2020

PROGRAM EXPENSES	LED QUANTITY	LED INCENTIVES
$2,506,527	766,622	$875,643

Presence and Absence of Retailers (Channel Variables)

The evaluation team conducted secondary internet research to determine the number and total square footage of store locations in each state for five primary energy-efficient bulb retailers—The Home Depot, Lowe's, Walmart, Costco, and Menards. The evaluation team used these data as explanatory variables in the model since these retailers sell a large quantity of energy-efficient bulbs and the percentage of efficient bulb sales could differ in states with more or fewer retail locations. The non-POS data (derived from the NCP) does include purchases made through online retailers.

State-Level Household and Demographic Characteristics

The evaluation team gathered state-level demographic data from the ACS, including annual state-level data for the population, total number of households, household tenure (own versus rent), home age, education, income, and average number of rooms in the home. As explained below, the evaluation team then combined these data with other possible explanatory variables, including political index, average cost of living, and average electric retail rates.

Modeling Methods

The primary objective of the CREED national sales model was to quantify the impact of state-level retail lighting program activity on the sales of LEDs, while controlling for demographic, household characteristics, and retail channel variables that could affect consumers' uptake of efficient lighting products.

The model's general form is specified below, followed by a more detailed discussion of the data sources for each variable. The evaluation team considered the comprehensive set of variables listed in the equation below. The final model, presented in Table 118, lists the variables ultimately selected for inclusion based on their statistical significance and ability to improve the model specification.

$$LED\ Market\ Share_i = \beta_0 + \beta_1 * Program\ Spending\ Variable_i + \beta_2 * Program\ Age_i + \beta_3 * \sum_{1}^{3} Channel\ Variables_i + \beta_4 * \sum_{1}^{7} Demographic\ Variables_i + \epsilon_i$$

Where:

LED Market Share$_i$	=	Proportion of total LED sales in state 'i'. Equal to [LED sales/total bulb sales]
β_0	=	The model intercept.
β_1	=	The primary coefficient of interest. This represents the marginal effect of program intensity.
β_2	=	Another coefficient of interest. This represents the marginal effect in additional program years since inception.
Program Spending Variable	=	A numeric variable that summarizes state-level retail lighting program dollars per household in state 'i'. Two different program spending variables were tested; Table 51 lists additional detail.
Program Age$_i$	=	The number of years state 'i' has been running an upstream lighting program. Two different program age variables were tested; Table 51 lists additional detail.
β_3 *and* β_4	=	Array of regression coefficients for the channel and demographic variables.
Channel Variables	=	Numeric variables summarizing state-level retailer characteristics. Table 51 lists additional detail.
Demographic Variables	=	Numeric variables that summarize state-level population, housing, and economic attributes. Table 51 lists additional detail.
ϵ_i	=	Error term.

Table 118. Program Intensity, Channel, and Demographic Variable Descriptions

TYPE OF VARIABLE	DESCRIPTION
Program Intensity Variables	
Program Spending per Household$_i$	Total upstream program budget in state 'i' divided by the number of households in state 'i'.
SQRT (Program Spending per Household)$_i$	Square root of the program spending per household.
Program Age$_i$	Number of years program administrators in state 'i' have operated upstream lighting programs (CFL or LED).
Channel Variables	
Sq ft NonPOS per HH$_i$	Average non-POS retail square footage per household in state 'i.' Equal to non-POS square footage divided by the number of households in state 'i'.
Percent Sq ft NonPOS$_i$	Percentage of total retail square footage belonging to non-POS retailers in state 'i.' Equal to non-POS square footage divided by (POS sq ft + non-POS sq ft).
Sq ft POS per HH$_i$	Average POS retail square footage per household in state 'i.' Equal to POS square footage divided by the number of households in state 'i'.

TYPE OF VARIABLE	DESCRIPTION
Demographic Variables	
Political Index$_i$	A state-level partisan voter index developed by Gallup [a] using presidential election voting results as a state-level partisan proxy. A higher than 1.0 value represents greater democratic influence and a value less than 1.0 indicates greater republican influence.
Average Electricity Cost$_i$	State-level average residential retail rate of electricity sourced directly from the Energy Information Agency. [b]
Cost of Living$_i$	State-level cost of living indices developed by the Missouri Economic Research and Information Center. [c]
Percentage of Renters Paying Utilities$_i$	All state-level demographic and household variables were derived from the most current US Census ACS. [d]
Median Income$_i$	
Percentage Owner Occupied$_i$	
Percentage of Population with College Degree$_i$	

[a.] *Gallup. "State of the States." Accessed February 2021: news.gallup.com/poll/125066/state-states.aspx*

[b.] *US Electricity Information Association. "Electricity." Accessed February 2021. eia.gov/electricity/data/state/*

[c.] *Missouri Economic Research and Information Center. "Cost of Living Data Series 2019 Annual Average." Accessed February 2021: https://meric.mo.gov/data/cost-living-data-series*

[d.] *US Census Bureau. "American Fact Finder." Accessed February 2021. The FactFinder page has since been decommissioned. Census data is available at https://data.census.gov/cedsci/*

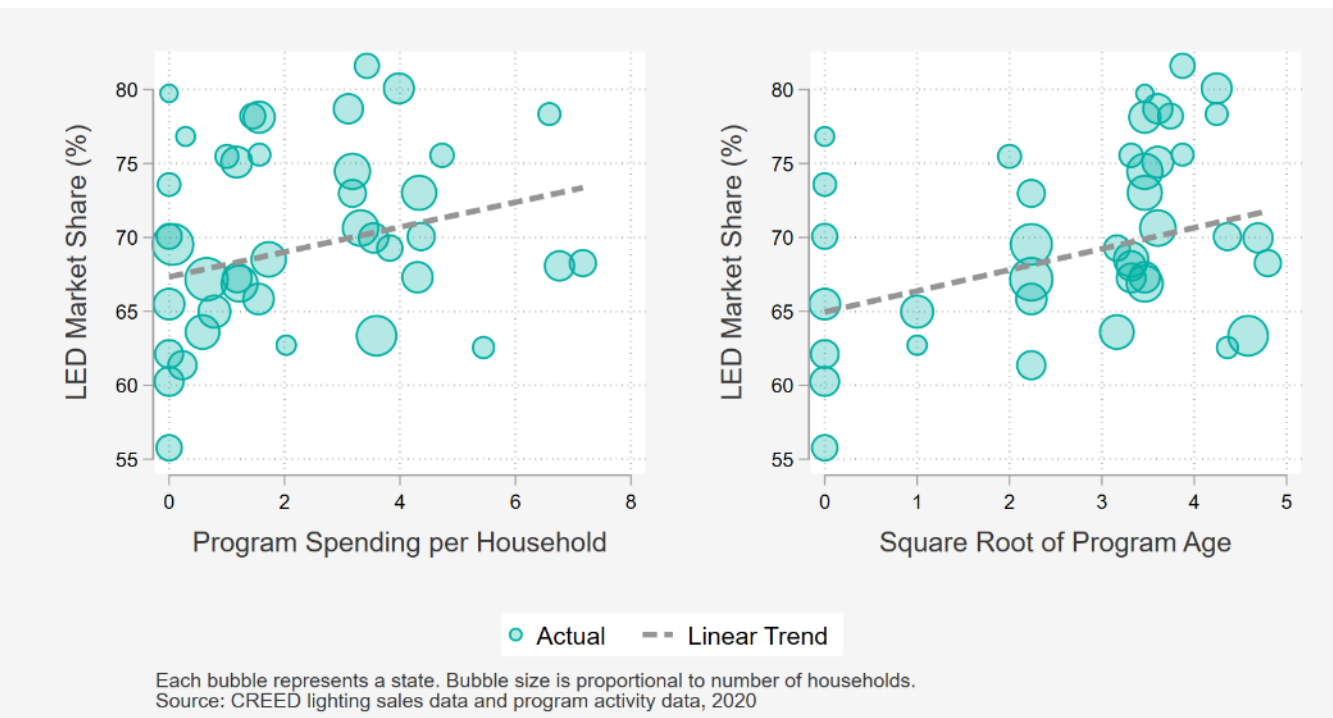
Correlation of the Independent (Explanatory) Variables

Figure 115 shows the correlation between the dependent variable (LED market share) and 14 potential explanatory variables – four program intensity variables (spending per household, square root of spending per household, and program age) and ten channel and demographic/household variables. Twelve variables are positively correlated with LED market share (green bars) and two are negatively correlated (red). The absolute value of the correlation coefficient indicates the strength of the linear correlation. As expected, of the 14 variables, the program intensity variables show the strongest correlation with LED market share (i.e., higher LED market shares typically occur in states with more program spending and longer-running programs). Figure 116 visualizes the correlation between these two key variables and LED market share.

Figure 115. Independent Variable Correlation Table

Explanatory Variable	Correlation with LED Market Share
Spending per Household	0.393
Square Root of Spending per Household	0.443
Program Age	0.335
Square Root of Program Age	0.394
Non-POS Square Footage per Household	0.221
POS Square Footage per Household	-0.152
Percentage of Square Footage in Non-POS	0.188
Political Index	0.069
Median Income	0.253
Average Electricity Cost	0.028
Cost of Living	0.024
Percentage of Renters Paying Utilities	-0.212
Percentage Owner Occupied	0.206
Percentage of Population with College Degree	0.320

Figure 116. LED Market Share against Program Intensity



In addition to being correlated with LED market share, many of the explanatory variables are correlated with each other. Figure 117 shows a pairwise correlation matrix among the potential independent variables. When two independent variables that are highly correlated with one another are included in a regression model, the model will have difficulty precisely estimating the effect of either variable, because the two variables carry similar information. This issue is compounded by the low number of observations in the dataset. Thus, the final model employs far fewer variables than the total number of tested variables since some of the variables only contribute redundant information.

Figure 117. Correlation Matrix for Potential Independent Variables

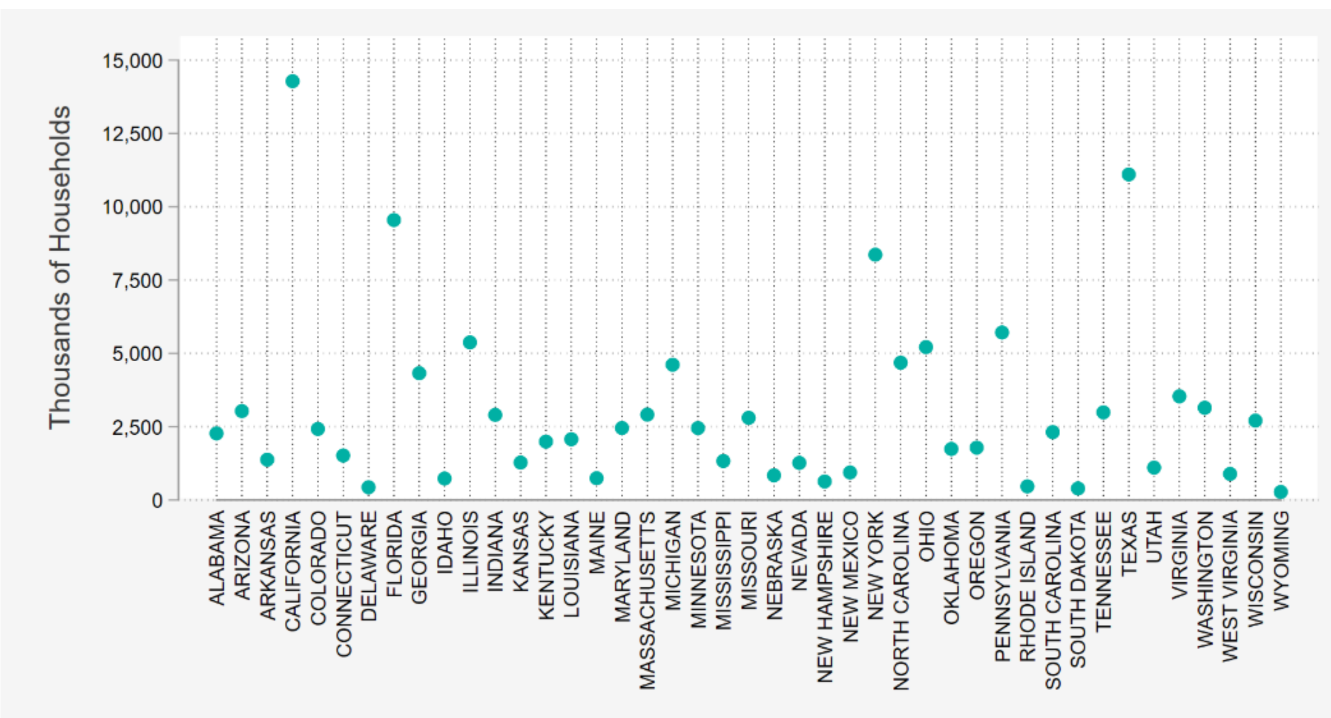
	LED Market Share	Spending per Household	Square Root of Spending per Household	Program Age	Square Root of Program Age	Non-POS Square Footage per Household	POS Square Footage per Household	Percentage of Square Footage in Non-POS	Political Index	Median Income	Average Electricity Cost	Cost of Living	Percentage of Renters Paying Utilities	Percentage Owner Occupied
Spending per Household	0.39													
Square Root of Spending per Household	0.44	0.90												
Program Age	0.34	0.61	0.78											
Square Root of Program Age	0.39	0.53	0.76	0.95										
Non-POS Square Footage per Household	0.22	-0.21	-0.12	-0.19	-0.10									
POS Square Footage per Household	-0.15	-0.42	-0.47	-0.64	-0.61	0.24								
Percentage of Square Footage in Non-POS	0.19	0.44	0.51	0.65	0.61	-0.03	-0.96							
Political Index	0.07	0.56	0.64	0.65	0.61	-0.27	-0.81	0.78						
Median Income	0.25	0.51	0.56	0.53	0.48	0.08	-0.65	0.73	0.69					
Average Electricity Cost	0.03	0.72	0.63	0.62	0.48	-0.34	-0.62	0.61	0.62	0.50				
Cost of Living	0.02	0.50	0.53	0.67	0.56	-0.42	-0.82	0.80	0.77	0.70	0.68			
Percentage of Renters Paying Utilities	-0.21	-0.57	-0.61	-0.63	-0.49	0.39	0.58	-0.53	-0.59	-0.57	-0.64	-0.69		
Percentage Owner Occupied	0.21	-0.12	-0.13	-0.31	-0.26	0.51	0.43	-0.37	-0.36	-0.33	-0.33	-0.60	0.29	
Percentage of Population with College Degree	0.32	0.38	0.44	0.50	0.46	0.17	-0.51	0.57	0.53	0.87	0.39	0.50	-0.43	-0.23

Model Weighting

One key consideration in developing the model was how to weigh each of the states. Each state is a single observation in the model, but the data for that state comes from summarized observations from sales and panel data. Weighting each state equally would not have accounted for larger states having larger sample sizes in the panel data and bigger impacts on the lighting market. To capture these differences, the evaluation team considered using either the number of households or total bulb sales as the weight. The evaluation team determined that using total bulb sales as analytic weights in the model was inappropriate because sales are correlated with the dependent variable. Specifically, states with high LED market share tend to have lower total lamp sales because efficient lamps have longer measure lives than inefficient lamps, so the sockets turn over less frequently.

In the NCP data, the sample size was generally proportional to number of households, and large states represented a larger share of the overall US lighting market than smaller states. Given the difference i n panel sizes, the average lighting share value in large states came from more measurements than small states, with a commensurate increase in aggregate measurement precision. Therefore, the evaluation team used number of households per state as the weight. Figure 118 shows the distribution of households for each of the 43 states in the model.

Figure 118. Number of Households by State

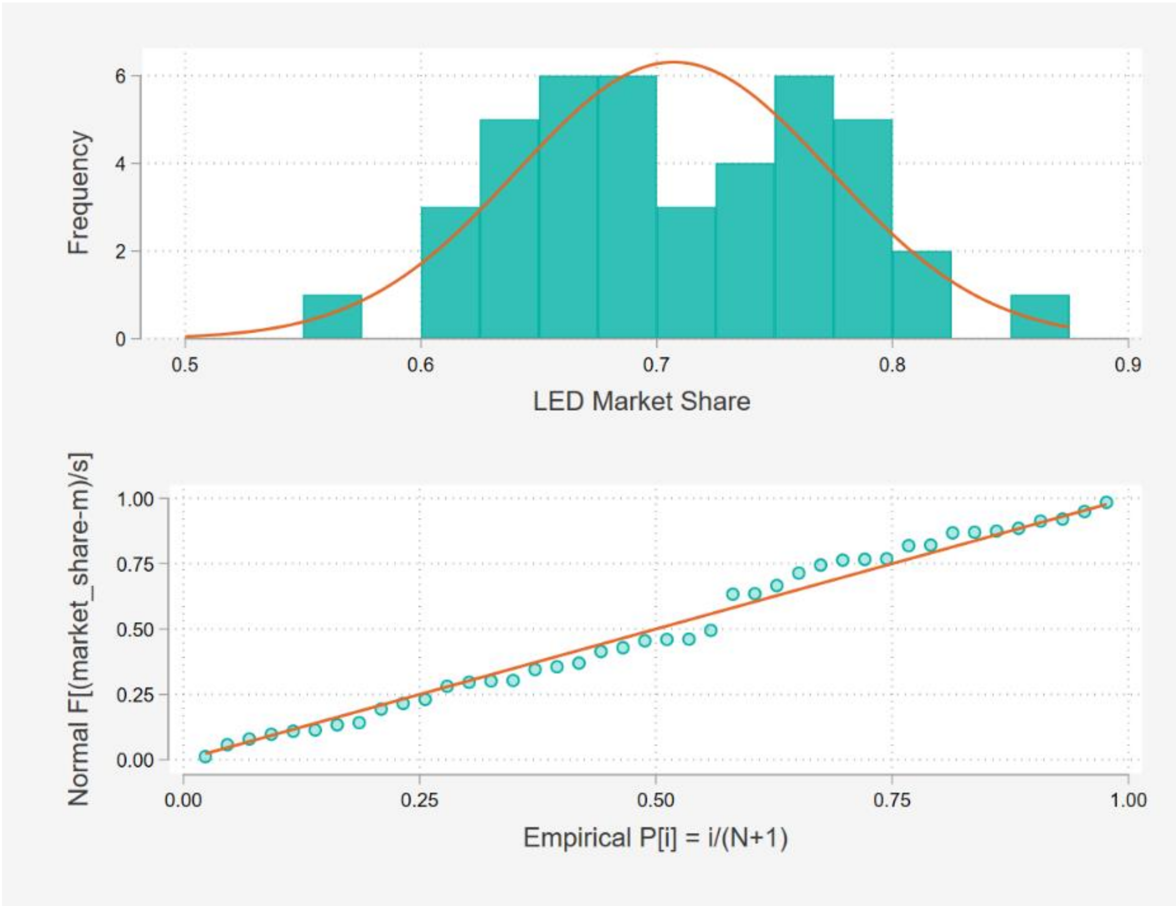


Model Functional Form

Another critical decision in the modeling process is the selection of the functional form of the model. The type of dependent variable we are analyzing is a key input in this decision. In this case, the dependent variable is constrained by 0 and 1. In other words, LED market share cannot be less than 0% and it cannot be greater than 100%. The evaluation team looked at functional forms such as beta regression that impose similar constraints (e.g., model predictions are bounded by 0 and 1). Since the LED market share values only range from 56% to 85%, and program intensity and program age explain so much of the variation, we elected to estimate the model using ordinary least squares (OLS) regression. Using OLS resulted in no unrealistic predictions (e.g., all under 100%).

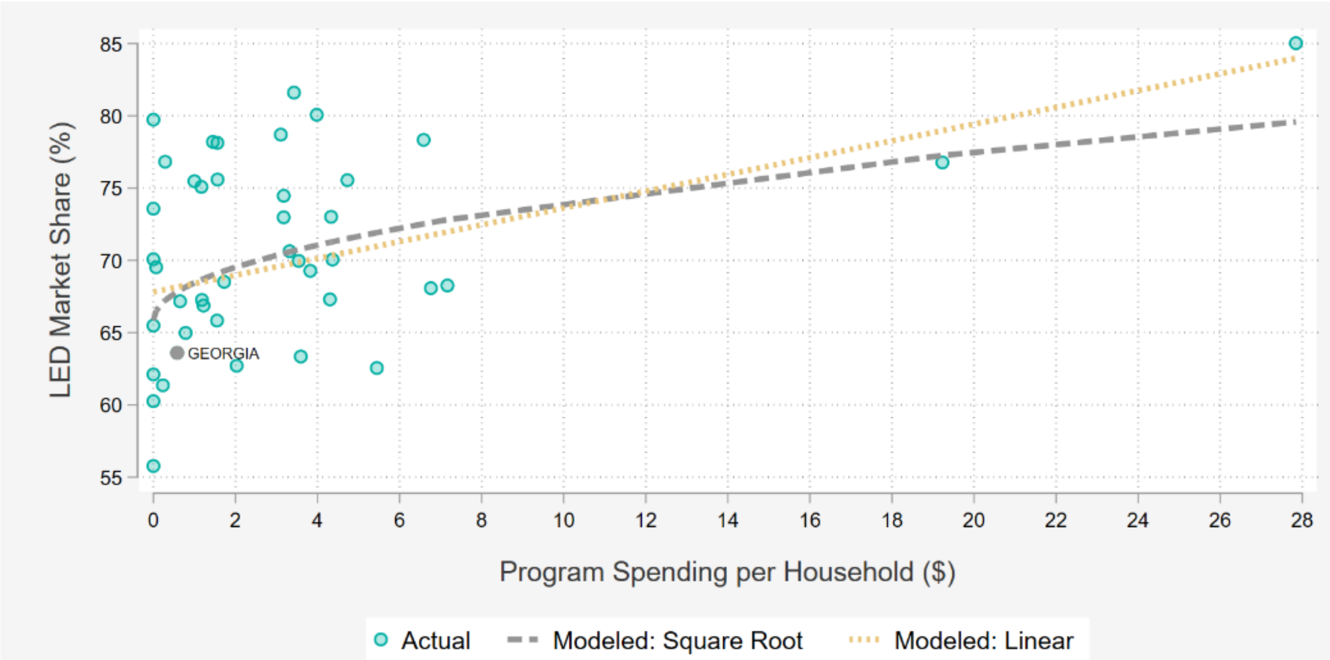
To support our decision to use OLS, we reviewed the distribution of LED market share (i.e., the dependent variable) across states. Figure 119 contains a histogram and a quantile-quantile (QQ) plot for the LED market share of the 43 states in the analysis dataset. It indicates that the data are approximately normally distributed. (A QQ plot will show an approximately straight trend line when the data are approximately normally distributed.) A Shapiro-Wilk test for normality also indicated no reason to believe the distribution of LED market share is non-normal (p-value = 0.75). If the distribution had been severely non-normal, then perhaps another model functional form would better suit the data.

Figure 119. Histogram and Quantile-Quantile Plot



The evaluation team also explored transformations of independent variables, including the square root of spending as the program intensity variable. Figure 120 shows that the square root model tapers LED market share as the square root of spending increases. This reflects diminishing returns in terms of market share as program spending increases and graphically provides a good fit for the data, and thus the model used this transformation.

Figure 120. Linear Versus Non-Linear Modeling



Source: CREED lighting sales data and program activity data, 2020

Shelf-Stocking Study

The Residential Specialty Lighting program evaluation considers the results of a shelf-stocking study in four states that have never had retail lighting efficiency programs (Tennessee, Nebraska, Florida, and Alabama) to examine the availability of incandescent and halogen lamps, as well as the share of LEDs versus these less efficient alternatives.[78] Georgia Power was one of five utility sponsors for this study. Joint sponsorship of studies like this allows utilities with similar evaluation objectives to share the study costs and conduct research that would not be practical to fund alone. The ILLUME team elected to include results of the study as part of the evaluation because the lighting markets in states that do not offer programs like the Residential Specialty Lighting program (or the lighting rebates offered through the Georgia Power Marketplace) are a useful baseline. Primary research areas for this study included:

[78] Note that Jacksonville Electric Association (JEA) does offer an upstream lighting program. This program, however, only serves 4% of the Florida population, and for purposes of this research, no shelf stocking research was conducted in the JEA service territory and Florida was considered a non-program state.

- Whether inefficient bulbs can be purchased in non-program states by the second half of 2020
- Measuring the retail placement of LEDs versus other options in non-program states
- Determining how inefficient lighting availability and stocking differs by style (standard versus specialty/reflector) and type of retailer

The findings from this recently completed study will help Georgia Power staff assess the effectiveness of program design changes made for the 2020 – 2022 cycle and inform the direction of the program for the remainder of the cycle. The findings may also help further inform Georgia Power's future planning efforts.

Key findings from the study include:

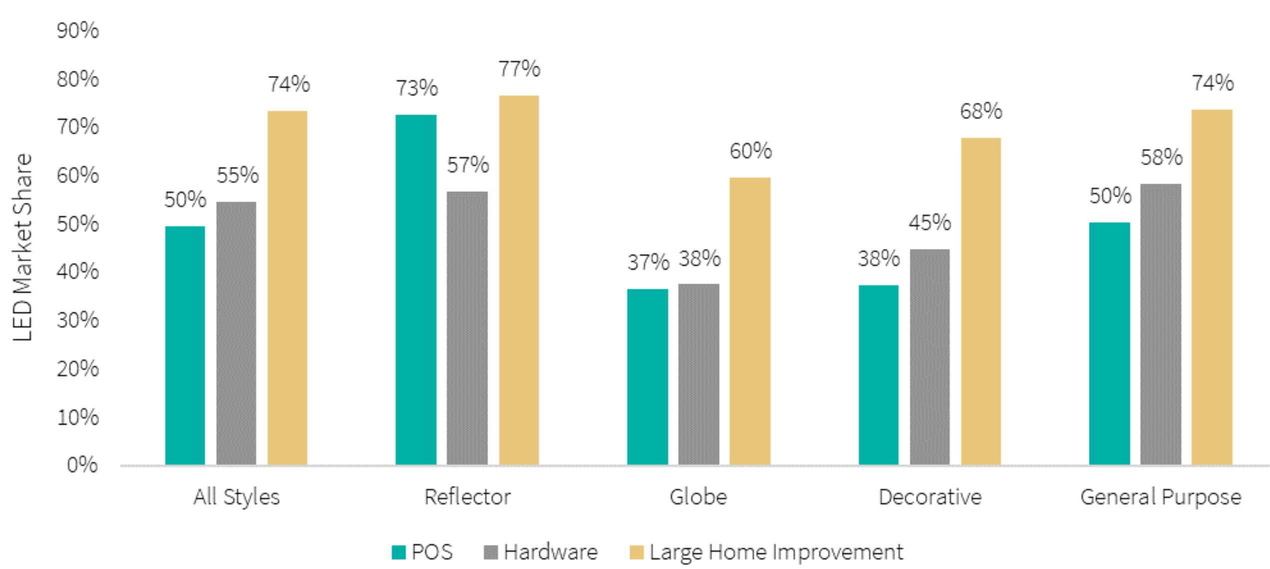
- LEDs make up most estimated lamp sales in non-program states (59% market share).

- LED market shares show considerable variation by lamp style, with reflectors having the highest LED market share at 69% and globes having the lowest at 43%.

- LED market shares are considerably higher in large home improvement stores compared to hardware stores and grocery/dollar/discount/drug stores (the latter store type is referred to as the "POS" store type, as the research team purchased point-of-sale data for this store type as part of this study).

This third finding is particularly important given the wide range of retail partners Georgia Power collaborates with to deliver the Specialty Lighting program. Figure 121, which shows LED share of sales by bulb style and store type, visualizes these key findings.

Figure 121. LED Share of Sales by Style and Store Type



"POS" store types include grocery, dollar, discount, and drug stores.

The key findings clearly support the program design decisions made by Georgia Power for 2020 – 2022 in focusing on specialty bulbs and moving from home improvement to hardware and grocery, dollar, discount, and drug stores. Additionally, the findings suggest that the opportunity for savings remains in the near term, as non-LEDs account for an estimated 41% of lamp sales in non-program states. This is particularly true among specialty lightbulbs in POS and small hardware stores, where non-LEDs account for more than half of lamp sales in non-program states. But we must not ignore the continuing transition to LEDs in the lighting market. Even in states without upstream lighting programs, LEDs currently represent most of all bulbs sold, and we expect the market share of LEDs to continue climbing in future years. Though energy savings potential exists in Georgia, the market transformation will lead to higher and higher freeridership estimates (i.e., lower, and lower NTGRs for the Residential Specialty Lighting program).

Appendix 3B: Recent Developments Regarding EISA Under the Biden Administration

President Biden issued an executive order on his first day in office (January 20, 2021) directing heads of federal agencies to review existing regulations, orders, and other policies that conflict with efforts to address climate change.[79] In response, the DOE identified 13 specific actions, including both of the 2019 final EISA rules.[80] On March 5, 2021, DOE and the litigants in the lawsuit agreed to a 60-day abeyance, putting the proceedings on hold to give DOE time to review the rules and determine next steps.[81] The abeyance was extended on June 1, 2021.

DOE (under the Biden administration) also released a semi-annual regulatory agenda on March 31, 2021 with Energy Conservation Standards for GSLs as the first item.[82] The agenda states that "DOE will issue a Supplemental Notice of Proposed Rulemaking (NOPR) that includes a proposed determination with respect to whether to amend or adopt standards for general service light-emitting diode (LED) lamps and that may include a proposed determination with respect to whether to amend or adopt standards for compact fluorescent lamps."

On May 20, 2021, DOE issued a Request for Information (RFI) regarding the EISA backstop provision.[83] In particular, DOE requested information on availability of lamps (those both defined as GSLs and those not defined as GSLs, according to EISA), market share for these lamps, ability to create lamps that meet the 45 lumen/Watt requirement, sell through periods for existing stock, and expectations around potential stranded inventory.

On August 9, 2021, DOE took additional action by issuing a Notice of Proposed Rulemaking (NOPR) that expands the GSL definition to include most specialty styles (e.g., globes, candelabras, and reflectors) that were initially exempt from EISA, but included by DOE under the Obama administration.[84]

The agenda item, RFI, and NOPR regarding the GSL definition imply that the Biden administration plans to take additional action on GSL standards in the next six months. Although the exact timing of a NOPR to reinstate the backstop is unclear, a final rule could follow the Supplemental NOPR relatively quickly; roughly seven months passed between the Trump DOE's NOPR on the expanded definition of GSLs and the final rule, and there were less than four months between the NOPR and the final rule rescinding the backstop. It is not

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[79] https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/20/executive-order-protecting-public-health-and-environment-and-restoring-science-to-tackle-climate-crisis/
[80] https://energycentral.com/c/ee/doe-eere-2021-02-19-memo-review-actions-prior-administration
[81] https://energycentral.com/system/files/ece/nodes/475624/16-3652_motion_to_hold_in_abeyance_for_review.pdf
[82] https://www.govinfo.gov/content/pkg/FR-2021-03-31/pdf/2021-05662.pdf
[83] https://www.energy.gov/sites/default/files/2021-05/gsl-backstop-rfi.pdf
[84] https://www.energy.gov/sites/default/files/2021-08/gsl-definition-nopr_0.pdf

yet clear how this proposed rulemaking might interact with the EISA standards, which the Trump administration defined narrowly as applying only to incandescent lamps in their justification for rescinding the EISA backstop.

Lighting manufacturers, through the National Electrical Manufacturer Association (NEMA) trade group, are likely to oppose any action DOE takes to restore the expanded GSL definition or the 45 lumen/Watt backstop and are preparing to do so.[85] For example, the lightbulb manufacturing industry could pursue legal challenges to any rules DOE (under the Biden administration) made without a decision from the court invalidating the Trump administration's previous actions. As part of those legal challenges, manufacturers could seek an injunction to prevent DOE from implementing revised rules while the lawsuit was decided.

It appears likely that the Biden administration will act before the end of 2021 to restore the Obama-era lighting standards, including both the expanded GSL definition as well as the 45 lumen/Watt efficiency standard. There is uncertainty, however, as to the length of time DOE will allow between adoption of the standards and the time it begins enforcing compliance. Lightbulb manufacturers will argue a period of years is necessary, while efficiency advocates believe six months would be generous. A 12-month sell-through period would represent a compromise between the matter of months efficiency advocates support and the years lightbulb manufacturers will seek, recognizing that the Biden administration appears motivated to restore these standards. The standards could also take years to take effect, however, if the DOE pursues new rulemaking and NEMA pursues litigation and wins an injunction against the DOE.

With all this uncertainty in mind, it appears reasonable to assume that the expanded GSL definition and 45 lumen/Watt efficiency standard will be in effect by sometime in 2023 or 2024. This means there is possibly only one to two additional years remaining for upstream lighting programs to impact the retail market for LEDs. Given the difficulty of restarting a program once it has been ended, we recommend planning for lighting programs to continue through at least the end of 2022 but being prepared to terminate the program should the EISA backstop be reinstated.

[85] In correspondence, one industry actor referred to the industry's analysis and preparations as "wargaming."

Appendix 3C: Survey Demographics

Below is a detailed table of the survey respondent demographics.

Table 119. Home Characteristics

HOME CHARACTERISTICS		PERCENT
Rent or own home	Rent	11%
	Own	89%
	Total respondents (n)	246
Type of home	Single Family	91%
	Multifamily	9%
	Total respondents (n)	249
Number of years lived in home	One year or less	10%
	2 – 3 years	21%
	4 – 5 years	13%
	6 – 10 years	13%
	More than 10 years	43%
	Total respondents (n)	249
Year home was built	Before 1900	1%
	1900 to 1939	6%
	1940 to 1959	8%
	1960 to 1979	14%
	1980 to 1989	13%
	1990 to 1999	20%
	2000 to 2004	13%
	2005 or later	25%
	Total respondents (n)	233
Number of people living in home	One	16%
	Two	44%
	Three	21%
	Four	10%
	Five	6%
	Six	1%
	Seven	0%
	Eight	1%
	Total respondents (n)	236
How number of people in home changed since 2019	Increased	8%
	Decreased	12%
	Stayed the same	80%
	Total respondents (n)	243

Source: Online Lighting Marketplace customer survey. H1-H6.

Table 120. Respondent Characteristics

RESPONDENT CHARACTERISTICS		PERCENT
Generation age grouping	Silent generation - 76 or older	7%
	Baby boomer - between 57 and 75	44%
	Gen X - between 45 and 56	21%
	Millennials - between 26 and 44	28%
	Gen Z - younger than 25	0%
	Total respondents (n)	230
Total annual household income	Less than $25,000	8%
	$25,000 to less than $50,000	17%
	$50,000 to less than $75,000	17%
	$75,000 to less than $100,000	16%
	$100,000 to less than $150,000	21%
	$150,000 to less than $200,000	10%
	$200,000 or over	12%
	Total respondents (n)	179
Highest level of education completed	Some high school or less	1%
	High school graduate or equivalent	7%
	Some college, no degree	8%
	Technical college degree or certificate	6%
	Two-year college degree	6%
	Four-year college degree	34%
	Graduate or professional degree	37%
	Total respondents (n)	233
Employment situation	Working or attending school outside of the home	34%
	Working or attending school from home	23%
	Retired	26%
	Stay-at-home parent or care provider	6%
	Unemployed	4%
	On medical, disability or maternity leave	3%
	Something else	3%
	Total respondents (n)	251
Has employment situation changed since 2019	Yes	17%
	No	83%
	Total respondents (n)	236
Race or ethnicity	White	69%
	Black or African American	15%

RESPONDENT CHARACTERISTICS		PERCENT
	Asian	7%
	Hispanic, Latino, or Spanish origin	5%
	American Indian or Alaska Native	1%
	Some other race, ethnicity, or origin	1%
	Middle Eastern or North African	1%
	Native Hawaiian or Other Pacific Islander	0%
	Total respondents (n)	234
Language spoken at home	English	90%
	Spanish	4%
	Cantonese	0%
	French	1%
	Hindi	2%
	Other	3%
	Total respondents (n)	234

Source: Online Lighting Marketplace customer survey. H7-H13.

APPENDIX 4. – HOME ENERGY IMPROVEMENT PROGRAM – INDIVIDUAL IMPROVEMENTS AND WHOLE HOUSE

Appendix 4A. Algorithms and Assumptions

This appendix contains the assumptions used in electric savings and demand reduction algorithms for the measures within the Home Energy Improvement program (HEIP). The team used industry standard algorithms and customized each assumption to reflect the population of projects claimed in 2020 and Q1 2021. Where appropriate, we leverage assumptions from the Georgia Power TRM and other state TRMs. Detailed information on the analysis and supporting assumptions for the following HEIP measures are included within this appendix:

- Attic insulation
- Duct sealing
- Heat pump water heater
- Air sealing

Table 121 lists the key parameters for each measure.

Table 121. HEIP Program Measures

MEASURE	REVIEWED ASSUMPTIONS
Attic Insulation	Pre-install and post-install R-values, square footage of installed insulation, cooling degree hours, heating degree days, cooling system SEER, heating system COP
Duct Sealing	Pre-install and post-install duct leakage rates, full load cooling hours, heating degree days, indoor and outdoor design enthalpy, efficiencies of heating and cooling equipment
Air Sealing	Pre-install and post-install infiltration rates, N-factor, latent multiplier, cooling and heating degree days, efficiencies of heating and cooling equipment
Heat Pump Water Heater	Daily hot water usage, water temperature difference, baseline and installed uniform energy factor,

The algorithms and assumptions the evaluation team used to calculate *verified* savings for each of these measures follow.

Attic Insulation

The team used the following equation to calculate electric energy and peak demand cooling savings for attic insulation:

$$kWh\ cooling\ savings = \frac{\left(\frac{1}{R_{exist}} - \frac{1}{R_{new}}\right) \times CDH \times DUA \times Area \times Adj_{cool}}{1{,}000 \times \eta Cool}$$

$$Summer\ kW\ savings = kWh\ cooling\ savings \times DTE_{cooling}$$

For homes with electric heating, the team used the following equation to calculate electric energy and peak demand heating savings for attic insulation:

$$kWh\ heating\ savings = \frac{\left(\frac{1}{R_{exist}} - \frac{1}{R_{new}}\right) \times HDD \times 24 \times Area \times 293.1 \times Adj_{heat}}{1{,}000{,}000 \times \eta Heat}$$

$$Winter\ kW\ savings = kWh\ heating\ savings \times DTE_{heating}$$

Where:

R_{exist} = Pre-installation R-value

R_{new} = Post-installation R-value

CDH = Cooling degree hours, base 75 degrees (F)

DUA = Discretionary use adjustment to account for not always running the cooling system above 75 degrees (F) outdoor air temperature

Area = Square footage of area covered by new insulation

Adj_{cool} = Adjustment factor to account for real world savings from calculation

1,000 = Constant to convert watts to kW

ηCool = Efficiency of the cooling system, SEER

HDD = Heating degree days

24 = Constant to convert days to hours

293.1 = Constant to convert MMBtu to kWh

Adj_{heat} = Adjustment factor to account for real world savings from calculation

1,000,000 = Constant to convert Btu to MMBtu

$\eta Heat$ = Efficiency of the heating system, COP

$DTE_{cooling}$ = Demand-to-energy ratio for space cooling end use

$DTE_{heating}$ = Demand-to-energy ratio for space heating end use

Table 122 lists the input assumptions and source of each assumption for the attic insulation measure savings calculations.

Table 122. Assumptions and Inputs for Attic Insulation

INPUT	VALUE	SOURCE
R_{exist}	Actual, if available; mean = R-13	Site-specific from project files, or mean average if not available.
R_{new}	Actual; mean = R-46	Site-specific from program tracking database.
CDH	14,577	TMY3 weather data for Atlanta.
DUA	0.75	Mid-Atlantic TRM version 9 which cites Energy Center of Wisconsin, May 2008 metering study. "Central Air Conditioning in Wisconsin, A Compilation of Recent Field Research", p31.
Area	Estimated	Estimated attic area based on home square footage from Georgia Power HEIP tracking database.
Adj_{cool}	0.8	Mid-Atlantic TRM version 9, which cites Illinois TRM, 9 as demonstrated in two years of metering evaluation by Opinion Dynamics. Adjusts savings derived through engineering algorithms to actual savings measured in field.
$\eta Cool$	12.94	Average cooling efficiency from the sampled projects in the HEIP Whole House evaluation sample.
HDD	2,826	TMY3 weather data for Atlanta-Hartsfield Airport at base 65.
Adj_{heat}	0.6	Mid-Atlantic TRM version 9, which cites Illinois TRM, 9 as demonstrated in two years of metering evaluation by Opinion Dynamics. Adjusts savings derived through engineering algorithms to actual savings measured in field.
$\eta Heat$	2.4	Average heating efficiency from the sampled projects in the HEIP Whole House evaluation sample.
$DTE_{cooling}$	0.00057	Average hourly fraction of residential space cooling load shape that falls in Georgia Power summer peak definition.
$DTE_{heating}$	0.00062	Average hourly fraction of residential space heating load shape that falls in Georgia Power summer peak definition.

Duct Sealing

The team used the following equation to calculate electric energy and peak demand cooling savings for duct sealing:

$$kWh\ cooling\ savings = \frac{\Delta CFM25DL \times EFLH_c \times 12{,}000 \times TRF_{cool}}{400 \times \eta Duct \times SEER \times 1{,}000}$$

$$Summer\ kW\ savings = kWh\ cooling\ savings\ \times DTE_{cooling}$$

For homes with electric heating, the team used the following equation to calculate electric energy and peak demand heating savings for duct sealing:

$$kWh\ heating\ savings = \frac{\Delta CFM25DL \times EFLH_h \times 12{,}000 \times TRF_{heat}}{400 \times \eta Duct \times HSPF \times C_{IV-III} \times 1{,}000}$$

$$Winter\ kW\ savings = kWh\ heating\ savings\ \times DTE_{heating}$$

Where:

ΔCFM25DL = Duct leakage reduction @ 25 pascals, CFM

$EFLH_c$ = Equivalent full-load hours of cooling

$EFLH_h$ = Equivalent full-load hours of heating

12,000 = Constant to convert tons to Btu/h

400 = Nominal CFM per ton of refrigeration

1,000 = Constant to convert watts to kW

SEER = Efficiency of the cooling system, SEER, Btu/W-hr

HSPF = Efficiency of the heating system, HSPF, Btu/W-hr

TRF_{cool} = Thermal regain factor for cooling depending on duct location

TRF_{heat} = Thermal regain factor for heating depending on duct location

ηDuct = Pre-duct sealing system distribution efficiency

C_{IV-III} = Conversion from rated HSPF to HSPF appropriate for AHRI climate zone III

$DTE_{cooling}$ = Demand-to-energy ratio for space cooling end use

$DTE_{heating}$ = Demand-to-energy ratio for space heating end use

Table 123. Assumptions and Inputs for Duct Sealing

INPUT	VALUE	SOURCE
ΔCFM25DL	Actual; mean = 207.3	Site-specific from program tracking database
EFLHc	816.4	Georgia Power Company TRM v2.0
EFLHh	728.7	Georgia Power Company TRM v2.0
SEER	12.94	Average cooling efficiency from the sampled projects in the HEIP Whole House evaluation sample
HSPF	8.2	Average heating efficiency from the sampled projects in the HEIP Whole House evaluation sample
TRFcool	1.0	MN TRM v3.2, value for unconditioned spaces (attic, crawl space, outdoors)
TRFheat	1.0	MN TRM v3.2, value for unconditioned spaces (attic, crawl space, outdoors)
ηDuct	0.89	Building Performance Institute, Inc., 11/20/2007, Distribution Efficiency look- Up Table, Building Performance Institute Technical Standards for the Heating Professional. Cited in MN TRM v3.2
CIV-III	1.1	C.K. Rice et al. An Analysis of Representative Heating Load Lines for Residential HSPF Ratings. July 2015. https://info.ornl.gov/sites/publications/files/Pub56184.pdf. Fig. B.4 shows an actual HSPF approximately 10% greater than rated HSPF for zone V, using the standard AHRI 210/240 load line. Cited in MN TRM 3.2 and adjusted for prevailing GA climate zone
DTEcooling	0.00057	Average hourly fraction of residential space cooling load shape that falls in Georgia Power winter peak periods
DTEheating	0.00062	Average hourly fraction of residential space heating load shape that falls in Georgia Power winter peak periods

lists the input assumptions and source of each assumption for the duct sealing measure savings calculations.

Table 123. Assumptions and Inputs for Duct Sealing

INPUT	VALUE	SOURCE
ΔCFM25DL	Actual; mean = 207.3	Site-specific from program tracking database
$EFLH_c$	816.4	Georgia Power Company TRM v2.0
$EFLH_h$	728.7	Georgia Power Company TRM v2.0
SEER	12.94	Average cooling efficiency from the sampled projects in the HEIP Whole House evaluation sample

HSPF	8.2	Average heating efficiency from the sampled projects in the HEIP Whole House evaluation sample
TRF_{cool}	1.0	MN TRM v3.2, value for unconditioned spaces (attic, crawl space, outdoors)
TRF_{heat}	1.0	MN TRM v3.2, value for unconditioned spaces (attic, crawl space, outdoors)
ηDuct	0.89	Building Performance Institute, Inc., 11/20/2007, Distribution Efficiency look- Up Table, Building Performance Institute Technical Standards for the Heating Professional. Cited in MN TRM v3.2
$C_{IV\text{-}III}$	1.1	C.K. Rice et al. An Analysis of Representative Heating Load Lines for Residential HSPF Ratings. July 2015. https://info.ornl.gov/sites/publications/files/Pub56184.pdf. Fig. B.4 shows an actual HSPF approximately 10% greater than rated HSPF for zone V, using the standard AHRI 210/240 load line. Cited in MN TRM 3.2 and adjusted for prevailing GA climate zone
$DTE_{cooling}$	0.00057	Average hourly fraction of residential space cooling load shape that falls in Georgia Power winter peak periods
$DTE_{heating}$	0.00062	Average hourly fraction of residential space heating load shape that falls in Georgia Power winter peak periods

Air Sealing

The team used the following equation to calculate electric energy and peak demand cooling savings for air Sealing:

$$kWh\ cooling\ savings = \frac{(CFM50_{pre} - CFM50_{post}) \times 60 \times 24 \times CDD \times C_{air} \times LM}{1{,}000 \times SEER \times N_{factor}}$$

$$Summer\ kW\ savings = kWh\ cooling\ savings \times DTE_{cooling}$$

For homes with electric heating, the team used the following equation to calculate electric energy and peak demand heating savings for air sealing:

$$kWh\ heating\ savings = \frac{(CFM50_{pre} - CFM50_{post}) \times 60 \times 24 \times HDD \times C_{air} \times 293.1}{1{,}000{,}000 \times COP \times N_{factor}}$$

$$Winter\ kW\ savings = kWh\ heating\ savings \times DTE_{heating}$$

Where:

$CFM50_{pre}$ = Pre-improvement air flow needed to depressurize the home to -50 pascals

$CFM50_{post}$ = Post improvement air flow needed to depressurize the home to -50 pascals

60 = Constant to convert from minutes to hours

24 = Constant to convert from days to hours

CDD = Cooling degree days

C_{air} = Volumetric heat capacity of air, Btu/cu.ft.-°F

LM = Latent multiplier to account for latent cooling performed by air conditioner

1,000 = Constant to convert watts to kW

SEER = Efficiency of the cooling system, SEER

N_{factor} = Conversion factor to convert from CFM50 to natural air flow

HDD = Heating degree days

293.1 = Constant to convert MMBtu to kWh

1,000,000 = Constant to convert Btu to MMBtu

COP = Efficiency of the heating system, COP

$DTE_{cooling}$ = Demand-to-energy ratio for space cooling end use

$DTE_{heating}$ = Demand-to-energy ratio for space heating end use

Table 124 lists the input assumptions and source of each assumption for the air sealing measure savings calculations.

Table 124. Assumptions and Inputs for Air Sealing

INPUT	VALUE	SOURCE
$CFM50_{pre}$	Actual; mean = 3,212	Site-specific from program tracking database
$CFM50_{post}$	Actual; mean = 2,197	Site-specific from program tracking database
CDD	1,722	TMY3 weather data for Atlanta-Hartsfield Airport at base 65
C_{air}	0.018	Constant
LM	7.9	Dehumidification and Cooling Loads from Ventilation Air; Harriman, Plager, Kosar; ASHRAE Journal, November 1997, pp 37 - 45
SEER	12.94	Average cooling efficiency from the sampled projects in the HEIP Whole House evaluation sample
N_{factor}	40.5	Infiltration as Ventilation: Weather- Induced Dilution; William J. N. Turner, Max H. Sherman, Iain S. Walker; Environmental Energy Technologies Division; December 2012; average of climate zones 3A and 4A
HDD	2,826	TMY3 weather data for Atlanta-Hartsfield Jackson Airport at base 65
COP	2.4	Average heating efficiency from the sampled projects in the HEIP Whole House evaluation sample
$DTE_{cooling}$	0.00057	Average hourly fraction of residential space cooling load shape that falls in Georgia Power summer peak demand definition
$DTE_{heating}$	0.00062	Average hourly fraction of residential space cooling load shape that falls in Georgia Power winter peak demand definition

Heat Pump Water Heater

The team used the following equation to calculate electric energy and peak demand savings for heat pump water heaters:

$$kWh\ savings = \frac{\left(\frac{1}{UEF_{base}} - \frac{1}{UEF_{eff} \times F_{derate}}\right) \times HW \times 365 \times 8.3 \times C_p \times water\_temp}{3{,}412}$$

$$Summer\ kW\ savings = \ kWh\ savings\ \times DTE_{DHW\_summer}$$

$$Winter\ kW\ savings = \ kWh\ savings\ \times DTE_{DHW\_winter}$$

Where:

UEF_{base} = Uniform energy factor of the baseline water heater

UEF_{eff} = Uniform energy factor of the new heat pump water heater

F_{derate} = COP derate factor to account for temperature in the space where the HPWH is installed

HW = Estimated daily hot water use, gallons

365 = Constant to convert days to year

8.3 = Density of water, lb/gallon

C_p = Specific heat of water, 1 Btu/lb-°F

water_temp = Delta between inlet and hot water supply temperature, °F

3,412 = Constant to convert from Btu to kWh

DTE_{DHW_summer} = Summer demand-to-energy ratio for domestic water heating

DTE_{DHW_winter} = Winter demand-to-energy ratio for domestic water heating

Table 125 lists the input assumptions and source of each assumption for the heat pump water heater measure savings calculations.

Table 125. Assumptions and Inputs for Heat Pump Water Heaters

INPUT	VALUE	SOURCE
UEF_{base}	0.90	Georgia Power Company TRM v2.0
UEF_{eff}	Actual; mean = 3.67	Site-specific from program tracking database
F_{derate}	0.85	Georgia Power Company TRM v2.0
HW	55	Georgia Power Company TRM v2.0
water_temp	58	Georgia Power Company TRM v2.0
DTE_{DHW_summer}	0.000078	Average hourly fraction of residential domestic water heating load shape that falls in Georgia Power summer peak demand definition
DTE_{DHW_winter}	0.000213	Average hourly fraction of residential domestic water heating load shape that falls in Georgia Power winter peak demand definition

Appendix 4B. Multifamily Site Visit Results and Verified Gross Savings Results

This appendix provides a detailed accounting of the savings adjustments made at the project level for the Stone Mountain and Douglasville developments' multifamily projects in HEIP's Whole House path.

Stone Mountain Housing Development

Table 126 and Table 127 show the reported and verified energy savings and demand reduction for the complete set of Stone Mountain projects in the HEIP Whole House Multifamily program pathway.

Table 126. Adjustments to Reported Energy Savings for Stone Mountain Location Projects and Resulting Verified Energy Savings

BUILDING LETTER	QUANTITY OF APARTMENT UNITS	SITE VISIT UNITS	REPORTED SAVINGS		ADJUSTMENTS TO SAVINGS, PER UNIT					VERIFIED SAVINGS		
			TOTAL ELECTRIC SAVINGS (KWH)	AVG. SAVINGS PER UNIT (KWH)	DISHWASHER ENERGY SAVINGS TO REMOVE (KWH)	CLOTHES WASHER ENERGY SAVINGS TO REMOVE (KWH)	HEATING SYSTEM ENERGY SAVINGS TO REMOVE (KWH)	CENTRAL AIR CONDITIONER ENERGY SAVINGS TO REMOVE (KWH)	TOTAL ADJUSTMENT TO SAVINGS (KWH)	SAVINGS PER UNIT (KWH)	TOTAL SAVINGS (KWH)	KWH REALIZATION RATE
A	16	A12	49,196	3,075	168	370	240	196	-973	2,101	33,622	68.3%
B	16	B5	48,988	3,062	168	370	241	198	-976	2,086	33,374	68.1%
C	16		48,988	3,062	168	370	241	196	-975	2,087	33,389	68.2%
D	16		49,800	3,113	168	370	237	192	-967	2,145	34,327	68.9%
E	16	E14	49,200	3,075	168	370	240	196	-973	2,102	33,627	68.3%
F	16	F10	49,236	3,077	168	0	240	195	-602	2,475	39,599	80.4%
G	16		49,264	3,079	168	370	244	196	-978	2,101	33,620	68.2%
H	16		46,488	2,906	168	370	248	198	-984	1,921	30,736	66.1%
I	16		47,856	2,991	168	370	245	196	-978	2,013	32,208	67.3%
J	16		47,092	2,943	168	370	248	198	-984	1,959	31,349	66.6%
K	6		18,654	3,109	168	370	243	177	-958	2,151	12,908	69.2%
L	4		13,032	3,258	168	370	231	171	-940	2,318	9,273	71.2%
Total	170		517,794	3,046						2,106	358,030	69.1%

Table 127. *Reported* Summer Demand Reduction and *Verified* Summer and Winter Gross Demand Reduction for Stone Mountain Location Projects

BUILDING LETTER	QUANTITY OF APARTMENT UNITS	SITE VISIT UNITS	REPORTED SAVINGS		VERIFIED SAVINGS				
			TOTAL DEMAND SAVINGS (KW)	AVG. SAVINGS PER UNIT (KW)	SUMMER DEMAND SAVINGS PER UNIT (KW)	TOTAL SUMMER DEMAND SAVINGS (KW)	SUMMER DEMAND REALIZATION RATE	WINTER DEMAND SAVINGS PER UNIT (KW)	TOTAL WINTER DEMAND SAVINGS (KW)
A	16	A12	9.92	0.62	0.81	13.03	131%	0.79	12.72
B	16	B5	9.76	0.61	0.81	12.94	133%	0.79	12.63
C	16		9.76	0.61	0.81	12.94	133%	0.79	12.63
D	16		10.08	0.63	0.83	13.31	132%	0.81	12.99
E	16	E14	9.92	0.62	0.81	13.04	131%	0.80	12.72
F	16	F10	9.92	0.62	0.96	15.35	155%	0.94	14.98
G	16		9.76	0.61	0.81	13.03	134%	0.79	12.72
H	16		9.60	0.60	0.74	11.92	124%	0.73	11.63
I	16		9.76	0.61	0.78	12.49	128%	0.76	12.18
J	16		9.60	0.60	0.76	12.15	127%	0.74	11.86
K	6		4.14	0.69	0.83	5.00	121%	0.81	4.88
L	4		2.88	0.72	0.90	3.59	125%	0.88	3.51
Total	170		105.10	0.62	0.82	138.79	132%	0.80	135.44

Douglasville Housing Development

Table 128 and Table 129 show the reported and verified energy savings and demand reduction for the complete set of projects at the Douglasville housing development in the HEIP Whole House – Multifamily program pathway.

Table 128. Adjustments to Reported Energy Savings for Douglasville Location Projects and Resulting Verified Energy Savings

BUILDING NUMBER	QUANTITY OF APARTMENT UNITS	SITE VISIT UNITS	REPORTED SAVINGS		ADJUSTMENTS TO SAVINGS, PER UNIT						VERIFIED SAVINGS		
			TOTAL ELECTRIC SAVINGS (KWH)	AVG. SAVINGS PER UNIT (KWH)	DISHWASHER ENERGY SAVINGS TO REMOVE (KWH)	HEATING SYSTEM ENERGY SAVINGS TO REMOVE (KWH)	CAC ENERGY SAVINGS TO REMOVE (KWH)	HEATING SAVINGS TO ADD BACK (KWH)	CAC SAVINGS TO ADD BACK (KWH)	TOTAL ADJUSTMENT TO SAVINGS (KWH)	SAVINGS PER UNIT (KWH)	TOTAL SAVINGS (KWH)	KWH REALIZATION RATE
5	10		43,235	4,324	168	304	349	109	70	-643	3,681	36,808	85.1%
6	10	6B	43,610	4,361	168	290	336	109	70	-616	3,745	37,451	85.9%
7	8		34,692	4,337	168	299	338	109	70	-627	3,710	29,678	85.5%
8	5		22,200	4,440	168	260	337	109	70	-587	3,853	19,266	86.8%
9	8	9G	33,904	4,238	168	262	338	0	70	-698	3,540	28,318	83.5%
10	11		47,311	4,301	168	272	356	0	70	-726	3,575	39,320	83.1%
Total	52		224,952	4,326							3,670	190,841	84.8%

Table 129. *Reported* Summer Demand Reduction and *Verified* Summer and Winter Gross Demand Reduction for Douglasville Location Projects

BUILDING NUMBER	QUANTITY OF APARTMENT UNITS	SITE VISIT UNITS	REPORTED SAVINGS		VERIFIED SAVINGS				
			TOTAL DEMAND SAVINGS (KW)	AVG. SAVINGS PER UNIT (KW)	SUMMER DEMAND SAVINGS PER UNIT (KW)	TOTAL SUMMER DEMAND SAVINGS (KW)	SUMMER DEMAND REALIZATION RATE	WINTER DEMAND SAVINGS PER UNIT (KW)	TOTAL WINTER DEMAND SAVINGS (KW)
5	10		10.40	1.04	1.41	14.13	136%	1.38	13.85
6	10	6B	10.30	1.03	1.44	14.38	140%	1.41	14.09
7	8		8.32	1.04	1.42	11.39	137%	1.40	11.16
8	5		5.25	1.05	1.48	7.40	141%	1.45	7.25
9	8	9G	8.16	1.02	1.36	10.87	133%	1.33	10.65
10	11		11.33	1.03	1.37	15.10	133%	1.34	14.79
Total	52		53.76	1.03	1.41	73.27	136%	1.38	71.79

Appendix 4C. Survey Demographics

Table 130. Household Characteristics

HOUSEHOLD CHARACTERISTICS		PERCENT OF RESPONDENTS
Rent or own home	Rent	21%
	Own	79%
	Total respondents (n)	258
Type of home	Single family	96%
	Multifamily	4%
	Total respondents (n)	251
Primary heating fuel	Electric	46%
	Natural gas	50%
	Propane	3%
	Wood	1%
	Total respondents (n)	251
Water heater fuel type	Electric	48%
	Natural gas	49%
	Propane	2%
	Total respondents (n)	244
Number of years lived in home	One year or less	20%
	2 – 3 years	28%
	4 – 5 years	11%
	6 – 10 years	12%
	More than 10	28%
	Total respondents (n)	249
Year home was built	Before 1900	0%
	1900 to 1939	10%
	1940 to 1959	20%
	1960 to 1979	28%
	1980 to 1989	17%
	1990 to 1999	12%
	2000 to 2004	6%
	2005 or later	7%
	Total respondents (n)	214
Number of people living in home	Zero	0%
	One	11%
	Two	44%

HOUSEHOLD CHARACTERISTICS		PERCENT OF RESPONDENTS
	Three	18%
	Four	17%
	Five	6%
	Six	4%
	Total respondents (n)	239
How number of people in home changed since 2019	Increased	11%
	Decreased	10%
	Stayed the same	79%
	Total respondents (n)	243

Source: HEIP customer survey. N9 – N15

[a] *Percentages do not total to 100% because the question allowed multiple responses.*

Table 131. Respondent Characteristics

RESPONDENT CHARACTERISTICS		PERCENT OF RESPONDENTS
Generation age grouping	Silent generation - 76 or older	3%
	Baby boomer - between 57 and 75	28%
	Gen X - between 45 and 56	23%
	Millennials - between 26 and 44	45%
	Gen Z - younger than 25	2%
	Total respondents (n)	217
Total annual household income	Less than $25,000	9%
	$25,000 to less than $50,000	19%
	$50,000 to less than $75,000	14%
	$75,000 to less than $100,000	15%
	$100,000 to less than $150,000	19%
	$150,000 to less than $200,000	12%
	$200,000 or over	11%
	Total respondents (n)	194
Highest level of education completed	Some high school or less	2%
	High school graduate or equivalent	10%
	Some college, no degree	11%
	Technical college degree or certificate	3%
	Two-year college degree	11%
	Four-year college degree	30%
	Graduate or professional degree	32%
	Total respondents (n)	235
Employment situation [a]	Working or attending school outside of the home	43%

RESPONDENT CHARACTERISTICS		PERCENT OF RESPONDENTS
	Working or attending school from home	28%
	Retired	17%
	Stay-at-home parent or care provider	4%
	Unemployed	2%
	On medical, disability or maternity leave	5%
	Something else	1%
	Total respondents (n)	230
Has employment situation changed since 2019	Yes	18%
	No	82%
	Total respondents (n)	239
Race or ethnicity [a]	White	78%
	Black or African American	12%
	Asian	2%
	Hispanic, Latino, or Spanish origin	5%
	American Indian or Alaska Native	1%
	Some other race, ethnicity, or origin	2%
	Total respondents (n)	213
Language spoken at home [a]	English	96%
	Spanish	2%
	Mandarin	0%
	Japanese	0%
	Other	1%
	Total respondents (n)	242

Source: HEIP customer survey. N9 – N15

[a.] Percentages do not total to 100% because the question allowed multiple responses.

APPENDIX 5. – HOME ENERGY IMPROVEMENT PROGRAM – THERMOSTAT MARKETPLACE

Appendix 5A: Methodology

This appendix contains the detailed methodology used in electric savings and demand reduction algorithms for the Thermostat Marketplace measure. The team pre-determined the methodological approach for the analysis to ensure reliable, scientific results. Detailed information on the analysis and supporting assumptions for the Thermostat Marketplace measure are included within this appendix.

Matching

The evaluation team performed matching through a two-step process which incorporates both billing data and hourly AMI data. In the first step, we used billing data to narrow the pool of candidates for matches from 170,000 to 30,000 customers. This billing phase of matching requires calendarizing the billing data of both participating customers and the pool of comparison group customers. The calendarization process allows for allocation of billed usage across the dates in a billing cycle. Usage is then aggregated to the monthly level and standardized for all customers. Thermostat purchase and installation occurred on a continuous basis, so there is variation in treatment timing. We defined a distinct post-period for every participant based on the purchase date of their first Marketplace thermostat. This ensured the pre-period did not include any potential savings from the thermostat.

The evaluation team compared 12 months of pre-period usage data for participating customers to the same 12 months for all nonparticipant customers in the pool provided by Georgia Power. Our matching mechanism used Euclidean distance matching to match each participant to the nearest three non-participating customers. The evaluation team performed matching with replacement, indicating that multiple participants can have the same comparison group customer that best matches the pre-period usage. Figure 122 shows the trend of average daily usage for the treatment group, along with the daily usage for the selected group of Stage 1 comparison group customers.

Figure 122. Equivalence Check on Stage 1 Matches

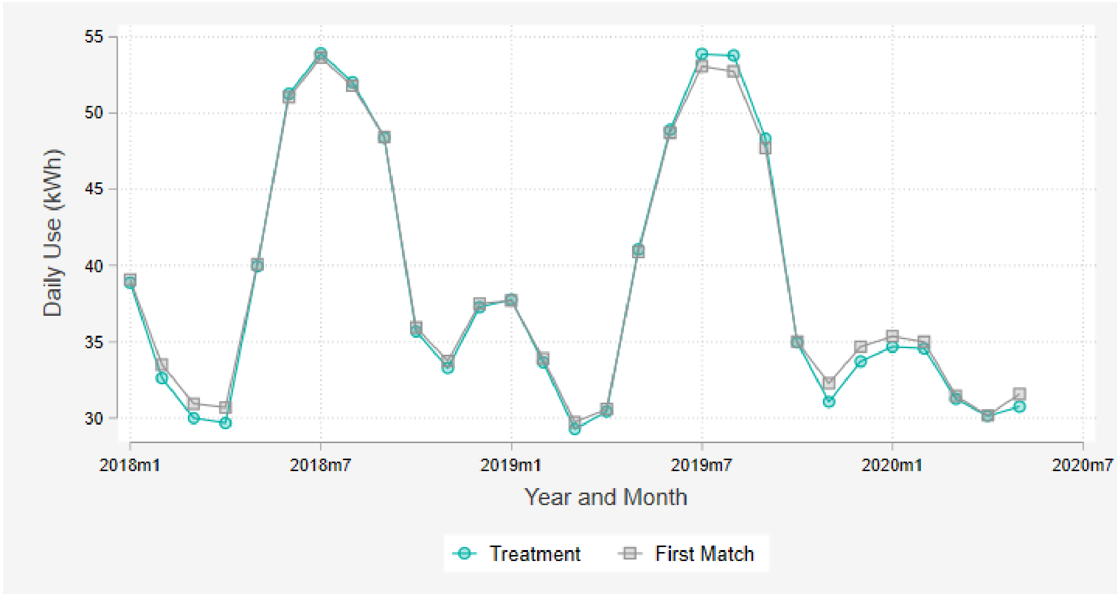
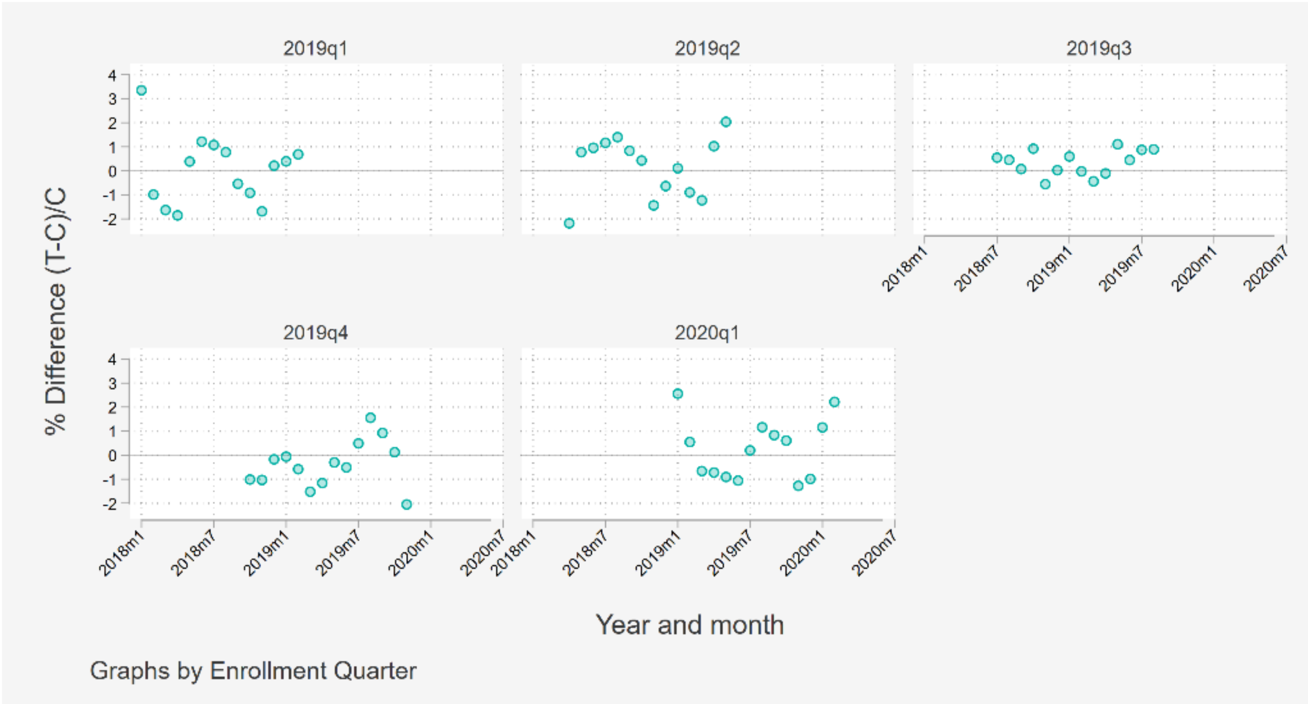


Figure 123 shows the percent difference of treatment and matched comparison group average daily usage by month for each possible participation quarter. Due to the continuous nature of program rebates and assumed thermostat installations, the date that any given account transitioned from “pre-smart thermostat” to “post-smart thermostat” ranged from late 2018 to mid-2020. To compare pre- and post-treatment periods, we separated participants based on when enrollment occurred. Matches were selected based on 12 months of pre-treatment data. Figure 123 shows this set of pre-period months in the scatter plot in teal. Ideally, treatment and comparison groups would be identical (percent difference = 0%) in each of the pre-period months. On average, the Stage 1 trends suggested differences were small, but we performed Stage 2 of matching using AMI data to improve these differences and minimize pre-treatment differences further.

Figure 123. Pre-Period Comparisons by Participation Quarter – Percent Difference in Daily kWh



Once the Stage 1 matching was complete, the evaluation team compiled and shared a list of 30,000 customers with Georgia Power. This list included each participant's closest match and their second-closest matches. The second closest matches were often the second best for multiple customers. Georgia Power provided the AMI data for these customers from January 2018 through March 2021, which were included in the Stage 2 matching. Before conducting the Stage 2 matching, we cross-referenced the list of accounts for participation in other Georgia Power residential programs. We removed comparison group customers that were enrolled in the Georgia Power Temp✓ program because we know smart thermostats are required for participation in this demand response program but were ideally matching to customers without smart thermostats.

To minimize the pre-period difference as much as possible, the Stage 2 matching used AMI data and implemented propensity score matching to further refine the matched comparison group pool. Using propensity score matching, we estimated a mix of model specifications and segmentation structures. In this sense, segmentation is used to describe the pre-matching categorization of customers to ensure customers are matched with nonparticipant customers that share common characteristics. For example, homes that purchased a Marketplace thermostat and receive Home Energy Reports (HERs) in the Behavioral program are matched with a comparison group home that also receives HERs. This ensured that we would isolate the effect of the thermostat by netting out any unrelated savings due to participation in the Behavioral program. We performed a similar segmentation for premise type (single family and multifamily) and clustered load shape bins. To classify customers with similar behavior patterns, we created these bins for monthly usage across the year and average hourly usage during summer and winter seasons. These three binning variables, in addition to HER status, premise type, and treatment month result in over 3,400 segments on which we performed propensity score matching.

The propensity score model used for matching specified average daily use as the matching variable. The process included a caliper to ensure that matches are within a specified range of the treated customer, indicating similar usage. Because of the pre-binning strategy and the caliper, 6.8% of participating customers were not matched. Ultimately, 13,091 participants matched to 10,174 nonparticipant customers. While we allowed for matching with replacement, most comparison group customers were selected for only one participant. Some nonparticipants were chosen for up to six participants, as shown in Figure 124. Notably, we did not restrict matches to the same zip code or weather station. The selected matches span most of the same territories as the treatment group, as seen in Figure 125. The participant group has a slightly higher concentration in the metro Atlanta area.

Figure 124. Comparison Group Matching Frequency

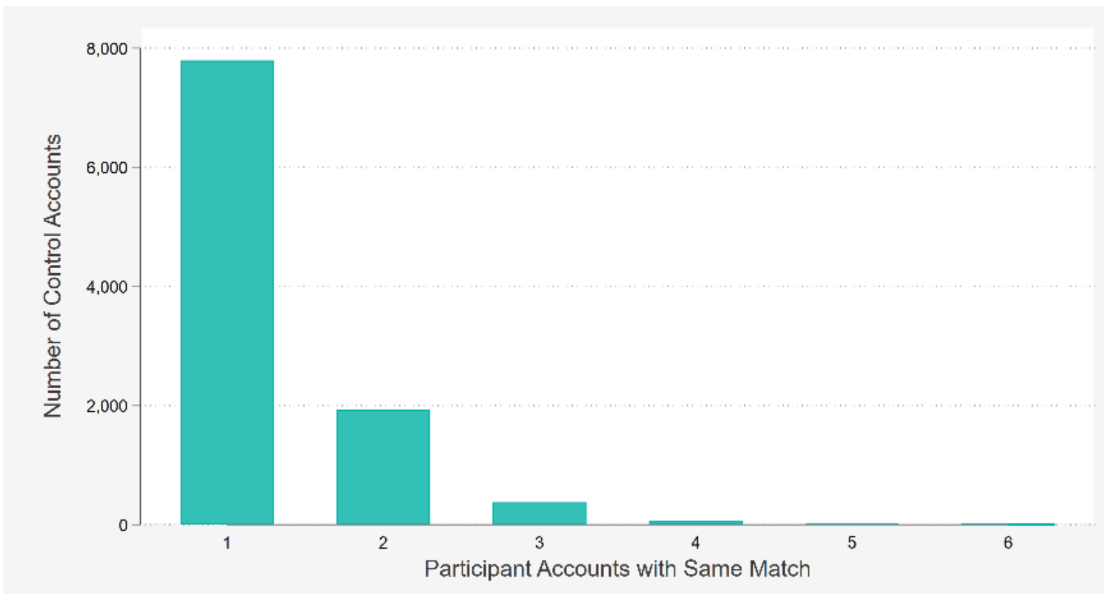


Figure 125. Distribution of Participant (Left) and Matched Comparison Group (Right) Customers

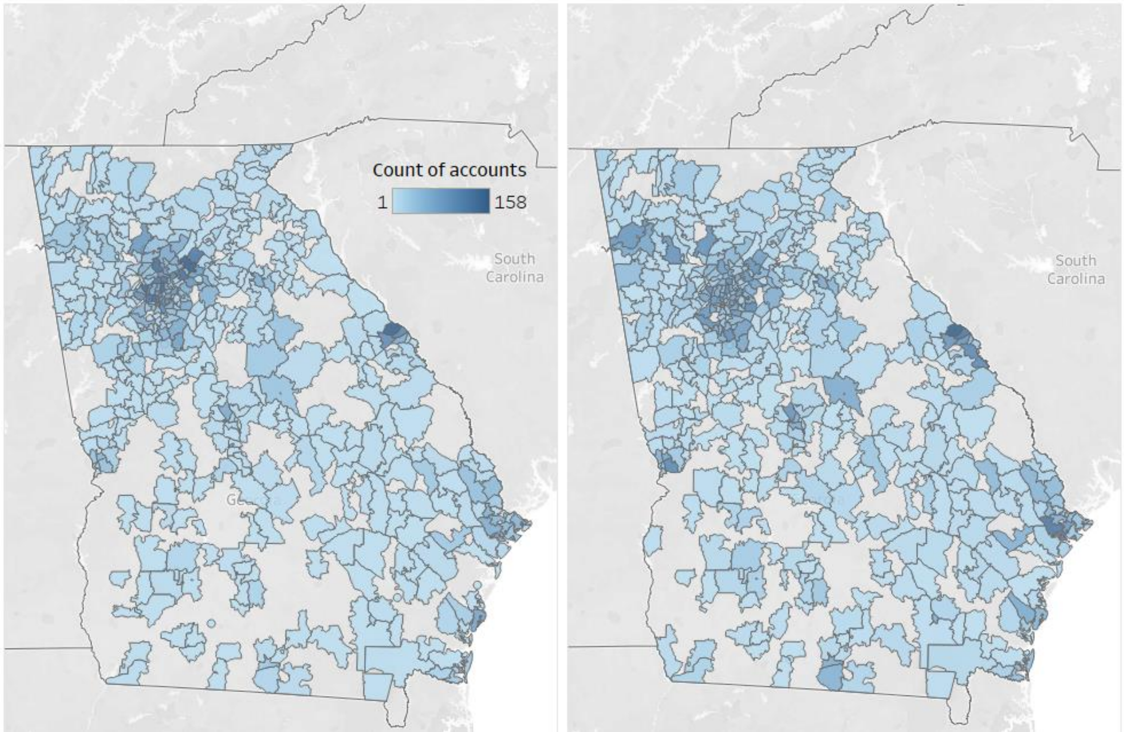
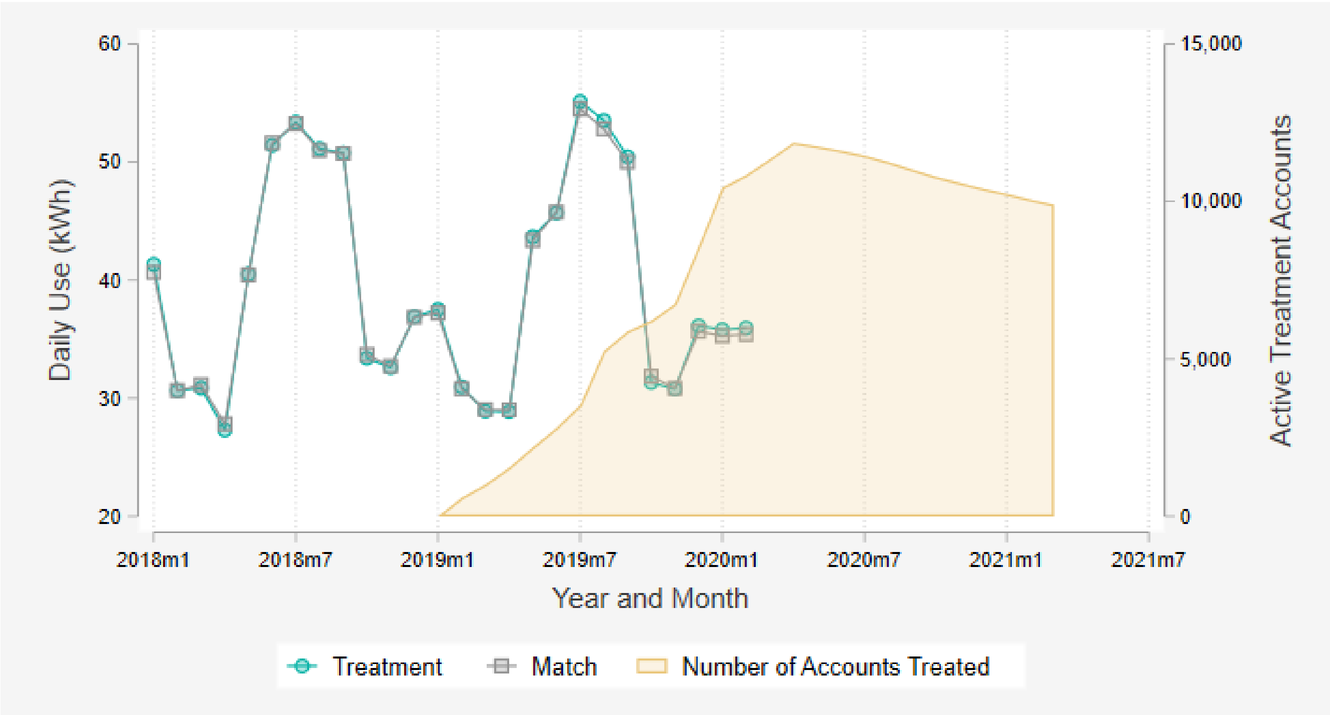


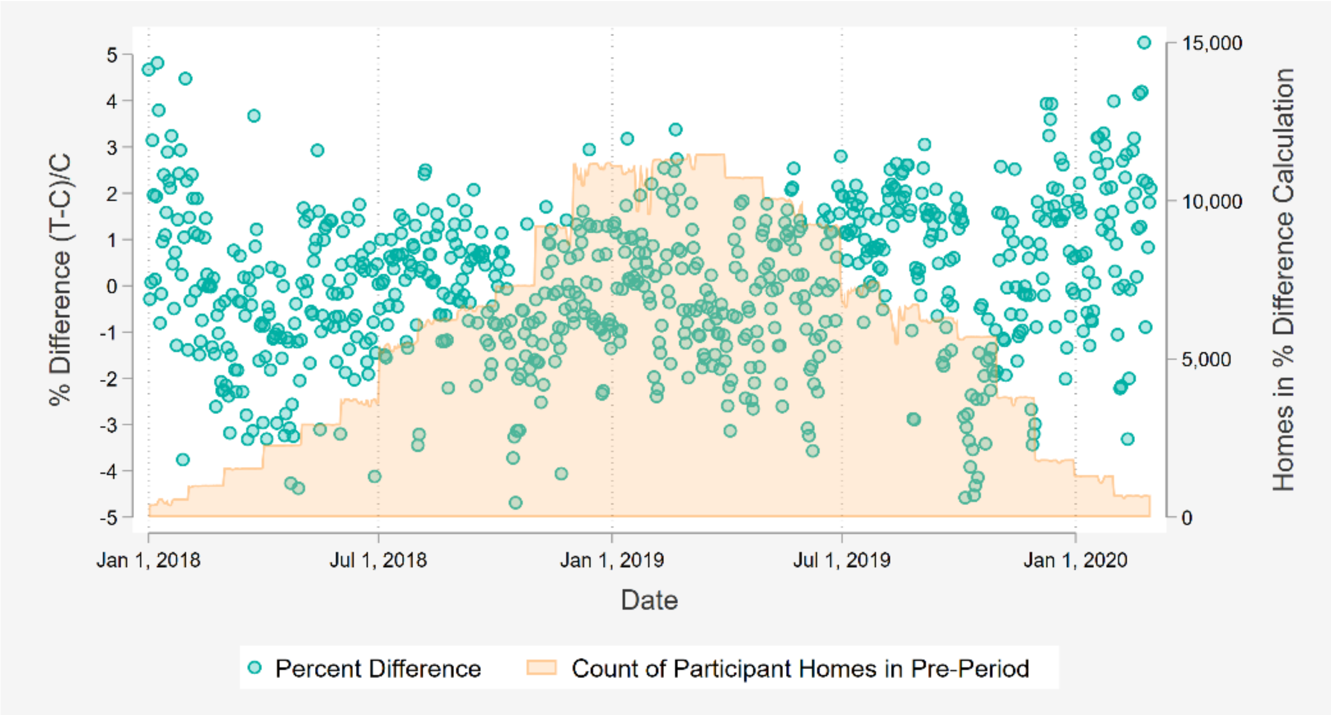
Figure 126 shows the match quality and the number of treated customers over the course of the evaluation period. Some treatment month cohorts have small differences in average usage from their matched comparison group. To net out remaining pre-treatment differences and further refine the analysis, the evaluation team used difference in difference regression analysis. We pre-determined the proposed modeling strategy used to account for these differences between the treatment and comparison groups. Over time, the number of active participant customers diminished as customers (or their matches) closed their Georgia Power electric account.

Figure 126. Stage Two Matches



While it is difficult to see any difference between the participants and their matches in Figure 126, small differences remain. Figure 127 focuses in on the pre-treatment differences at the daily level. The weighted average difference across all the green points in Figure 127 is 0.06%.

Figure 127. Stage 2 Matches – Average Difference in Daily kWh



Modeling

The impact evaluation model identified the effect of treatment in the post-period by keeping only the participants in the dataset and including the electricity usage of the matched home as an explanatory variable. The evaluation team omitted demand response days from the data, as well as months of installation for each customer and its matched nonparticipant. The model estimated daily usage (kWh) using a fixed effects panel regression with the average daily usage of the comparison group and a post-period indicator as the only explanatory variables. The comparison group's average daily usage variable explains most of the variation in the participant group because the two groups experience similar weather, day of week, and other factors. This allowed us to isolate the impact of treatment (i.e., the installation of a rebated smart thermostat) in the post-period by estimating the effect of the post indicator. The model relied on customer level fixed effects and cluster robust standard errors.

$$\boldsymbol{kWh_{a,h,d} = \beta_0 + \beta_1 Matched\ kWh_{a,h,d} + \beta_2 Post_d}$$

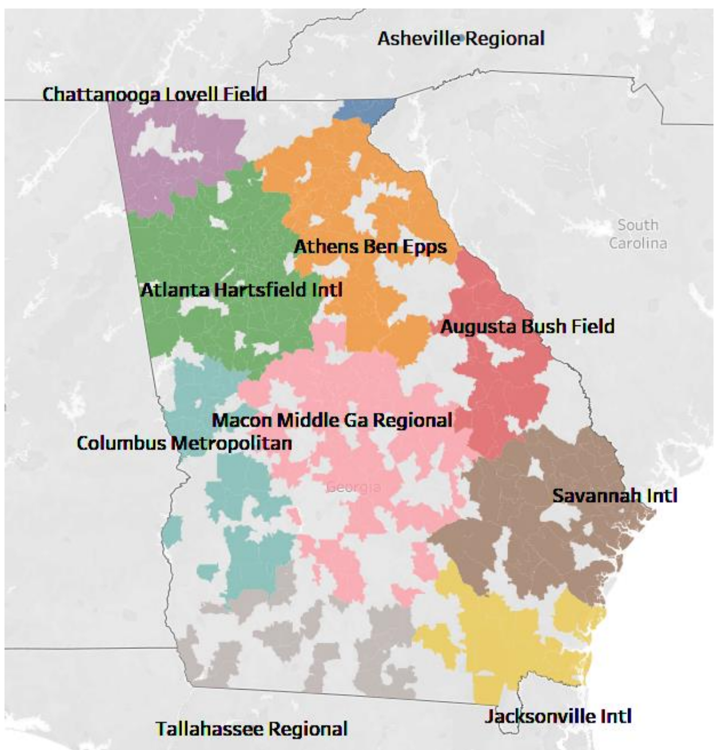
- $kWh_{a,h,d,tr}$: The hourly (h) usage for customer a, on day of week d, for the treated customer.
- Matched $kWh_{a,h,d}$: The usage for customer a's match, in each hour. Captures the effects of weather variation, hour of day, day of week, and other factors that affect energy use.
- Post: Integer equal to zero prior to a customer's first thermostat purchase and equal to one after the customer's first thermostat purchase. The coefficient on the post term is our parameter of interest.

We performed the regression analysis on customer-level AMI usage data, but accounts can have multiple thermostats per home. To convert from per customer to per home impacts, we divided the coefficient of interest (on the post term) by the average number of thermostats per home in the estimation sample.

We used this regression model to study the impacts of the full sample and for various segmentations of our population. The primary segmentation of interest was Single Family versus Multifamily.

To obtain the time-differentiated impacts, we ran a time of week and temperature (TOWT) model to distribute the annual savings calculated in the core analysis, 205 kWh per thermostat. We applied the TOWT model to the same estimation data set as the core regression but used temperature and time of week as the predictors to understand the savings. Temperature was pulled from a customer's nearest weather station, as shown in Figure 128. The regression coefficients were predicted on TMY3 weather data to estimate savings for each hour of a typical weather year.

Figure 128. Customer Mapping of Service Zip Code to Weather Station



Appendix 5B: Survey Demographics

Table 132. Home Characteristics

HOME CHARACTERISTICS		PERCENT OF RESPONDENTS
Rent or own home	Rent	7%
	Own	93%
	Total respondents (n)	204
Type of home	Single Family	91%
	Multifamily	9%
	Total respondents (n)	205
Number of years lived in home	One year or less	28%
	2 – 3 years	25%
	4 – 5 years	12%
	6 – 10 years	10%
	More than 10 years	25%
	Total respondents (n)	204
Year home was built	Before 1900	1%
	1900 to 1939	2%
	1940 to 1959	8%
	1960 to 1979	15%
	1980 to 1989	9%
	1990 to 1999	19%
	2000 to 2004	15%
	2005 or later	32%
	Total respondents (n)	199
Number of people living in home	Zero	1%
	One	19%
	Two	33%
	Three	20%
	Four	16%
	Five	9%
	Six	2%
	Seven	1%
	Eight	0%
	Nine	1%
	Total respondents (n)	197
How number of people in home changed since 2019	Increased	15%
	Decreased	11%
	Stayed the same	74%
	Total respondents (n)	201

Source: Online Marketplace customer survey. J1 – J7

Table 133. Respondent Characteristics

RESPONDENT CHARACTERISTICS		PERCENT OF RESPONDENTS
Generation age grouping	Silent generation - 76 or older	2%
	Baby boomer - between 57 and 75	23%
	Gen X - between 45 and 56	28%
	Millennials - between 26 and 44	46%
	Gen Z - younger than 25	2%
	Total respondents (n)	187
Total annual household income	Less than $25,000	4%
	$25,000 to less than $50,000	10%
	$50,000 to less than $75,000	14%
	$75,000 to less than $100,000	17%
	$100,000 to less than $150,000	32%
	$150,000 to less than $200,000	7%
	$200,000 or over	16%
	Total respondents (n)	166
Highest level of education completed	Some high school or less	0%
	High school graduate or equivalent	7%
	Some college, no degree	12%
	Technical college degree or certificate	4%
	Two-year college degree	4%
	Four-year college degree	30%
	Graduate or professional degree	38%
	Total respondents (n)	194
Employment situation [a]	Working or attending school outside of the home	56%
	Working or attending school from home	43%
	Retired	14%
	Stay-at-home parent or care provider	5%
	Unemployed	2%
	On medical, disability or maternity leave	3%
	Something else	3%
	Total respondents (n)	182
Has employment situation changed since 2019	Yes	20%
	No	80%
	Total respondents (n)	194
Race or ethnicity [a]	White	64%
	Black or African American	21%
	Asian	9%

RESPONDENT CHARACTERISTICS		PERCENT OF RESPONDENTS
	Hispanic, Latino, or Spanish origin	9%
	American Indian or Alaska Native	2%
	Some other race, ethnicity, or origin	2%
	Middle Eastern or North African	0%
	Native Hawaiian or Other Pacific Islander	2%
	Total respondents (n)	174
Language spoken at home [a]	English	98%
	Spanish	5%
	Korean	1%
	French	2%
	Hindi	2%
	Other	4%
	Total respondents (n)	194

Source: Online Marketplace customer survey. J8 – J14

[a] Percentages do not total to 100% because the question allowed multiple responses.

APPENDIX 6. – HOME ENERGY EFFICIENCY ASSISTANCE PROGRAM(HEEAP)

Appendix 6A: Algorithms and Assumptions

This appendix contains the assumptions used in electric savings and demand reduction algorithms for the measures within HEEAP. The team examined each assumption behind the algorithms to capture savings and compared it against the Georgia Power TRM version 2.0, as well as other state and industry approaches. Detailed information on the analysis and supporting assumptions for the following HEEAP measures are included within this appendix:

- LEDs
- Ceiling insulation
- Duct sealing
- HVAC Servicing
- Air sealing
- Smart thermostats
- Pipe insulation
- Water heater insulation jacket

Table 134 lists the assumptions of the *verified* per-measure savings.

Table 134. HEEAP Measures

MEASURE	KEY PARAMETERS
LEDs	Per-unit verified savings are adapted from the results of the 2021 Specialty Lighting program impact evaluation and mirror Food Bank LEDs with a 100% in-service rate.
Ceiling Insulation	Pre-install and post-install R-values, square footage of installed insulation, cooling degree hours, heating degree days, cooling system SEER, heating system COP, heating and cooling savings adjustment factors and discretionary use adjustment factors space heating and cooling load shapes.
Duct Sealing	Pre-install and post-install duct leakage rates, full load cooling hours, heating degree days, indoor and outdoor design enthalpy, efficiencies of heating and cooling equipment, space heating and cooling load shapes.
HVAC Servicing	Average heating and cooling end use consumption, maintenance savings factor, space heating and cooling load shapes.
Air Sealing	Pre-install and post-install infiltration rates, N-factor, latent multiplier, cooling and heating degree days, efficiencies of heating and cooling equipment, space heating and cooling load shapes.
Smart Thermostats	Verified savings comes from 2021 Thermostat Marketplace impact evaluation, number of smart thermostats per home/project.
Pipe Insulation	R-value of existing uninsulated pipe, R-value of insulation added to pipe, length of pipe, diameter of pipe, difference in temperature between hot water and ambient air, recovery efficiency of domestic hot water heater, water heating load shape.
Water Heater Insulation Jacket	Size of water heaters in program, water heating load shape.

The algorithms and assumptions the evaluation team used to calculate *verified* savings for each of these measures follow.

LEDs

The team applied the following per-unit savings to calculate electric energy and peak demand savings for LEDs:

$$kWh\ savings\ per\ lamp = 31.8\ \text{kWh}$$

$$Summer\ kW\ reduction\ per\ lamp = 0.004\ \text{kW}$$

$$Winter\ kW\ reduction\ per\ lamp = 0.005\ \text{kW}$$

These per-unit savings values were calculated as part of the 2021 Specialty Lighting evaluation. Since LED bulbs are directly installed in HEEAP, the in-service rate parameter is set to 100%. This leads to slightly higher per-unit savings assumptions than the values shown in Table 135 because an in-service rate of 85.2% is assumed for standard LEDs in the Specialty Lighting program.

Attic Insulation

The team used the following equations to calculate electric energy and peak demand cooling savings for attic insulation:

$$kWh\ cooling\ savings = \frac{\left(\frac{1}{R_{exist}} - \frac{1}{R_{new}}\right) \times CDH \times DUA \times Area \times Adj_{cool}}{1{,}000 \times \eta Cool}$$

$$Summer\ kW\ savings = \ kWh\ cooling\ savings\ \times DTE_{cooling}$$

For homes with electric heating, the team used the following equations to calculate electric energy and peak demand heating savings for attic insulation:

$$kWh\ heating\ savings = \frac{\left(\frac{1}{R_{exist}} - \frac{1}{R_{new}}\right) \times HDD \times 24 \times Area \times 293.1 \times Adj_{heat}}{1{,}000{,}000 \times \eta Heat}$$

$$Winter\ kW\ savings = \ kWh\ heating\ savings\ \times DTE_{heating}$$

Where:

R_{exist} = Pre-installation R-value

R_{new} = Post-installation R-value

CDH = Cooling degree hours

DUA = Discretionary use adjustment to account for not always running the cooling system above 75°F OAT

Area = Square footage of area covered by new insulation

Adj_{cool} = Adjustment factor to account for real world savings from calculation

1,000 = Constant to convert watts to kW

ηCool = Efficiency of the cooling system, SEER

HDD = Heating degree days

24 = Constant to convert days to hours

293.1 = Constant to convert MMBtu to kWh

Adj_{heat} = Adjustment factor to account for real world savings from calculation

1,000,000 = Constant to convert Btu to MMBtu

ηHeat = Efficiency of the heating system, COP

$DTE_{cooling}$ = Demand-to-energy ratio for space cooling end use

$DTE_{heating}$ = Demand-to-energy ratio for space heating end use

Table 135 lists the input assumptions and source of each assumption for the attic insulation measure savings calculations.

Table 135. Assumptions and Inputs for Attic Insulation

INPUT	VALUE	SOURCE
R_{exist}	Site-specific or 13.65	HEEAP project documents or average baseline R-value from 2021 HEIP Individual Improvements impact evaluation.
R_{new}	Site-specific or 38	HEEAP project documents or average baseline R-value from 2021 HEIP Individual Improvements impact evaluation.
CDH	14,577	TMY3 weather data for Atlanta.
DUA	0.75	Mid-Atlantic TRM version 9 which cites Energy Center of Wisconsin, May 2008 metering study. “Central Air Conditioning in Wisconsin, A Compilation of Recent Field Research”, p31.
Area	Site-specific, estimated	Estimated attic area based on Google Earth inspection of property address.
Adj_{cool}	0.8	Mid-Atlantic TRM version 9, which cites Illinois TRM, v9.0 as demonstrated in two years of metering evaluation by Opinion Dynamics. Adjusts savings derived through engineering algorithms to actual savings measured in field.
ηCool	12.94	Average cooling efficiency from the sampled projects in the HEIP Whole House evaluation sample.
HDD	2,826	TMY3 weather data for Atlanta-Hartsfield Airport at base 65.
Adj_{heat}	0.6	Mid-Atlantic TRM v9, which cites Illinois TRM v9 as demonstrated in two years of metering evaluation by Opinion Dynamics. Adjusts savings derived through engineering algorithms to actual savings measured in field.
ηHeat	2.4	Average heating efficiency from the sampled projects in the HEIP Whole House evaluation sample.

INPUT	VALUE	SOURCE
$DTE_{cooling}$	0.00057	Average hourly fraction of residential space cooling load shape that falls in Georgia Power peak periods.
$DTE_{heating}$	0.00062	Average hourly fraction of residential space heating load shape that falls in Georgia Power peak periods.

Duct Sealing

The team used the following equations to calculate electric energy and peak demand cooling savings for duct sealing:

$$kWh\ cooling\ savings = \frac{\Delta CFM25DL \times EFLH_c \times 12{,}000 \times TRF_{cool}}{400 \times \eta Duct \times SEER \times 1{,}000}$$

$$Summer\ kW\ savings = \ kWh\ cooling\ savings\ \times DTE_{cooling}$$

For homes with electric heating, the team used the following equations to calculate electric energy and peak demand heating savings for duct sealing:

$$kWh\ heating\ savings = \frac{\Delta CFM25DL \times EFLH_h \times 12{,}000 \times TRF_{heat}}{400 \times \eta Duct \times HSPF \times C_{IV-III} \times 1{,}000}$$

$$Winter\ kW\ savings = \ kWh\ heating\ savings\ \times DTE_{heating}$$

Where:

ΔCFM25DL = Duct leakage reduction @ 25 pascals, CFM

$EFLH_c$ = Equivalent full-load hours of cooling

$EFLH_h$ = Equivalent full-load hours of heating

12,000 = Constant to convert tons to Btu/h

400 = Nominal CFM per ton of refrigeration

1,000 = Constant to convert watts to kW

SEER = Efficiency of the cooling system, SEER, Btu/W-hr

HSPF = Efficiency of the heating system, HSPF, Btu/W-hr

TRF_{cool} = Thermal regain factor for cooling depending on duct location

TRF_{heat} = Thermal regain factor for heating depending on duct location

$\eta Duct$ = Pre-duct sealing system distribution efficiency

C_{IV-III} = Conversion from rated HSPF to HSPF appropriate for AHRI climate zone III

$DTE_{cooling}$ = Demand-to-energy ratio for space cooling end use

$DTE_{heating}$ = Demand-to-energy ratio for space heating end use

Table 136 lists the input assumptions and source of each assumption for the duct sealing measure savings calculations.

Table 136. Assumptions and Inputs for Duct Sealing

INPUT	VALUE	SOURCE
ΔCFM25DL	207.3	Average CFM25 reduction from the 2021 HEIP Individual Improvements impact evaluation.
$EFLH_c$	816.4	Georgia Power Company TRM v2.0.
$EFLH_h$	728.7	Georgia Power Company TRM v2.0.
SEER	12.94	Average cooling efficiency from the sampled projects in the HEIP Whole House evaluation sample.
HSPF	8.2	Average heating efficiency from the sampled projects in the HEIP Whole House evaluation sample.
TRF_{cool}	1.0	MN TRM v3.2, value for unconditioned spaces (attic, crawl space, outdoors).
TRF_{heat}	1.0	MN TRM v3.2, value for unconditioned spaces (attic, crawl space, outdoors).
$\eta Duct$	0.89	Building Performance Institute, Inc., 11/20/2007, Distribution Efficiency look- Up Table, Building Performance Institute Technical Standards for the Heating Professional. Cited in MN TRM v3.2.
C_{IV-III}	1.1	C.K. Rice et al. An Analysis of Representative Heating Load Lines for Residential HSPF Ratings. July 2015. https://info.ornl.gov/sites/publications/files/Pub56184.pdf. Fig. B.4 shows an actual HSPF approximately 10% greater than rated HSPF for zone V, using the standard AHRI 210/240 load line. Cited in MN TRM 3.2 and adjusted for prevailing GA climate zone.
$DTE_{cooling}$	0.00057	Average hourly fraction of residential space cooling load shape that falls in Georgia Power winter peak periods.
$DTE_{heating}$	0.00062	Average hourly fraction of residential space heating load shape that falls in Georgia Power winter peak periods.

HVAC Servicing

The team used the following equations to calculate electric energy and peak demand cooling savings for HVAC servicing:

$$kWh\ cooling\ savings = \ Cooling\ Energy\ Consumption\ \times \text{Cooling Savings Factor}$$

$$Summer\ kW\ savings = \ kWh\ cooling\ savings\ \times DTE_{cooling}$$

For homes with electric heating, the team used the following equations to calculate electric energy and peak demand heating savings for air sealing:

$$kWh\ heating\ savings = \ Heating\ Energy\ Consumption\ \times \text{Heating Savings Factor}$$

$$Winter\ kW\ savings = \ kWh\ heating\ savings\ \times DTE_{heating}$$

Where:

Cooling Energy Consumption = Average annual energy consumption per home for space cooling

Heating Energy Consumption = Average annual energy consumption per home for space heating

Cooling Savings Factor = Percent cooling consumption savings from HVAC maintenance

Heating Savings Factor = Percent heating consumption savings from HVAC maintenance

$DTE_{cooling}$ = Demand-to-energy ratio for space cooling end use

$DTE_{heating}$ = Demand-to-energy ratio for space heating end use

Table 137 lists the input assumptions and source of each assumption for the HVAC servicing measure savings calculations.

Table 137. Assumptions and Inputs for HVAC Servicing

INPUT	VALUE	SOURCE
Cooling Energy Consumption	3,370	Evaluation team estimate of annual weather-normalized cooling consumption (kWh) per residential condensing unit.
Heating Energy Consumption	2,486	Evaluation team estimate of annual weather-normalized heating consumption (kWh) per residential air source heat pump.
Cooling Savings Factor	5%	Pennsylvania TRM (2019) and the Illinois TRM v7.0 both use a 5% “maintenance factor” for cooling and heating.
Heating Savings Factor	5%	Pennsylvania TRM (2019) and the Illinois TRM v 7.0 both use a 5% “maintenance factor” for cooling and heating.

$DTE_{cooling}$	0.00057	Average hourly fraction of residential space cooling load shape that falls in Georgia Power summer peak demand definition.
$DTE_{heating}$	0.00062	Average hourly fraction of residential space cooling load shape that falls in Georgia Power summer peak demand definition.

Air Sealing

The team used the following equations to calculate electric energy and peak demand cooling savings for air sealing:

$$kWh\ cooling\ savings = \frac{(CFM50_{pre} - CFM50_{post}) \times 60 \times 24 \times CDD \times C_{air} \times LM}{1{,}000 \times SEER \times N_{factor}}$$

$$Summer\ kW\ savings = \ kWh\ cooling\ svings\ \times DTE_{cooling}$$

For homes with electric heating, the team used the following equations to calculate electric energy and peak demand heating savings for air sealing:

$$kWh\ heating\ savings = \frac{(CFM50_{pre} - CFM50_{post}) \times 60 \times 24 \times HDD \times C_{air} \times 293.1}{1{,}000{,}000 \times COP \times N_{factor}}$$

$$Winter\ kW\ savings = \ kWh\ heating\ savings\ \times DTE_{heating}$$

Where:

$CFM50_{pre}$ = Pre-improvement air flow needed to depressurize the home to -50 pascals

$CFM50_{post}$ = Post improvement air flow needed to depressurize the home to -50 pascals

60 = Constant to convert from minutes to hours

24 = Constant to convert from days to hours

CDD = Cooling degree days

C_{air} = Volumetric heat capacity of air, Btu/cu.ft.-°F

LM = Latent multiplier to account for latent cooling performed by air conditioner

1,000 = Constant to convert watts to kW

SEER = Efficiency of the cooling system, SEER

N_{factor} = Conversion factor to convert from CFM50 to natural air flow

HDD = Heating degree days

293.1 = Constant to convert MMBtu to kWh

1,000,000 = Constant to convert Btu to MMBtu

COP = Efficiency of the heating system, COP

$DTE_{cooling}$ = Demand-to-energy ratio for space cooling end use

$DTE_{heating}$ = Demand-to-energy ratio for space heating end use

Table 138 lists the input assumptions and source of each assumption for the air sealing measure savings calculations.

Table 138. Assumptions and Inputs for Air Sealing

INPUT	VALUE	SOURCE
$CFM50_{pre}$	Site-specific	HEEAP project files
$CFM50_{post}$	Site-specific	HEEAP project files
CDD	1,722	TMY3 weather data for Atlanta-Hartsfield Airport at base 65°F
C_{air}	0.018	Constant
LM	7.9	Dehumidification and Cooling Loads from Ventilation Air; Harriman, Plager, Kosar; ASHRAE Journal, November 1997, pp 37 - 45
SEER	12.94	Average cooling efficiency from the sampled projects in the HEIP Whole Home evaluation sample
N_{factor}	40.5	Infiltration as Ventilation: Weather- Induced Dilution; William J. N. Turner, Max H. Sherman, Iain S. Walker; Environmental Energy Technologies Division; December 2012; average of climate zones 3A and 4A
HDD	2,826	TMY3 weather data for Atlanta-Hartsfield Airport at base 65
COP	2.4	Average heating efficiency from the sampled projects in the HEIP Whole Home evaluation sample
$DTE_{cooling}$	0.00057	Average hourly fraction of residential space cooling load shape that falls in Georgia Power summer peak demand definition
$DTE_{heating}$	0.00062	Average hourly fraction of residential space cooling load shape that falls in Georgia Power summer peak demand definition

Smart Thermostat

The team estimated the following per unit savings to calculate electric energy and peak demand savings for smart thermostats:

$$kWh\ savings\ per\ home\ with\ 1\ smart\ thermostat\ = 274.6\ \mathrm{kWh}$$

$$Summer\ kW\ reduction\ per\ home\ with\ 1\ smart\ thermostat = 0.075\ \mathrm{kW}$$

$$Winter\ kW\ reduction\ per\ home\ with\ 1\ smart\ thermostat = 0.059\ \mathrm{kW}$$

$$kWh\ savings\ per\ home\ with\ 2\ smart\ thermostats = 310.2\ \mathrm{kWh}$$

$$Summer\ kW\ reduction\ per\ home\ with\ 2\ smart\ thermostats = 0.084\ \mathrm{kW}$$

$$Winter\ kW\ reduction\ per\ home\ with\ 2\ smart\ thermostats = 0.067\ \mathrm{kW}$$

These per unit savings values were calculated as part of the 2021 Thermostat Marketplace evaluation and represent net savings. Each of the values above were divided by an assumed 77% NTG ratio to arrive at the HEEAP per-unit savings.

Pipe Insulation

The team used the following equations to calculate electric energy and peak demand cooling savings for pipe insulation:

$$kWh\ savings = \frac{\left(\frac{1}{R_{exist}} - \frac{1}{R_{new}}\right) \times L \times C \times \Delta T \times 8760}{DHW_{recovery} \times 3{,}413}$$

$$Summer\ and\ Winter\ kW\ savings = \frac{kWh\ savings}{8{,}760}$$

Where:

R_{exist}	= Assumed R-value of existing uninsulated pipe
R_{new}	= R-value of existing pipe plus new insulation
L	= Length of pipe in feet
C	= Circumference of pipe in feet
ΔT	= Temperature difference between water in pipe and ambient air in °F
8,760	= Hours per year
$DHW_{recovery}$	= DHW recovery efficiency
3,413	= Conversion from BTU to kWh

Table 139 lists the input assumptions and source of each assumption for the air sealing measure savings calculations.

Table 139. Assumptions and Inputs for Pipe Insulation

INPUT	VALUE	SOURCE
R_{exist}	1.0	Mid-Atlantic TRM v9 measure DHW Pipe Insulation.
R_{new}	4.5	Assume R-3.5 pipe insulation added.
L	6	HEEAP measure definition of deemed pipe insulation units.
C	0.196	Circumference in feet of 0.75” diameter pipe.
ΔT	65	Assume average hot water supply temperature of 130 °F and average temperature of basement of 65°F.
$DHW_{recovery}$	0.98	Estimated recovery efficiency of electric storage water heater.

Water Heater Insulation Jacket

The team applied the following per unit savings to calculate electric energy and peak demand savings for water heater insulation jackets:

$$kWh\ savings = \frac{\left((U_{base} \times A_{base}) - (U_{insul} \times A_{insul})\right) \times \left(T_{setpoint} - T_{ambient}\right) \times HOU}{3{,}412 \times Eff_{elec}}$$

$$Summer\ kW\ savings = \ kWh\ savings\ \times DTE_{DHW\_summer}$$

$$Winter\ kW\ savings = \ kWh\ savings\ \times DTE_{DHW\_winter}$$

Where:

A_{base} = Surface area of unwrapped water heater tank, ft^2

U_{base} = Heat transfer coefficient of unwrapped tank, Btu/hr- °F-ft^2, inverse of R-8.3

A_{insul} = Surface area of wrapped water heater tank, ft^2

U_{insul} = Heat transfer coefficient of wrapped tank, Btu/hr-°F-ft^2, inverse of R-20

$T_{setpoint}$ = Water heater temperature setpoint, °F

$T_{ambient}$ = Temperature of ambient air, °F

Eff_{elec} = Electric resistance water heater baseline efficiency

3,412 = Conversion from Btu/h to kW

HOU = Piping and insulation hours of use

DTE_{DHW_summer} = Demand-to-energy ratio for domestic hot water heating during summer

DTE_{DHW_winter} = Demand-to-energy ratio for domestic hot water heating during winter

The energy savings value is the average of deemed savings values for all permutations of the 40-gallon size from the Mid-Atlantic TRM v9 Domestic Hot Water Tank Wrap measure.

Table 140 lists the input assumptions and source of each assumption for the air sealing measure savings calculations.

Table 140. Assumptions and Inputs for Water Heater Insulation Jacket

INPUT	VALUE	SOURCE
A_{base}	23.18	Georgia Power TRM v2.0 which cites PA TRM, June 2016; based on 40-gallon size.
U_{base}	0.12	Georgia Power TRM v2.0 which cites PA TRM, June 2016; default assumed value.
A_{insul}	25.31	Georgia Power TRM v2.0 which cites PA TRM, June 2016; based on 40-gallon size.
U_{insul}	0.05	Georgia Power TRM v2.0 which cites PA TRM, June 2016; default assumed value.
$T_{setpoint}$	119	Georgia Power TRM v2.0 which cites PA TRM, June 2016; default assumed value.
$T_{ambient}$	63.9	Georgia Power TRM v2.0; Based on 30-year historical average Georgia climate data (http://www.ncdc.noaa.gov/cag/), average temperature in Georgia is 63.9°F.
Eff_{elec}	0.95	IECC 2012
HOU	8,760	Georgia Power TRM v2.0 which cites PA TRM, June 2016; default assumed value.
DTE_{DHW_summer}	0.00012	Average hourly fraction of residential domestic water heating load shape that falls in Georgia Power peak periods.
DTE_{DHW_winter}	0.00017	Average hourly fraction of residential domestic water heating load shape that falls in Georgia Power peak periods.

APPENDIX 7. – RESIDENTIAL REFRIGERATOR RECYCLING PROGRAM

Appendix 7A: Algorithms, Assumptions, and Additional Background

This appendix contains the algorithms and assumptions used in electric savings and demand reduction for the measures within the Residential Refrigerator Recycling program. The team examined each assumption behind the algorithms to capture savings and compared it against the Uniform Methods Project Refrigerator Recycling Evaluation Protocol (Chapter 7), as well as other state and industry approaches. This section also includes additional background and context on other research activities, including surveys and net-to-gross analysis.

For impact calculations the verified gross and verified net savings numbers only include appliances recycled in PY 2020 and Q1 of PY 2021, while the per-unit savings value (existing UEC) calculation below utilized all available program tracking data, including all appliances recycled in PY 2020, through June (Q2) of PY 2021.

Survey Sampling and Approach

The evaluation team collected surveys from both participants and nonparticipants to provide input into the gross and net impact evaluations as well as process evaluation. Because the program was paused for the majority of 2020, the evaluation team sought to include most of program year 2021 in the sample to achieve enough completed surveys for analysis. These surveys were fielded in June and July of 2021 and included all available participation in 2020 and Q1 and Q2 2021 to-date. This was the same date range used to feed into the UEC calculation.

Participant Survey Sampling

The evaluation team utilized a stratified random sample of program participants as part of the process and impact evaluations. The sample was stratified by appliance type (refrigerator and freezer) and targeted 70 survey completes per appliance. The initial survey deployment satisfied the freezer respondent quota, but not the refrigerator respondent quota. A secondary sample of 300 refrigerator participants was thus provided and recruited for surveys.

Table 141. Participant Survey Sampling and Response Rate

UNIT TYPE	POPULATION	TARGET	SAMPLE 1	SUPPLEMENTARY SAMPLE	COMPLETES	RESPONSE RATE
Refrigerator	2,509	70	300	300	117	20%
Freezer	372	70	300	-	99	33%

General Population Survey Sampling

The evaluation team randomly sampled 2,500 Georgia Power customers, with a goal of 250 completed surveys assuming a 10% response rate. A second sample of 1,000 Georgia Power customers was later provided to achieve response quotas. In addition to providing process and market findings, a primary goal of this survey was to identify customers who have disposed of a refrigerator or freezer as a point of triangulation for the Refrigerator Recycling net-to-gross analysis (per UMP recommendations). Of the 250 completed surveys, the evaluation team estimated that approximately 70 will have disposed of an appliance recently (based on other similar surveys completed); 72 survey respondents had recently disposed of an appliance, satisfying statistical requirements.

Table 142. General Population Survey Sampling and Response Rate

TARGET	SAMPLE 1	SUPPLEMENTARY SAMPLE	COMPLETES	DISPOSED OF APPLIANCE N	RESPONSE RATE
250	2,500	1,000	250	72	7.1%

Impact Calculation Overview

The evaluation team used the following equations to calculate electric savings for recycled refrigerators and freezers. Gross energy savings are calculated by multiplying the number of verified measures incentivized through the program by the existing UEC value, and then by the participant use factor.

$$GROSS_{kWh} = N * EXISTING_{UEC} * PART\_USE$$

Where:

GROSS_kWh	=	Annual electric savings measures in kilowatt hours
N	=	The number of refrigerators recycled through the program
EXISTING_UEC	=	The average annual unit energy consumption of participating refrigerators
PART_USE	=	The portion of the year the average refrigerator would likely have operated if not recycled through the program

Due to the considerable potential for freeridership in appliance recycling programs in general, net savings adjustments are necessary. The net adjustment accounts for current early replacement and recycling practice of both participants and nonparticipants, as well as hypothetical behavior of participants in the absence of the program. The total net energy savings (kWh/year) is calculated as follows:

$$NET_{kWh} = N * NET\_FR\_SMI\_kWH$$

Where:

NET_FR_SMI_kWh = Average per-unit energy savings net of naturally occurring removal from grid and secondary market impacts

Below, we iteratively walk through the entire savings calculation, including all constituent calculations used in both the gross and net savings calculations.

Gross Savings

The evaluation team collected data from the 2020 and first quarter 2021 participation tracking data, customer surveys, and nonparticipant surveys to calculate the parameters included in both the ***Participant Use*** and ***Existing_UEC*** algorithms. These data use slightly different parameters than the reported values cited earlier in the report. As such, the numbers used to calculate the gross savings values to not align perfectly with the reported values cited earlier in the report. Specifically, the following data was collected, analyzed, and used to evaluate gross impacts, as appropriate, depending on the regression model being used:

Table 143. Data Inputs and Sources to Calculate Gross Impacts

INPUT FOR MODEL	DATA SOURCE
Age (in years or year manufactured)	Tracking data
Size (in cubic feet)	Tracking data
Configuration (e.g., top freezer, side-by-side)	Tracking data
Use of appliance (primary or secondary)	Tracking and/or self-report survey data
Location of appliance (conditioned or unconditioned space)	Tracking and/or self-report survey data
Appliance use (percentage of year it was plugged in)	Self-report survey data

Measure Verification

Table 144 presents the total verified count of appliances recycled through the Refrigerator Recycling program in 2020 and Q1 of 2021, according to the date that the appliance was indicated to have been picked up in the tracking data.

Table 144. Measure Verification

MEASURE	TIME PERIOD	QUANTITY [a]
Refrigerators	2020	802
	2021 Q1	1,517
	Total	**2,319**
Freezers	2020	128
	2021 Q1	208
	Total	**336**
Total	2020	930
	2021 Q1	1,725
	Total	**2,655**

[a] *Quantity reflects totals by appliance pick up date, not rebate commit date.*

Existing UEC Calculation

Existing_UEC was calculated using the regression equation derived from the 2011 Georgia Power field study of 24 program refrigerators and seven freezers:

$$Existing\_UEC = B_0 + B_1 * Age + B_2 * Size + B_3 * Freezer\ Indicator$$

Where:

Existing_UEC = *The annual kWh consumption of the unit extrapolated from the consumption recorded during the metering period*

B_0 = *The intercept term of the regression equation*

B_1 = *Coefficient determined during the modeling process. This represents the additional number of kilowatt hours a unit is expected to consume for each additional year of age*

Age = *The age of the unit in years. Equal to 2011 – Vintage.*

B_2 = *Coefficient determined during the modeling process. This represents*

		the additional number of kilowatt hours a unit is expected to consume for each cubic foot of interior space
Size	=	*The size of the unit in cubic feet.*
B_3	=	*Coefficient determined during the modeling process. This term accounts for observed differences in consumption between refrigerators and freezers.*
Freezer Indicator	=	*If the unit is a freezer, this term is equal to 1. If the unit is a refrigerator, it is equal to 0.*

Table 145 presents the values used to calculate the existing UEC value for refrigerators and freezers. The first number represents the average value of the variable for each appliance as measured in the program tracking data, while the number in parentheses represents that value of the coefficients derived from the 2011 field study. Multiplying each average value from the tracking data by the respective coefficient and adding the intercept value of -704.8 provides the final existing UEC value for each appliance.

Table 145. 2020 Refrigerator Recycling Program – Existing UEC Values

APPLIANCE TYPE	APPLIANCE AGE (B_1)	APPLIANCE VOLUME (FT^3) (B_2)	FREEZER INDICATOR (B_3)	EXISTING UEC VALUE
Refrigerator	15.8 (35.2)	19.1 (59.9)	0 (78.37)	**995.0**
Freezer	17.7 (35.2)	16.7 (59.9)	1 (78.37)	**996.1**

Before using this model, the evaluation team conducted a secondary research review of available recent peer utility evaluations (2011 – present) to determine if another, more recent study exists that is appropriate to reference for this evaluation. Findings from this review are in the

Annual Energy Consumption Secondary Research Review section below.

Part-Use Calculation

The participant use (part-use) factor represents the average amount of time that appliances recycled through the program were plugged in during the year prior to program intervention and is used to convert the UEC into an average per-unit gross savings value. The participant survey was used to determine the portion of the year that the average recycled appliance would have been operational in the absence of the program intervention. The part-use factor used in the gross savings calculation is a weighted average of the part use factor of all secondary units, and of all units (primary and secondary). This analysis acknowledges that the Georgia Power program is intended to only recycle secondary units; however, the UMP directs evaluators to treat any appliance that was indicated to have been in the participants kitchen (prior to any movement in preparation for disposal) as a primary appliance. Table 146 displays these results.

Table 146. 2020 Refrigerator Recycling Program - Refrigerator Part-Use factors

USAGE TYPE AND PART-USE CATEGORY	PERCENTAGE OF RECYCLED UNITS	PART-USE FACTOR	PER-UNIT ENERGY SAVINGS (KWH/YR.)
Secondary Units Only			
Not in Use	4%	0.00	0
Used Part-Time	11%	0.48	477
Used Full-Time	85%	1.00	995
Weighted Average	**100%**	**0.90**	**897**
All Units (Primary and Secondary)			
Not in Use	3%	0.00	0
Used Part-Time	7%	0.48	477
Used Full-Time	90%	1.00	995
Weighted Average	**100%**	**0.94**	**931**

Table 147. 2020 Refrigerator Recycling Program - Freezer Part-Use factors

USAGE TYPE AND PART-USE CATEGORY	PERCENTAGE OF RECYCLED UNITS	PART-USE FACTOR	PER-UNIT ENERGY SAVINGS (KWH/YR.)
Secondary Units Only			
Not in Use	6%	0.00	-
Used Part-Time	11%	0.41	406
Used Full-Time	83%	1.00	996
Weighted Average	**100%**	**0.87**	**871**
All Units (Primary and Secondary)			
Not in Use	5%	0.00	-
Used Part-Time	11%	0.44	440
Used Full-Time	84%	1.00	996
Weighted Average	**100%**	**0.89**	**884**

Historically observed part-use factors were then weighted against the self-reported action of survey respondents regarding whether they would have kept the appliance had the program not been available, and if so, where. The final part-use factors were determined to be 0.93 for refrigerators (Table 148), and 0.89 for freezers (Table 149).

Table 148. 2020 Refrigerator Recycling Program - Refrigerator Part-Use factors

USAGE PRIOR TO RECYCLING	LIKELY USE INDEPENDENT OF RECYCLING	PART-USE FACTOR	PERCENTAGE OF PARTICIPANTS [a]
Primary	Kept (as primary unit)	1.00	5%
	Kept (as secondary unit)	0.90	2%
	Discarded	0.94	27%
Secondary	Kept (as secondary unit)	0.90	26%
	Discarded	0.94	41%
Total	All	0.93	100%

[a] *Total does not sum to 100% due to rounding*

Table 149. 2020 Refrigerator Recycling Program - Freezer Part-Use factors

USAGE PRIOR TO RECYCLING	LIKELY USE INDEPENDENT OF RECYCLING	PART-USE FACTOR	PERCENTAGE OF PARTICIPANTS
Primary	Kept (as primary unit)	1.00	3%
	Kept (as secondary unit)	0.87	1%
	Discarded	0.89	8%
Secondary	Kept (as secondary unit)	0.87	28%
	Discarded	0.89	60%
Total	All	0.89	100%

Gross Savings Calculation

Table 150 presents the gross savings calculation for refrigerators and freezers, inclusive of PY2020 and Q1 2021. The gross savings values presented here were calculated using the program tracking data and reflect the number of units with "actual pickup dates" that fell within the evaluation time frame; as such, they do not align with the reported savings values presented in the report.

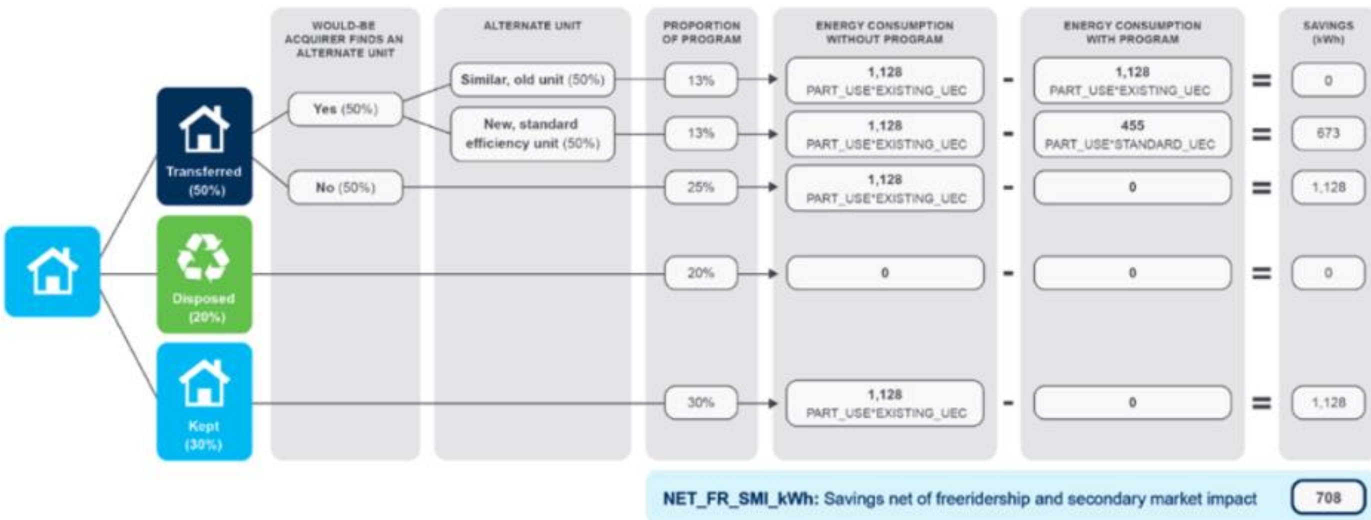
Table 150. 2020 Refrigerator Recycling Program - Refrigerator Part-Use factors

MEASURE	NUMBER OF RECYCLED UNITS (N)	EXISTING UEC VALUE	PART USE FACTOR	FINAL VERIFIED PER-UNIT SAVINGS (KWH)	GROSS SAVINGS (KWH)
Refrigerators	2,319	995	0.93	925	2,145,661
Freezers	336	996	0.89	884	296,874
Total	2,655	-	-	-	**2,442,535**

Net Savings

The UMP states that for refrigerator recycling programs, net savings are only generated when the recycled appliance would have continued to operate in the absence of program intervention, whether that be within the participating customer's home, or in the home of another utility customer. The participant survey thus asked questions designed to discern the likelihood of each of these scenarios, while the nonparticipant survey included similar questions to calculate a weighted average of hypothetical behavior in the absence of program intervention. The UMP utilizes a flow chart to illustrate how final savings are calculated, net of freeridership.[86] Figure 129 shows the example flow chart from the UMP. More detail on each of the components of this flow chart, including specific calculations, are included below.

Figure 129. Savings Net of Freeridership and Secondary Market Impacts



[86] The UMP does not currently recommend calculating participant spillover from appliance recycling programs, as these programs are often not used as primary channels of energy education, and spillover is typically negligible.

Freeridership

Independent of program intervention, participants are likely to have engaged in one of the three following scenarios:

- The appliance would have been kept by the household
- The appliance would have been discarded by a method that transfers it to another customer for continued use
- The appliance would have been discarded by a method leading to its removal from service

These three scenarios comprise the freeridership component of the NTG calculation (the proportion of appliances that would have been removed from the grid in the absence of the program). Table 151 presents the freeridership behaviors provided by respondents of the participant survey, while Table 152 provides a historical comparison of the percentage of respondents who indicated they would have kept their appliance in the absence of the program. We see that a smaller percentage of respondents indicated they would have kept their appliance in 2020 compared to 2017, indicative of higher levels of freeridership; however, our results align closely with findings from 2014. It is unclear what is driving such low values for 2011.

Table 151. Freeridership Behaviors in 2020 – 2021

STATED ACTION ABSENT PROGRAM	INDICATIVE OF FREERIDERSHIP	REFRIGERATORS (N=110)	FREEZERS (N=91)
Kept	No	35%	34%
Transferred	Varies	34%	37%
Destroyed	Yes	32%	29%

Table 152. Historical Percentage of Units Kept Independent of RRP

STUDY – YEAR	REFRIGERATORS	FREEZERS
Georgia Power 2020	35%	34%
Georgia Power 2017	49%	42%
Georgia Power 2014	38%	33%
Georgia Power 2011	9%	6%

Participants reported hypothetical behaviors may be biased, as they are not fully aware of the barriers implicit in various disposal options. As such, the UMP recommends using nonparticipant data to understand customers' actual behavior discarding appliances in the absence of the program. We observe that nonparticipants who discarded an appliance within the past year indicated that they were significantly more likely to have destroyed their appliance (61%, Table 153 and Table 154) compared to the hypothetical behavior of refrigerator participants (49%, Table 153,) or of freezer participants (43%, Table 154). The UMP recommends combining these estimates and weighting the overall proportion using the inverse of variance (between those that would have transferred or destroyed within each sample), to place greater weight on the more precise (less variable) values. The result is an estimate of the proportion of participating appliances that in the absence of the program would have been permanently destroyed, transferred to another user, or kept.

Table 153. Determination of Discard and Keep Distribution: Refrigerators

DISCARD/ KEEP	PROPORTION OF PARTICIPANT SAMPLE	SAMPLE	DISCARD SCENARIO	N	VARIANCE	WEIGHT	PROPORTION OF DISCARDS	OVERALL PROPORTION
Discard	65%	Part	Transfer	37	0.25	0.49	51%	-
			Destroy	35			49%	-
		Non-Part	Transfer	27	0.24	0.51	39%	-
			Destroy	43			61%	-
		Weighted Average	Transfer	-	-	-	45%	**29%**
			Destroy	-			55%	**36%**
Kept	35%			38				**35%**

Table 154. Determination of Discard and Keep Distribution: Freezers

DISCARD/ KEEP	PROPORTION OF PARTICIPANT SAMPLE	SAMPLE	DISCARD SCENARIO	N	VARIANCE	WEIGHT	PROPORTION OF DISCARDS	OVERALL PROPORTION
Discard	66%	Part	Transfer	34	0.25	0.45	57%	-
			Destroy	26			43%	-
		Non-Part	Transfer	27	0.24	0.55	39%	-
			Destroy	43			61%	-
		Weighted Average	Transfer	-	-	-	47%	**31%**
			Destroy	-			53%	**35%**
Kept	34%			38				**34%**

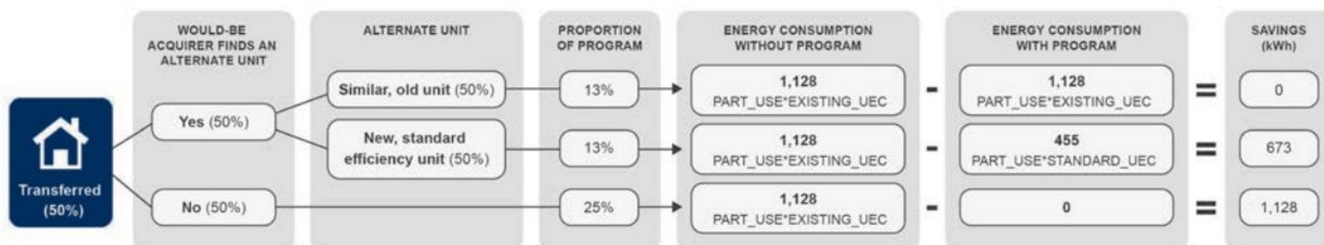
Secondary Market Impacts

If it is determined that a participant would have directly or indirectly transferred a recycled appliance to another customer on the electric grid, there are three potential scenarios that need to be addressed:

- None of the potential recipients would find another unit
- All potential recipients would find another unit
- Some potential recipients would find another unit

These questions are difficult to answer with certainty. As such, the UMP recommends if half of the potential secondary appliance acquirers would have found an alternative unit, and half would have not. Furthermore, among the half assumed to have acquired an alternative unit, half are assumed to have received a new appliance, while the other half are assumed to have received a different used appliance. Figure 130 depicts this calculation using hypothetical values taken from the UMP.

Figure 130. Secondary Market Impacts



For the half assumed to have received a new appliance, the value for energy consumption of the appliance in the absence of the program is taken as the standard operating efficiency of a new appliance as specified by ENERGY STAR, assuming a value of **407.3 kWh/year** for refrigerators, and **330.9 kWh/year** for freezers.[87] The values used for energy consumption without the program are the product of the new appliances existing UEC by the product's participant use factor. Table 155 and Table 156 present these calculations as applied to the program specific data.

Table 155. Secondary Market Impacts: Refrigerator

DISCARD/ KEEP	WOULD-BE ACQUIRER FINDS AN ALTERNATE UNIT	ALTERNATE UNIT	PROPORTION OF PROGRAM	ENERGY CONSUMPTION WITHOUT PROGRAM	ENERGY CONSUMPTION WITH PROGRAM	SAVINGS
Transferred	Yes	Similar, old unit	7.3%	926.3	926.3	0.0
		New, standard	7.3%	926.3	407.3	519.0

[87] https://www.energystar.gov/products/refrigerators

		efficiency unit				
	No	-	14.7%	926.3	0.0	926.3

Table 156. Secondary Market Impacts: Freezer

DISCARD/ KEEP	WOULD BE ACQUIRER FINDS AN ALTERNATE UNIT	ALTERNATE UNIT	PROPORTION OF PROGRAM	ENERGY CONSUMPTION WITHOUT PROGRAM	ENERGY CONSUMPTION WITH PROGRAM	SAVINGS
Transferred	Yes	Similar, old unit	7.7%	882.6	882.6	0.0
		New, standard efficiency unit	7.7%	882.6	330.9	551.7
	No	-	15.4%	882.6	0.0	882.6

Final Estimates of Net Savings

The evaluation team used the UMP approach as described above, to estimate final net savings by appliance type, using combined and weighted participant and nonparticipant data. The following tables show the Georgia Power specific inputs for each step of the net savings flow chart as described by the UMP.

Table 157. Integration of Freeridership and Secondary Market Impacts: Refrigerators

DISCARD/ KEEP	WOULD-BE ACQUIRER FINDS AN ALTERNATE UNIT	ALTERNATE UNIT	PROPORTION OF PROGRAM	ENERGY CONSUMPTION WITHOUT PROGRAM	ENERGY CONSUMPTION WITH PROGRAM	SAVINGS
Transferred	Yes	Similar, old unit	7.3%	926.3	926.3	0.0
		New, standard efficiency unit	7.3%	926.3	407.3	519.0
	No	-	14.7%	926.3	0.0	926.3
Disposed	-	-	36.1%	0.0	0.0	0.0
Kept	-	-	34.5%	926.3	0.0	926.3
Total						494.2

Table 158. Integration of Freeridership and Secondary Market Impacts: Freezers

DISCARD/ KEEP	WOULD BE ACQUIRER FINDS AN ALTERNATE UNIT	ALTERNATE UNIT	PROPORTION OF PROGRAM	ENERGY CONSUMPTION WITHOUT PROGRAM	ENERGY CONSUMPTION WITH PROGRAM	SAVINGS
Transferred	Yes	Similar, old unit	7.7%	882.6	882.6	0.0
		New, standard efficiency unit	7.7%	882.6	330.9	551.7
	No	-	15.4%	882.6	0.0	882.6
Disposed	-	-	35.1%	0.0	0.0	0.0
Kept	-	-	34.1%	882.6	0.0	882.6
Total						479.3

Net Savings Calculation

The final net-to-gross ratio is simply the quotient of the final net savings value, divided by the existing UEC value.

Table 159. Net-to-Gross Ratios

MEASURE	EXISTING UEC	NET SAVINGS VALUE	NET-TO-GROSS RATIO
Refrigerator	996	494	49.6%
Freezer	995	479	48.2%

NTG Sensitivity Analysis

Due to the ongoing COVID-19 pandemic, the Refrigerator Recycling program was completely shut down for a portion of 2020, between the months of March and November. As a result, several interested participants were placed on a waiting list and required to wait an (sometimes) extended period before their appliance was picked up and recycled. Furthermore, once the program resumed, participants were now required to have their appliance placed outside and plugged in. These program changes could have potentially i mpacted the programs NTG value, as they may have impacted customers willingness and ability to participate in the program. We thus conducted sensitivity analyses of the NTG results of:

- Participants who indicated in the participant survey that they had been placed on a waitlist, against those who indicated that they had not[88]

- Participants who indicated in the participant survey that they had to move their appliance before it was picked up, against those who indicated that they had not

- Participant age

- Participants who indicated that they would have participated in the program without an incentive against those who did not

Table 160 and Table 161 below show the two “waitlist” groups’ results. While slightly different, these results are not statistically significant.

Table 160. NTG Values of Waitlisted Participants - Refrigerators

ACTION IN ABSENCE OF PROGRAM	WAITLISTED (N=45)	NOT WAITLISTED (N=51)
Kept	36%	31%
Transferred	33%	33%
Destroyed	31%	35%
Final NTG	**49%**	**46%**

Table 161. NTG Values of Waitlisted Participants - Freezers

ACTION IN ABSENCE OF PROGRAM	WAITLISTED (N=41)	NOT WAITLISTED (N=37)
Kept	39%	27%
Transferred	27%	54%
Destroyed	34%	19%
Final NTG	**49%**	**45%**

The evaluation team recommends using the final NTG values calculated using the entire survey population, rather than selecting those who indicated having not been on a waitlist. While we observe higher final NTG values among waitlisted customers compared to those that were not waitlisted, the differences in the relative percentage of participants who indicated they would have kept their appliance in the absence of the program are not significant, nor are the differences in the resulting final NTG values. Furthermore, these calculations do not include the subset of participants who were unsure whether they had been on a waitlist or not.

[88] We did not include customers who indicated that they were uncertain if they had been on a waitlist in this analysis. As such, the Final NTG values for refrigerators of waitlisted and non-waitlisted participants are both lower than the Final NTG value documented in the report (50%), as those who were unaware whether they were on a wait list generated a final NTG value of 54%.

Finally, the evaluation team also explored if there were any differences among participants who said they would have kept their appliance (versus transferred or destroyed), as those who said they would have kept their appliances are assigned 0% freeridership. Overall, the team identified two groups that may be helpful for program staff to keep in mind while designing marketing and outreach efforts: participants over the age of 70, and participants who said they were unlikely to participate in the program if the incentive was decreased. Both groups were more likely to say they would have kept their appliance in the absence of the program.

Annual Energy Consumption Secondary Research Review

The 2011 impact evaluation of Georgia Power's Residential Refrigerator Recycling program developed a regression model based on an appliance metering study, as specified in Section 9 of the 2012 report.[89] Before using this model, the evaluation conducted a secondary research review of available recent peer utility evaluations (2011 – present) to determine if another, more recent study exists that is appropriate to reference for this evaluation. In this review, the evaluation team considered both the recency of the study and the applicability of other study factors, such as climate zone and appliance population characteristics, in the determination of the best model to use. The results of this secondary research review are presented below.

In our scan of technical reference manuals and DSM program evaluations, we found ten regression models based on metering studies for estimating refrigerator and freezer UEC values. These regression models largely aligned with the recommended methods described in Chapter 7 of the Uniform Methods Project (NREL 2017).[90] The metering study years range from 2008 to 2017 with most studies taking place between 2012 and 2014. These studies were predominantly from Midwestern or Atlantic Coast states such as Illinois, Michigan, Minnesota, and New York, in climate zones 5 – 6. The exception was the Mid-Atlantic TRM v.7 which was based on a 2016 metering study in Maryland (zone 4) which represented the most recent study from a climate most like Georgia (zone 3). Among studies considered (bolded in the table below), typical UEC estimates for refrigerators range from 1,040 to 1,098 kWh/year, while typical UEC values for freezers range from 669 to 1,080 kWh/year. We also present the values specified in the UMP.

Table 162. Sample of the Most Recent Refrigerator and Freezer Metering Studies Reviewed

MODEL SOURCE	STUDY YEAR	REFRIGERATOR AVG. UEC (KWH/YR.)	FREEZER AVG. UEC (KWH/YR.)
Georgia Power	2011	1,065	1,080

[89] Nexant, December 21, 2012. 'Impact Evaluation of Georgia Power Company's 2011 DSM Programs'

[90] Kurnik, Charles W., Josh Keeling, and Doug Bruchs. "Chapter 7: Refrigerator Recycling Evaluation Protocol. The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures." National Renewable Energy Lab. (NREL), Golden, CO (United States), October 4, 2017. https://doi.org/10.2172/1398879

MODEL SOURCE	STUDY YEAR	REFRIGERATOR AVG. UEC (KWH/YR.)	FREEZER AVG. UEC (KWH/YR.)
Indiana Power & Light	2017	1,040	669
Mid-Atlantic TRM v.7	2016	1,098	715
UMP 2017	2017	1,240	1,007
TVA TRM 2015	2015	595	597
New York TRM v.8	2015	1,218	846
ComEd NY	2015	948	NA
ConEd IL	2013	1,010	NA
Minnesota TRM v.3	2012	915	1,134
Michigan TRM	2012	1,135	994
Illinois TRM v.9	2012	901	905
Indiana TRM v2.2	2012	761	NA

As the 2016 Mid-Atlantic TRM is the most recent study in a somewhat comparable climate zone to Georgia, the 2017 Indiana Power and Light evaluation is the most recent available study overall, and the UMP is the accepted industry standard, we conducted a sensitivity analysis of the UEC calculation using the coefficients produced in each of those studies, and the 2020 – 2021 Georgia Power RRP tracking data. Table 163 presents the coefficients used in each of those studies, respective regression analysis, along with the final calculated UEC values achieved when applying those coefficients to the program tracking data.

Table 163. Comparison of Georgia Power Refrigerator Power Model Terms to Recent UMP-Based Regression Fits for Other Programs (all values have been converted to kWh per year)

MODEL TERM	GPC (2011)	IN POWER & LIGHT (2017)	MID-ATLANTIC TRM (2016)	UMP - REFRIGERATOR	UMP - FREEZER
Intercept	-700.8	292.2	293.9	212.6	-348.8
Age	35.2	7.3	7.7	9.9	16.4
Pre-1990	-	379.9	378.4	385.3	198.3
24.543.8Size	59.9	21.9	21.7	24.5	43.8
Single door	-	-639.2	-639.7	-722.1	-
Side-by-side door	-	409.1	408.9	391.2	-
Chest Freezer	-	-	-	-	108.8
Primary appliance [a]	-	204.5	204.5	221.1	-
HDD unconditioned space [b]	-	-7.3	-14.7	-16.4	-11.3
CDD unconditioned space [b]	-	11.0	9.6	7.3	30.0
Is freezer	78.4	-	-	-	
Refrigerator Average UEC (kWh/yr.)	996.1	953.1	900.0	1,270.2	-
Freezer Average UEC (kWh/yr.)	995.0	831.0	779.1	-	888.7.0

MODEL TERM	GPC (2011)	IN POWER & LIGHT (2017)	MID-ATLANTIC TRM (2016)	UMP - REFRIGERATOR	UMP - FREEZER

[a] Appliances with a location of "first-floor" were counted as primary appliances

[b] Average HDD and CDD values were taken from the Hartsfield Jackson Airport weather station and averaged for calendar year 2020. Unconditioned space was defined as appliances with a location of "Garage", "Outbuilding", "Porch", or "Yard".

A variety of factors contribute to the team's decision that the 2011 Georgia Power study is the most appropriate to use for this evaluation. Primarily, the Georgia Power study uses data that is specific to Georgia, which is best practice, and the values found for the refrigerator average UEC utilizing the coefficients derived from the 2011 Georgia Power model fall within the range of values from the other various studies researched. Finally, each of the other studies rely on additional coefficients that aren't tracked in the Georgia Power data (primary appliance and conditioned space), and thus were interpreted from other similar variables.

References

Table 164. Sample of the Most Recent Refrigerator and Freezer Metering Studies Reviewed

MODEL SOURCE	UNDERLYING METERING STUDY	STUDY YEAR
Georgia Power	Nexant. "Impact Evaluation of Georgia Power Company's 2011 DSM Programs," 2012.	2011
Indiana Power DSM Eval Report Vol 2 2018	Program average coefficients based on program database of participants (2017) Cadmus Demand-Side Management Portfolio Evaluation Report Appendices, June 28, 2018	2017
Mid-Atlantic TRM v.7 2017	Memo from Navigant Consulting to EmPOWER Maryland utilities, Appliance Recycling Program Regression Modeling Analysis, Eval Yr. 6 July 12, 2016.	2016
Illinois TRM v.9	July 30, 2014, memo from Cadmus: "Appliance Recycling Update no single door July 30, 2014". (2012 data)	2012
IN TRM July 2015 v2.2	Parameters for NIPSCO recycling program. TecMarket Works. Evaluation of the NIPSCO Appliance Recycling Program. 2012.	2012
NY TRM v.8	Cadmus memo to Consolidated Edison, "Recommended Gross Savings Values for Refrigerator Recycling Programs", December 17, 2015	2015

MODEL SOURCE	UNDERLYING METERING STUDY	STUDY YEAR
MN TRM v.3	Itron. Navigant. Fridge & Freezer Recycle Rewards Program PY4 Metering Study: Preliminary Savings Results, May 4, 2012.	2011
MI TRM	The Cadmus Group, Inc. Opinion Dynamics. Michigan Appliance Recycling Metering Study. August 2012.	2012
PA TRM vol 2 2021	US DOE Uniform Method Project, Savings Protocol for Refrigerator Retirement, April 2017. https://www.nrel.gov/docs/fy17osti/68563.pdf	2016
ConEd Eval	ERS Con Edison EEPS Programs - Impact Evaluation of Residential Appliance Bounty Program ConEd Evaluation, 2015, ERS	2014
ComEd Eval	Navigant's report prepared for Commonwealth Edison Company on January 22, 2013. "Energy Efficiency / Demand Response Plan: Plan Year 4 (6/1/2011–5/31/2012) Evaluation Report: Residential Fridge and Freezer Recycle Rewards Program." http://ilsagfiles.org/SAG_files/Evaluation_Documents/ComEd/ComEd%20EPY4%20Evaluation%20Reports/ComEd_Res_Fridge&Freezer_Recycle_Rewards_EPY4_Eval_Report_Final.pd	2021

Appendix 7B. General Population Survey

Below we detail findings from the cross-cutting general population survey with Georgia Power's residential customers. The primary goal of this survey was to provide input into the net-to-gross analysis for the Refrigerator Recycling program; however, the evaluation team was able to gather additional information on customer attitudes, perspectives, and awareness of energy efficiency and Georgia Power programs that may benefit the larger portfolio design and delivery.

Survey Overview

The general population survey characterized residential customers in terms of their:

- Attitudes toward energy efficiency
- Awareness of Georgia Power's residential program offerings
- Actions taken to save energy
- Likely future equipment replacements
- Satisfaction with Georgia Power

In addition to providing process and market findings, a primary goal of this survey was to identify customers who disposed of a refrigerator or freezer as a point of triangulation for the Refrigerator Recycling net-to-gross analysis (per UMP recommendations).

The evaluation team explored differences in customer responses according to demographic characteristics and found that homeownership status had the strongest relationship to certain customer attitudes and behaviors. Below, results are segmented by homeownership status (homeowner or renter) where significant differences in responses existed; any results where differences are not segmented by homeownership status should be interpreted as being statistically equivalent between homeowners and renters. All significance tests reported below were conducted at the 90% significance level.

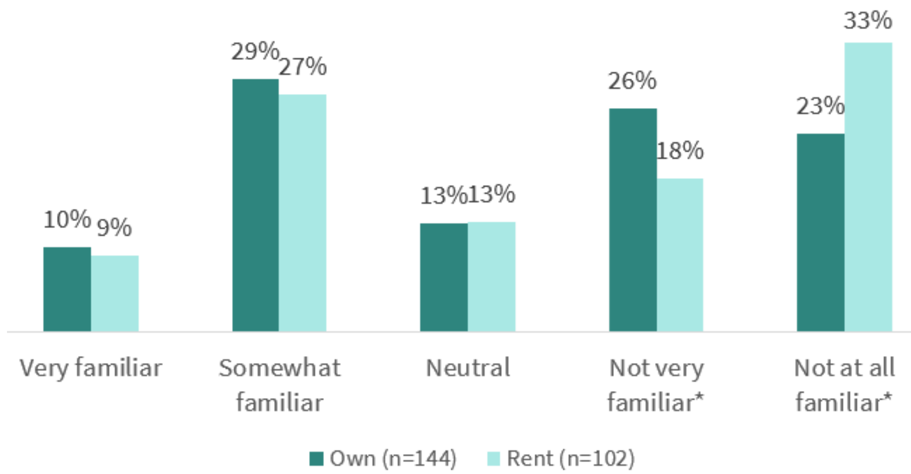
To conduct this survey, the evaluation team randomly sampled 3,500 residential customers and completed 250 total surveys (189 phone, 61 web) with Georgia Power customers, representing a 7% response rate. Sampled participants with listed emails were sent an email invitation including a link to complete the survey online and were then sent two subsequent follow-up reminder emails. The survey administrators then followed-up with phone calls to customers who had not responded to the email request.

The evaluation team compared demographic results to key demographics of the overall state of Georgia, because we did not have access to exact demographics of Georgia Power customers. Most were relatively closely aligned (such as race/ethnicity and median income). Results are presented unweighted.

Energy Efficiency Program Awareness and Participation

Overall, respondents reported moderate levels of awareness with Georgia Power program offerings, with 37% of all respondents (renters and homeowners) reporting they were either very familiar or somewhat familiar with Georgia Power rebates or programs (Figure 131). Among those that expressed unfamiliarity with program offerings (not very familiar or not at all familiar), renters were significantly more likely to report that they were not at all familiar (33%) than owners (23%), while the opposite held true for those who reported they were not very familiar.

Figure 131. Familiarity of Programs

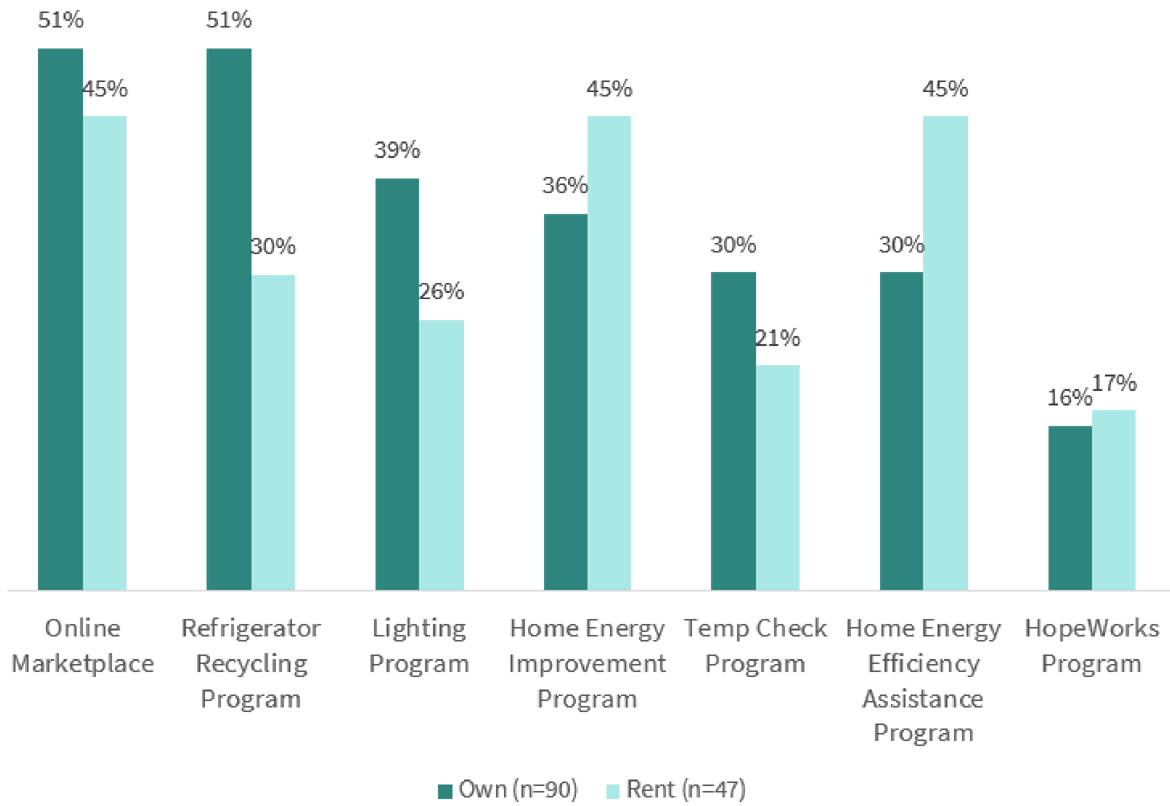


Source: General Population Survey. B1. How familiar are you with energy efficiency rebates or programs from Georgia Power?
**Indicates responses are significantly different between groups (p < .05).*

While overall awareness of Georgia Power program offerings was statistically equivalent among homeowners and renters, the specific programs with which they expressed familiarity varied considerably (Figure 132). Specifically, among those who noted they were either *very familiar* or *somewhat familiar* with program offerings, homeowners expressed significantly higher levels of awareness of both the Refrigerator Recycling program and the Lighting program, while renters expressed significantly higher awareness of both the Home Energy Efficiency Assistance Program and the Home Energy Improvement Program.[91] Overall, the Online Marketplace was the most well-known by all respondents overall (49%), followed by the Refrigerator Recycling program (44%), the Home Energy Improvement Program (39%), the Lighting program (34%), and Home Energy Efficiency Assistance Program (35%).

[91] HEEAP is a brand-new offering to Georgia power in 2020. As such, this number includes respondents who cited awareness in "the low-income program", as many survey respondents were better able to describe the general nature of the program, rather than the specific name.

Figure 132. Specific Program Awareness by Home Occupancy Type

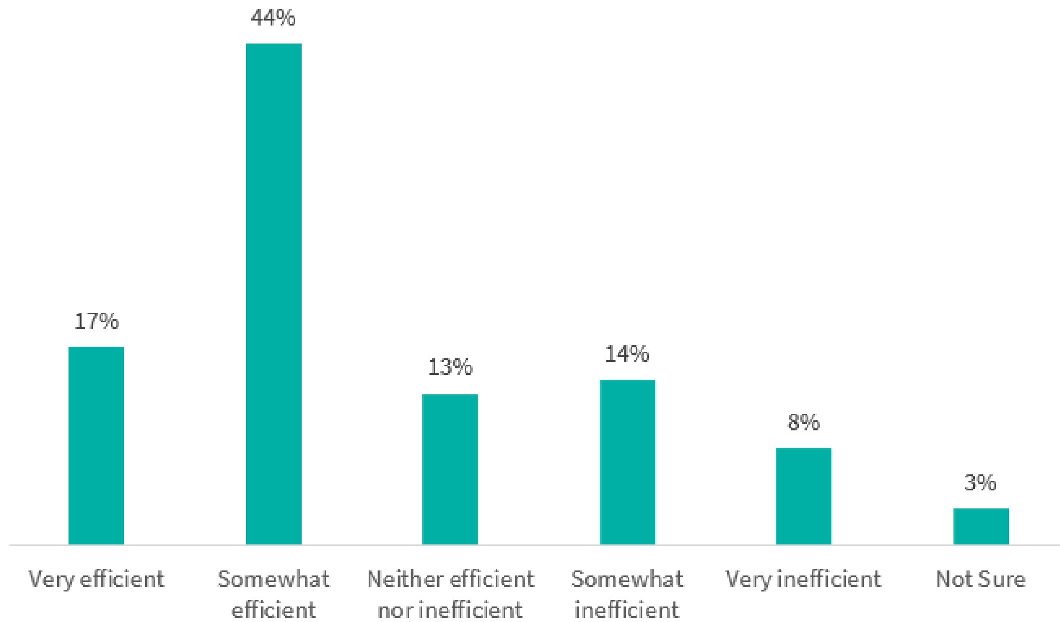


Source: General Population Survey. B2. Which energy-saving rebates or programs offered by Georgia Power have you heard of?

Energy Efficiency Attitudes

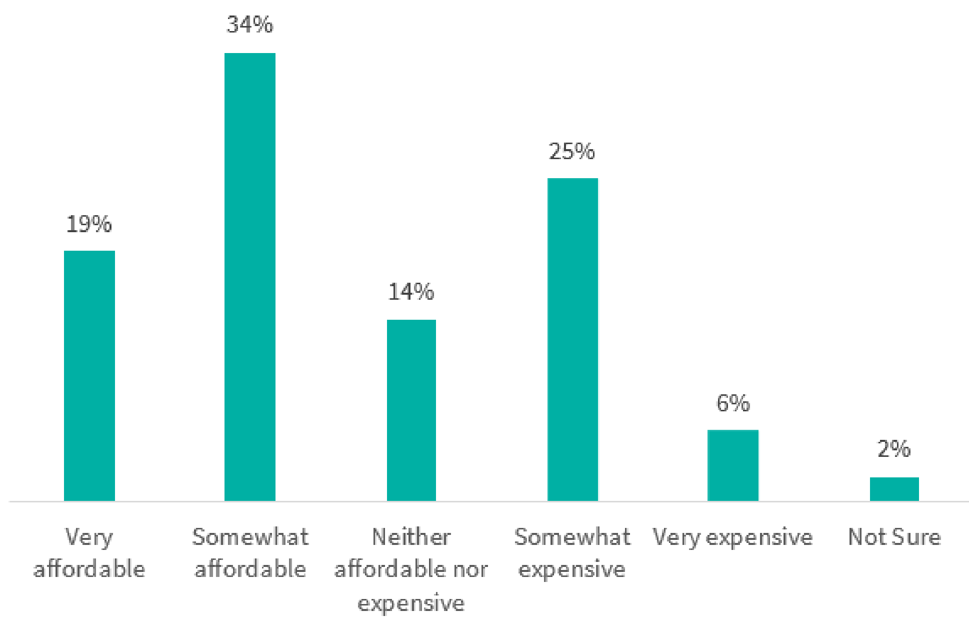
Survey respondents indicated a perception that there is room for improvement regarding their home's energy efficiency, as only 17% reported that their home was very efficient (Figure 133). Most respondents (44%) stated that their home was somewhat efficient, which while a positive perception, indicates a belief that improvements could be made. Respondents' attitudes related to the affordability of their electric bills followed a similar distribution to their perceptions of their home's efficiency, with most respondents (34%) indicating that their bills were somewhat affordable (Figure 134). However, one-quarter of respondents indicated that their bills were somewhat expensive (25%). Only 6% of respondents indicated that their bills were very expensive.

Figure 133. Perception of Home Efficiency



Source: General Population Survey. B3. In your opinion, how energy efficient or energy inefficient is your home?

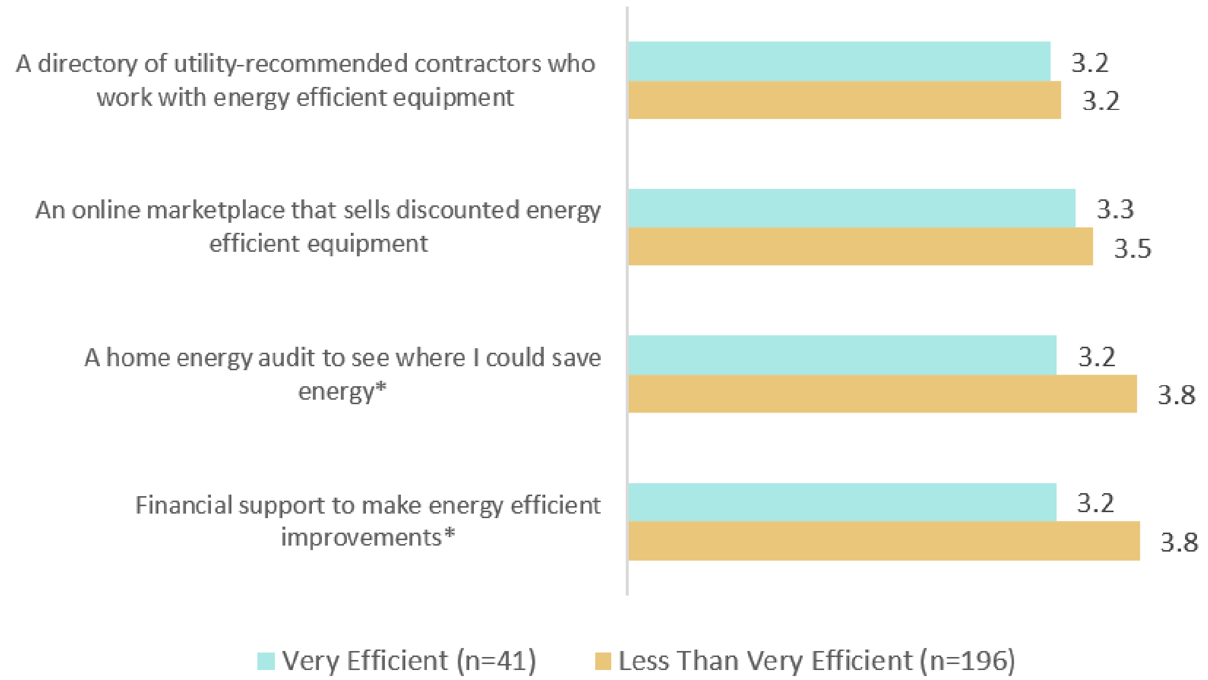
Figure 134. Perception of Energy Bill Affordability



Source: General Population Survey. B4. In your opinion, how affordable or expensive are your energy bills from Georgia Power?

Respondents' opinions of the energy efficiency of their home were correlated with how useful they would find potential services that could improve their home's efficiency. Those who reported that their home was less than very efficient (n=196) indicated that they would find certain services more useful than those who reported that their home was very efficient (n=41), including financial support to make energy efficient improvements, or a home energy audit to see where they could save (Figure 135). When considering that only about 20% of respondents indicated that they were aware of either of the Georgia Power programs that provide home energy assessments (HEIP 53 out of 250, HEEAP 48 out of 250), responses show there is simultaneously strong interest in these program offerings and opportunities to improve awareness of them.

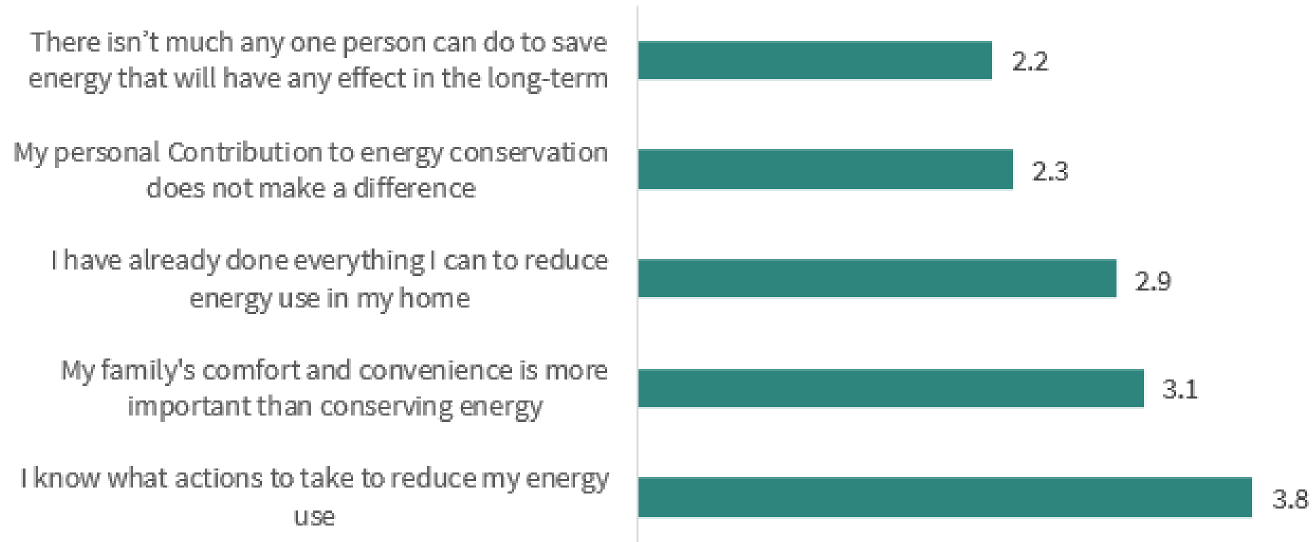
Figure 135. Usefulness of Services



Source: General Population Survey. B5. On a scale of 1 to 5, where 1 is not at all useful, and 5 is very useful, how useful would the following services be in helping you make your home more energy efficient?
**Indicates responses are significantly different among the two groups at the 90% confidence level.*

Respondents' general attitudes towards the importance of energy efficiency in their daily lives were somewhat mixed. Respondents overall tended to agree with the idea that they knew what actions to take to reduce their energy use (3.8 out of 5) (Figure 136), but they agreed on whether they had already done everything they could to reduce energy use in their home (2.9 out of 5). Respondents slightly agreed that their family's comfort and convenience was more important than conserving energy (3.1 out of 5). Respondents somewhat disagreed with the ideas that there is not much any one person can do to save energy to have any effect in the long-term (2.2 out of 5) or that their personal contribution to energy conservation does not make a difference (2.3 out of 5).

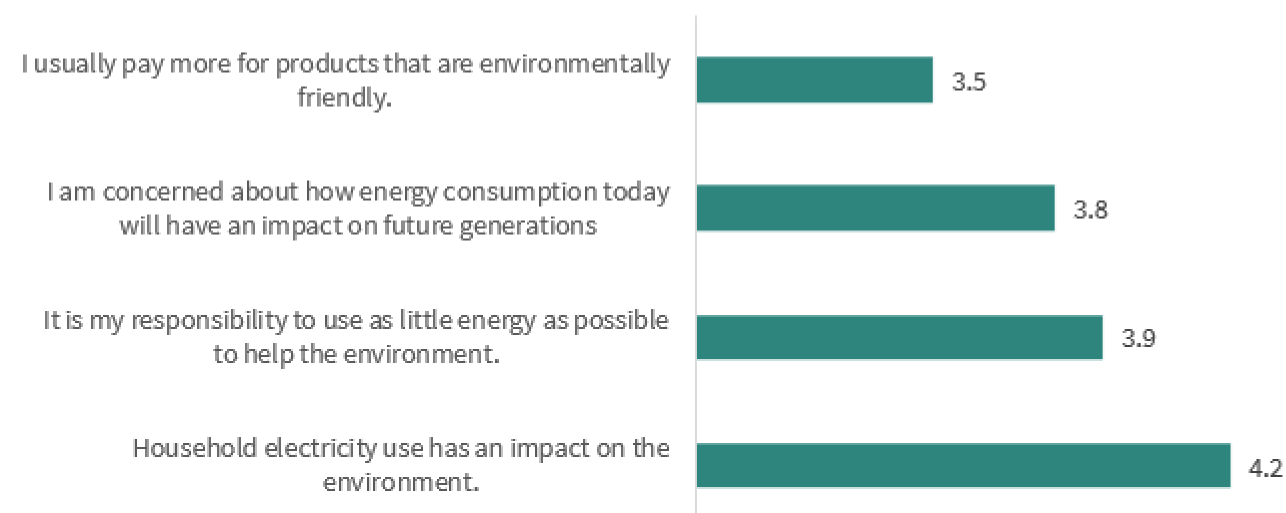
Figure 136. General Energy Efficiency Attitudes



Source: General Population Survey. C1. For each of the next statements, please tell me if you [1] strongly disagree, [2] somewhat disagree; [3] neither agree or disagree; [4] somewhat agree; or [5] strongly agree:

Regarding the beliefs that behaviors related to energy consumption have environmental impacts, most respondents strongly agree (4.2 out of 5) that their household electricity use has an impact on the environment (Figure 137). Respondents also showed strong support for the idea that it is their responsibility to use as little energy as possible to help the environment (3.9 out of 5), and that they are concerned with how energy consumption today will have an impact on future generations (3.8 out of 5). Respondents were least likely to agree that they usually pay more for products that are environmentally friendly (3.5 out of 5).

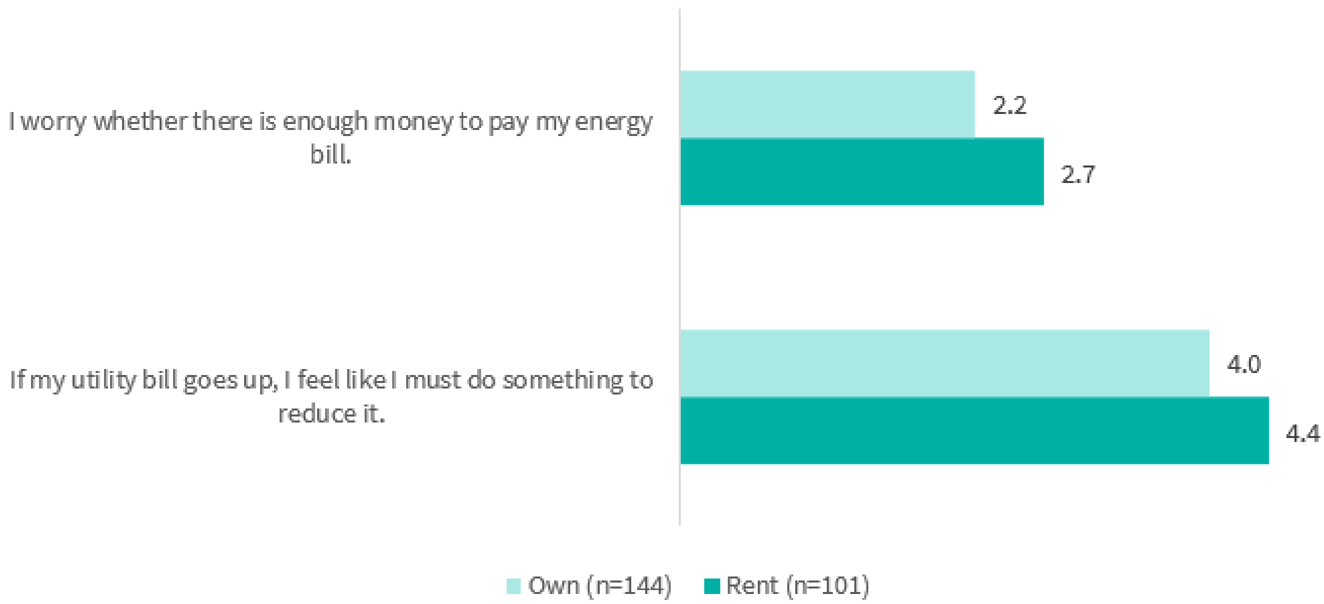
Figure 137. Environmental Stewardship and Energy Efficiency Attitudes



Source: General Population Survey. C2. Using the following scale of [1] strongly disagree, [2] somewhat disagree; [3] neither agree or disagree; [4] somewhat agree; or [5] strongly agree, please rate how much you agree with the following statements:

Concerning their attitudes with energy and energy efficiency, the only two topics that homeowners and renters disagreed on were related to the financial implication of their energy use. While both groups strongly agreed with the idea that they must do something to reduce their energy bill if it goes up (Figure 138), renters indicated significantly stronger agreement with this statement (4.4 out of 5) compared to homeowners (4.0 out of 5). Likewise, while the concept of worrying whether they had enough money to pay their energy bill was comparatively lower than the other metrics, renters were once again significantly more likely (2.7 out of 5) to agree with this statement as compared to homeowners (2.2 out of 5). This could be explained in part by the fact that 52% of renters indicated they had household incomes under $50,000 annually, compared to just 23% of homeowners.

Figure 138. Financial Energy Attitudes

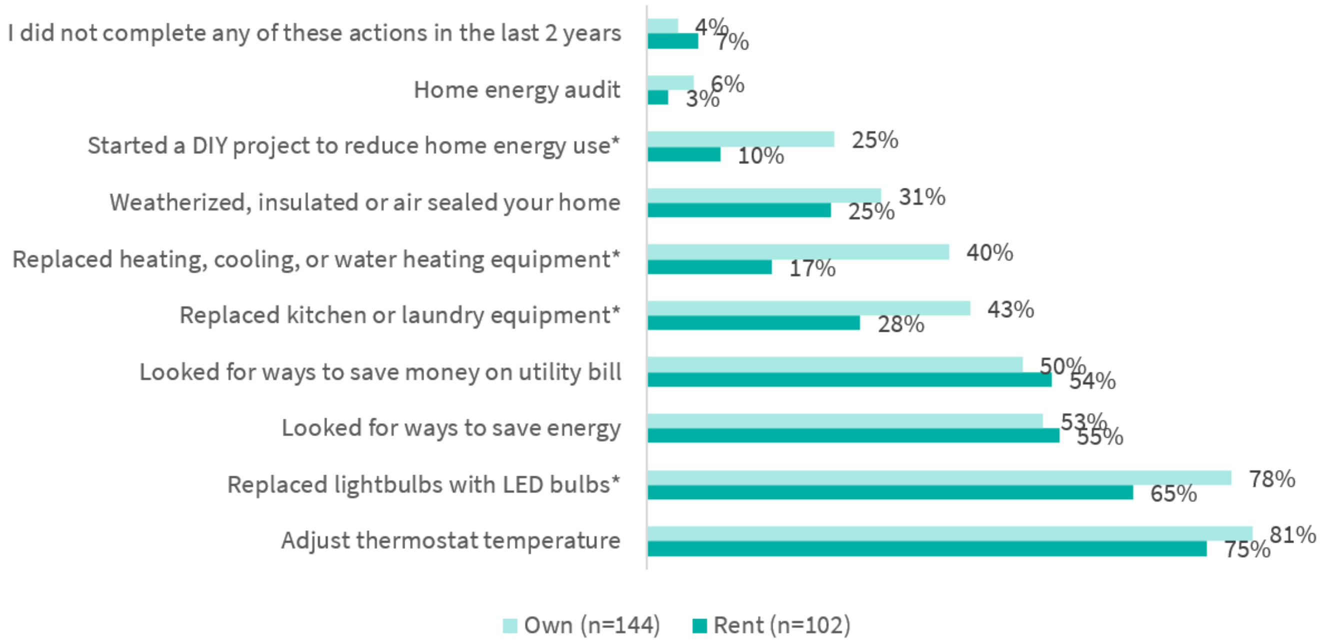


Source: General Population Survey. C2. Using the following scale of [1] strongly disagree, [2] somewhat disagree; [3] neither agree or disagree; [4] somewhat agree; or [5] strongly agree, please rate how much you agree with the following statements:

Energy Efficiency Behaviors

Most survey respondents indicated conducting some type of energy saving action over the past two years, with over 70% of all respondents reporting simple actions such as adjusting the thermostat or replacing lightbulbs with LEDs (Figure 139). Over half of the respondents reported that they looked for ways to save energy or money on their utility bill in the last two years. Compared to renters, homeowners were significantly more likely to report they had conducted deeper energy saving actions such as replacing kitchen or laundry equipment, replacing HVAC or water heating equipment, or beginning a DIY project to reduce energy use.

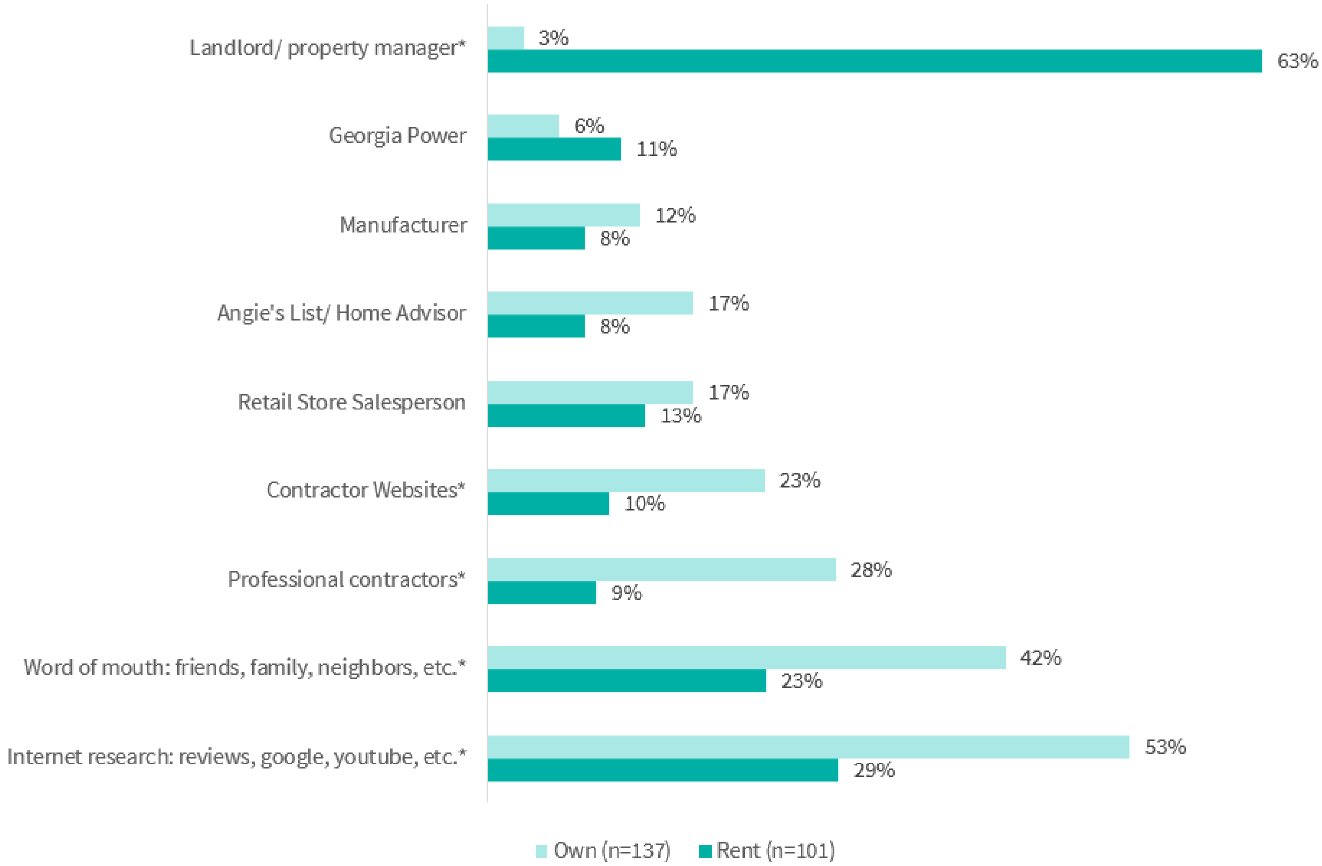
Figure 139. Energy-Saving Actions



Source: General Population Survey. C3. Below we list a few ways to use less energy in your home. Which, if any, of these energy-saving actions did you or someone in your household do in the last 2 years?
**Indicates significant difference between homeowners and renters at the 90% confidence level.*

Homeowners and renters varied most significantly regarding the sources of information they utilize when they need to have repairs conducted on their homes (Figure 140). Compared to renters, homeowners were significantly more likely to conduct research online, rely on word-of-mouth advice, or consult with contractors or their websites, while renters were significantly more likely to speak with a landlord or property manager.

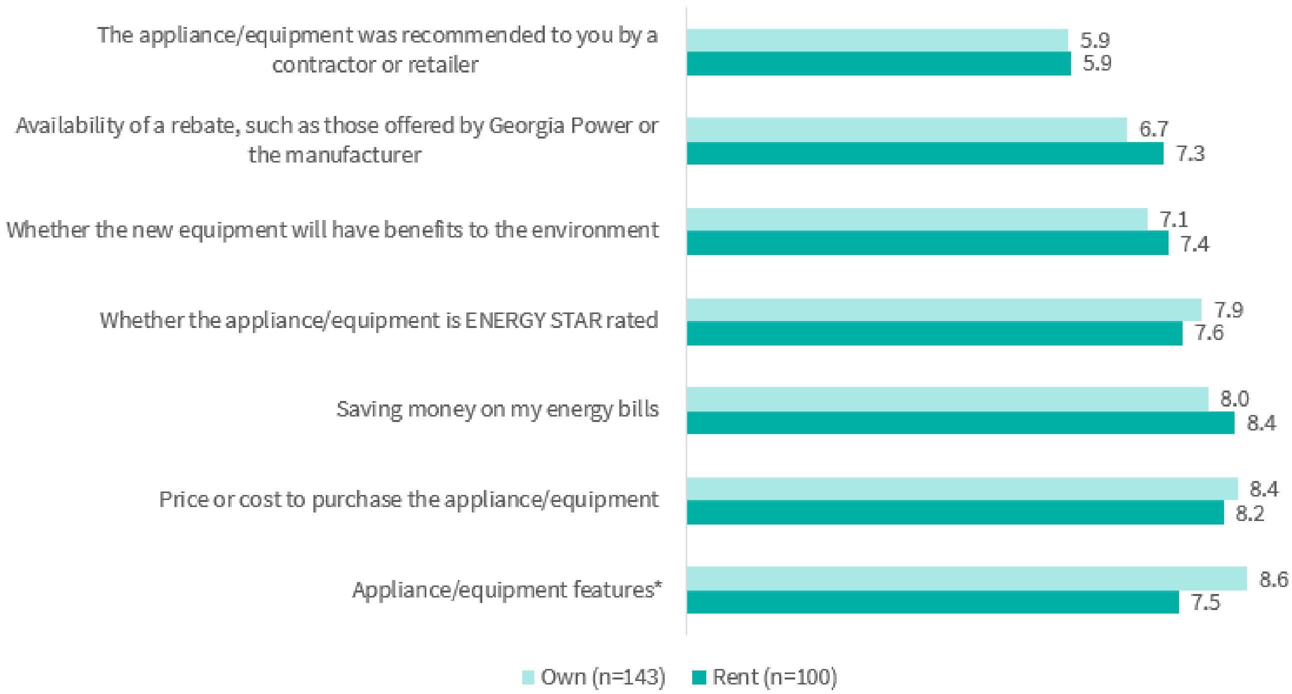
Figure 140. Sources of Information*



Source: General Population Survey. C4. When you need to have work done (repairs, remodeling, or other improvements) in your home where would you go for information?
**Multiple responses allowed. Totals do not sum to 100%.*

Homeowners and renters prioritized similar factors when making appliance purchases, only differing in the relative importance of an appliance's equipment or features (Figure 141), which was rated as the top priority among homeowners, but only the fourth most important among renters. Renters prioritized saving money on their energy bills above all else, followed by the appliance's cost. Other factors such as whether the appliance or equipment is ENERGY STAR rated, whether the equipment will have benefits to the environment, or the availability of a rebate, were relatively less important, while an appliance or equipment being recommended by a contractor or retailer was the least important to all respondents.

Figure 141. Factors Influencing Appliance Purchases

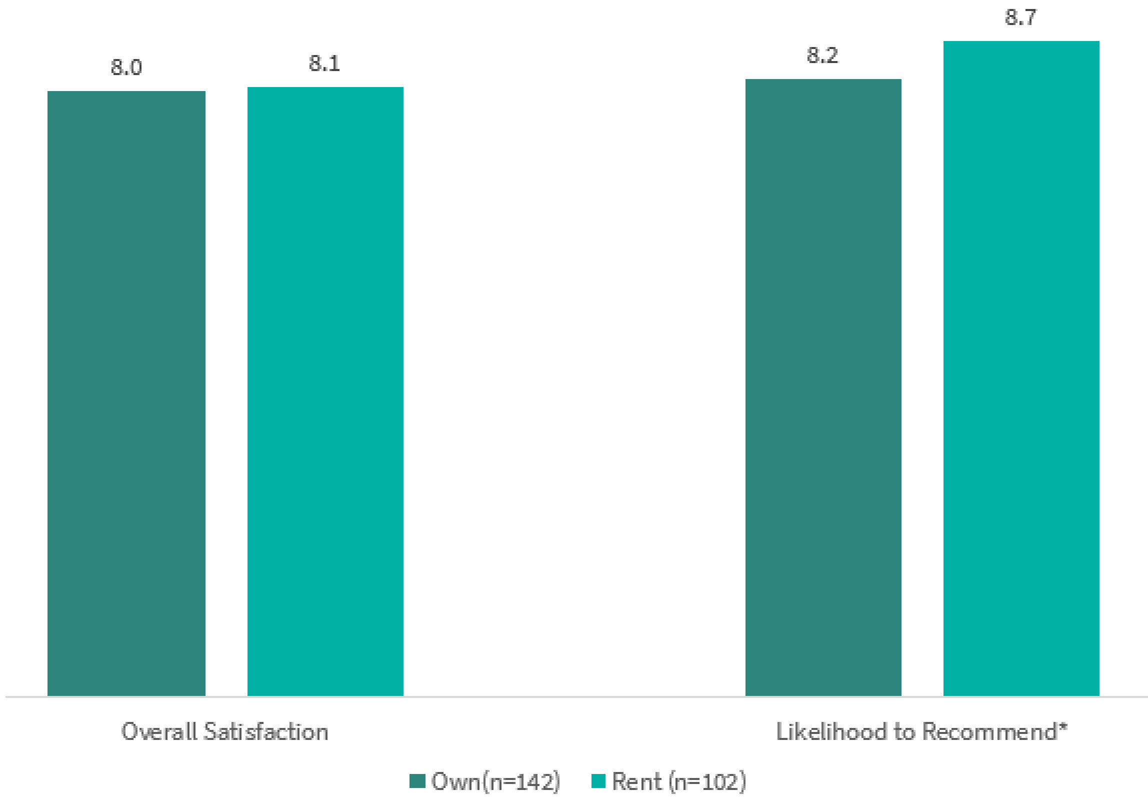


Source: General Population Survey. C5. When considering an appliance or equipment purchase for your home, how important are each of the following factors in your decision? Please use a 1 to 10 scale, with 1 being "Not at all important" and 10 being "Extremely important".

Satisfaction

Respondents indicated high levels of satisfaction with Georgia Power as a utility provider, with 30% reporting that they are extremely satisfied, for an overall satisfaction score of 8.0 (Figure 142), with only 7% of respondents providing a score less than 5. Respondents were similarly highly likely to recommend Georgia Power as a utility provider, with renters indicating significantly higher levels of support (8.7) compared to homeowners (8.2).

Figure 142. Satisfaction with Georgia Power and Likelihood to Recommend



Source: General Population Survey. E1. Taking into consideration all aspects of your utility service experience, how would you rate Georgia Power overall? Please use a 1 to 10 scale, where 1 is "extremely dissatisfied" and 10 is "extremely satisfied." E3. If you could recommend them as an electricity provider, how likely is it that you would recommend Georgia Power to a friend or colleague? Please select the rating scale point that best describes how you feel.

Overall, 17 respondents provided an overall satisfaction score of less than five. Through open-end responses, those respondents cited a variety of reasons for their relatively lower levels of satisfaction with Georgia Power, with the three most common being:

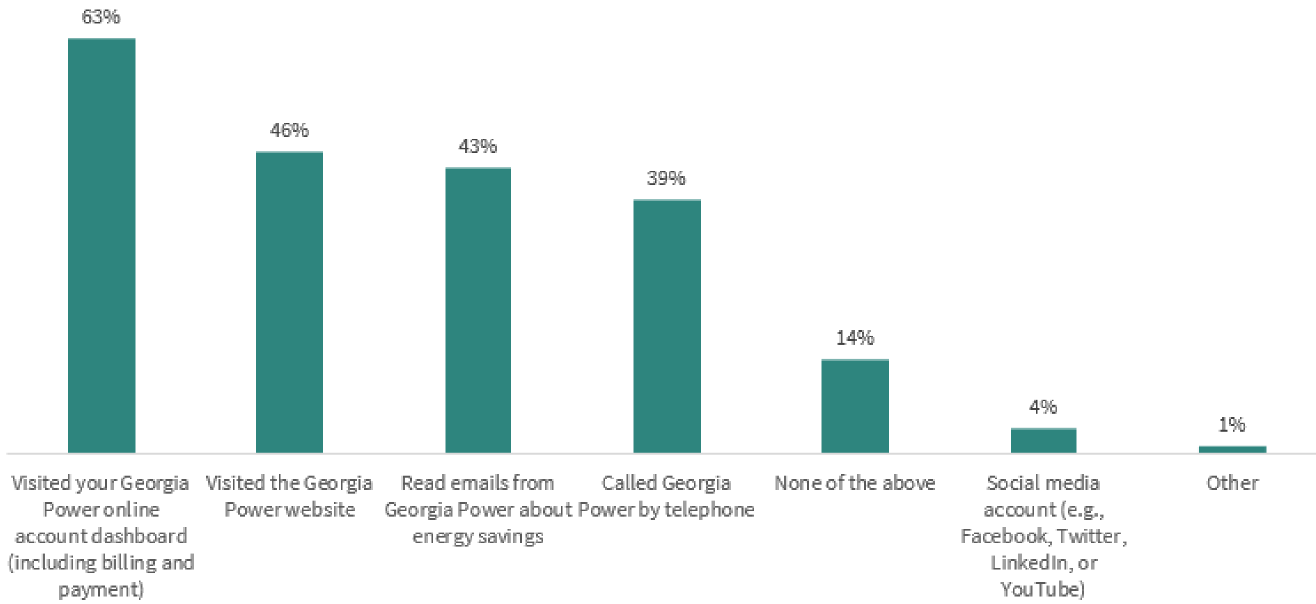
- Power outages or inconsistent power (n=4)
- Georgia Power's status as a monopoly (n=2)
- Concerns over the Vogtle Plant (n=2)

Among those who were highly satisfied (9 or 10 out of 10, n=118), the most common drivers of high satisfaction included (open-end responses):

- Good customer service (n=27)
- Consistent, reliable power (n=18)
- Good communication during/response to outages (n=12)
- Website is informative and easy to use (n=8)

Respondents indicated that most of their interaction with Georgia Power occurs online, with the most common types of contact coming from visiting the Georgia Power online account dashboard (63%), visiting the Georgia Power website (46%), or reading Georgia Power emails about energy savings (43%, Figure 143). Calling Georgia Power on the phone was less common (39%), while social media interaction was reported as the least common type of contact (4%). Only 14% of respondents indicated having no contact with Georgia Power in the past year.

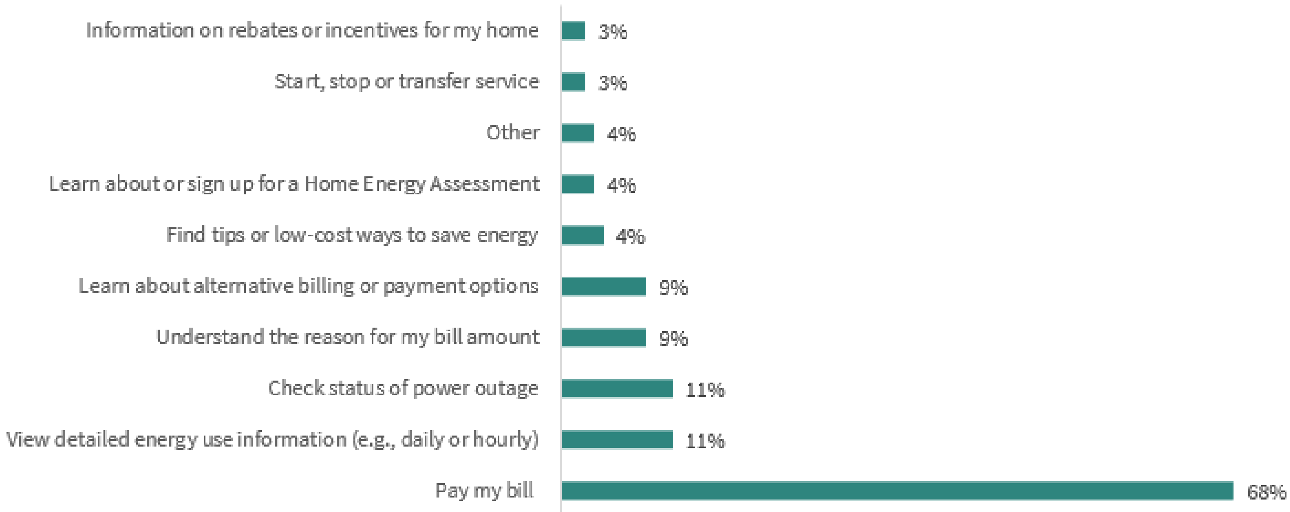
Figure 143. Types of Contact with Georgia Power



Source: General Population Survey. E4. Have you had any of the following types of contact with Georgia Power in the past year?

Bill payment was the largest driver of traffic to the Georgia Power website, as indicated by 68% of all respondents (Figure 144). The next most common reasons for customers' most recent visits were to view detailed energy use information (11%), check the status of a power outage (11%), understand the reason for their bill amount (9%), or learn about alternative billing or payment options (9%). The least common reasons reported for their most recent visit to the Georgia Power website included information on rebate or incentives for their home (3%), start/stop/transfer service (3%), learn about or sign up for a home energy assessment, or find tips or low-cost ways to save energy (4%).

Figure 144. Reason for Visit to Georgia Power Website

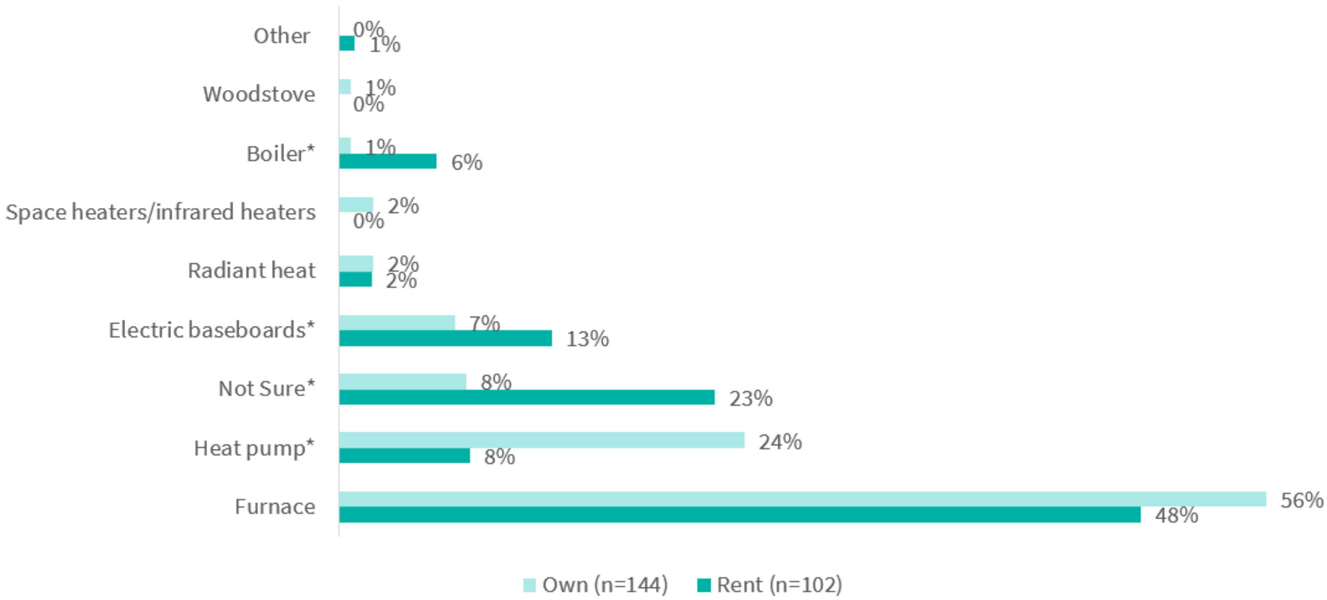


Source: General Population Survey. E5. What was the reason for your most recent visit to the Georgia Power website?

Home Systems and Equipment

Homeowners and renters indicated using significantly different heating systems (Figure 145). While furnaces were the most common system referenced by both groups, homeowners were significantly more likely to use a heat pump, while renters were significantly more likely to use either electric baseboards or boilers, or to indicate that they were not sure what their heating system was. While the specific heating systems used by renters varied significantly, the fuel used to power those systems was reported to be identical across those two groups (Figure 146), with electricity (57%) and natural gas (41%) the two most common.

Figure 145. Heating Systems



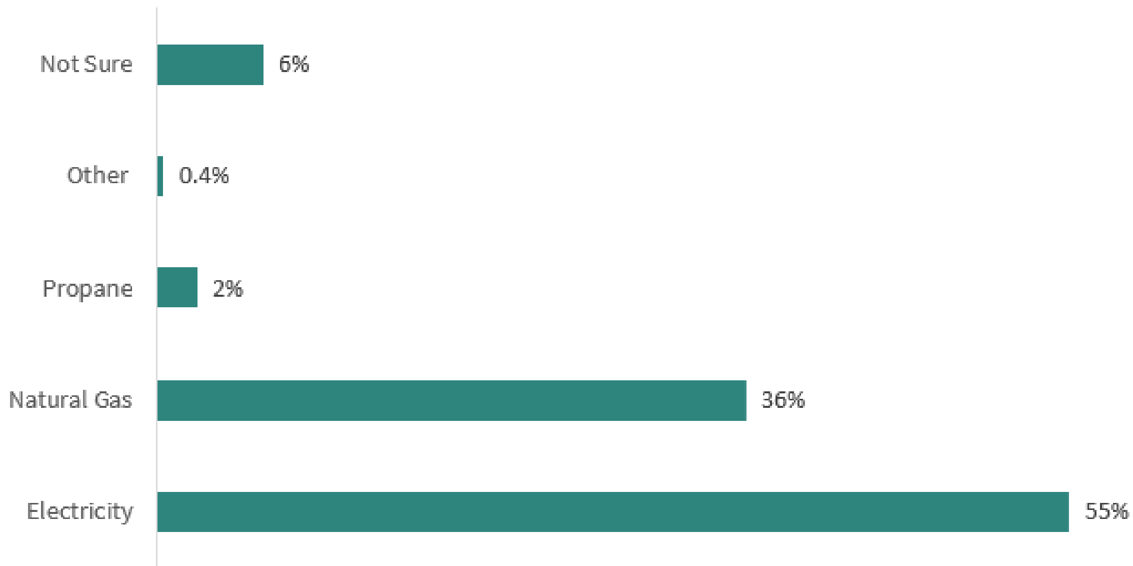
Source: General Population Survey. D1. Which of the following best describes the main heating system in your home?

Figure 146. Fuel Source for Space Heating

Source: General Population Survey: D2. What is the main fuel used to heat rooms or spaces in your home?

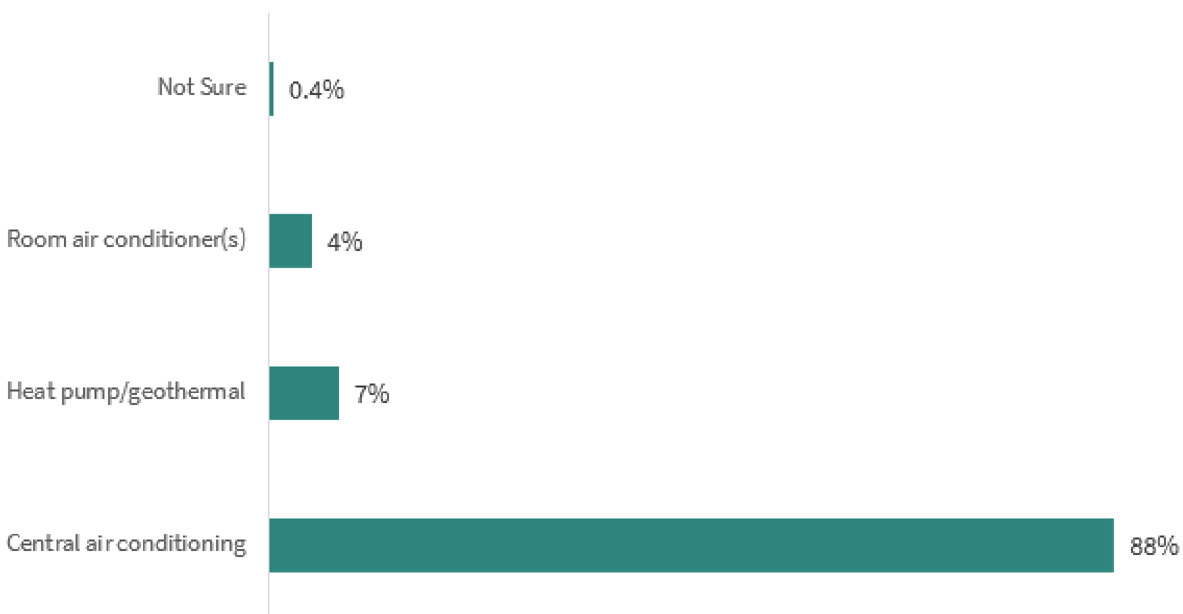
The fuel source of water heaters followed a similar distribution as space heating equipment (Figure 147), with electricity (55%) and natural gas (36%) again the dominant fuel sources among both homeowners and renters. Likewise, homeowners and renters use similar cooling systems (Figure 148), with most respondents indicating they have central air conditioning (88%), and few respondents indicating they use either heat pumps or geothermal (7%) or room air conditioners (4%).

Figure 147. Fuel Source for Water Heating



Source: General Population Survey. D3. What is the main fuel your water heater uses?

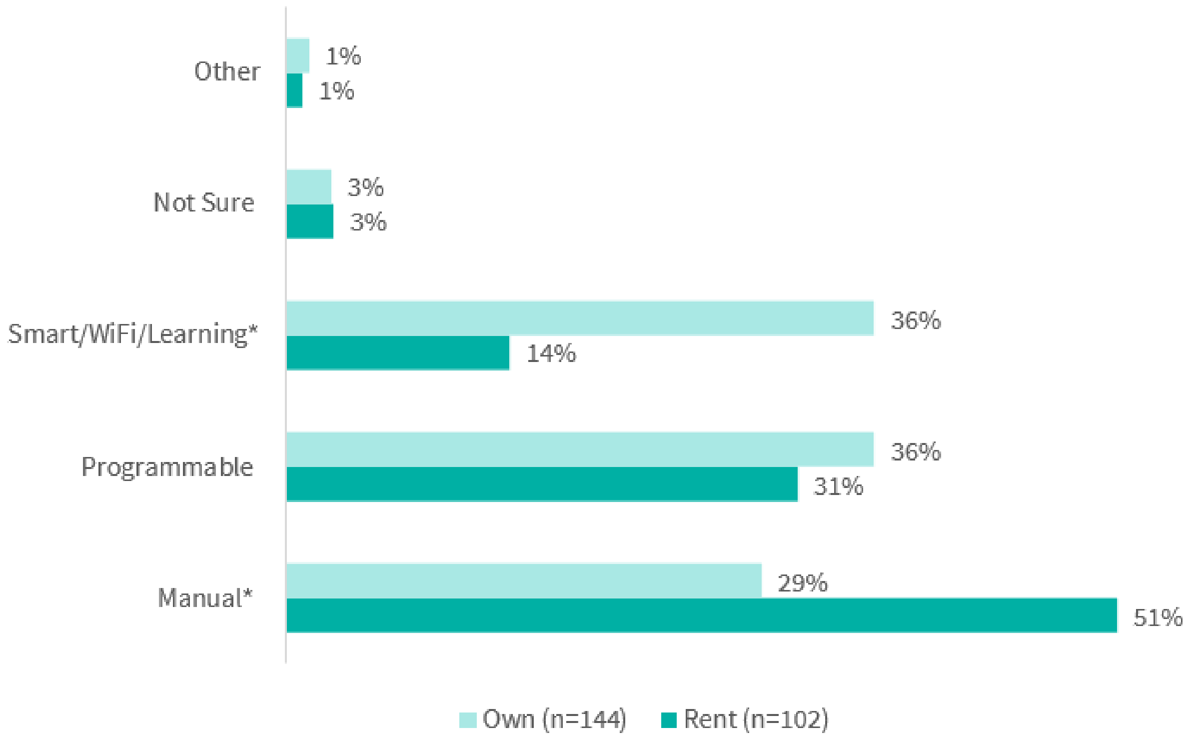
Figure 148. Cooling System



Source: General Population Survey. D4. Which of the following best describes the main cooling system in your home?

Regarding the type of thermostat utilized, homeowners and renters vary considerably (Figure 149), with significantly more renters possessing manual thermostats, and significantly more homeowners using smart, Wi-Fi, or learning thermostats.

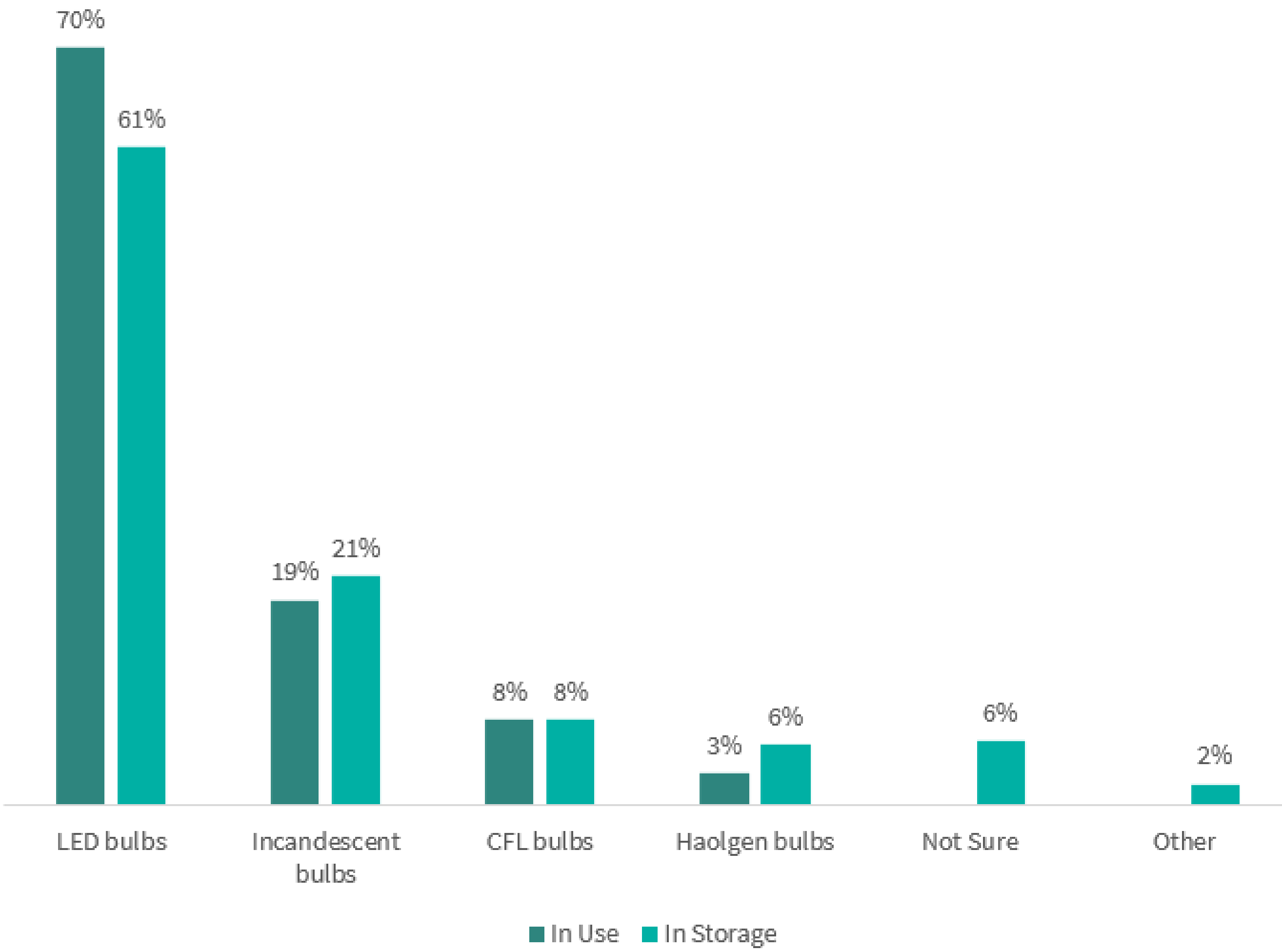
Figure 149. Thermostat Type



Source: General Population Survey. D5. What type of thermostat(s) do you have in your home?

LEDs dominated the lightbulb landscape, comprising 70% of all the lightbulbs in use in homes and 61% of those in storage (Figure 150). Other types of bulbs including incandescent (19% in use and 21% in storage), CFLs (8% in use and in storage) and halogen bulbs (3% in use and 6% in storage) comprised significantly smaller amounts of the lighting market.

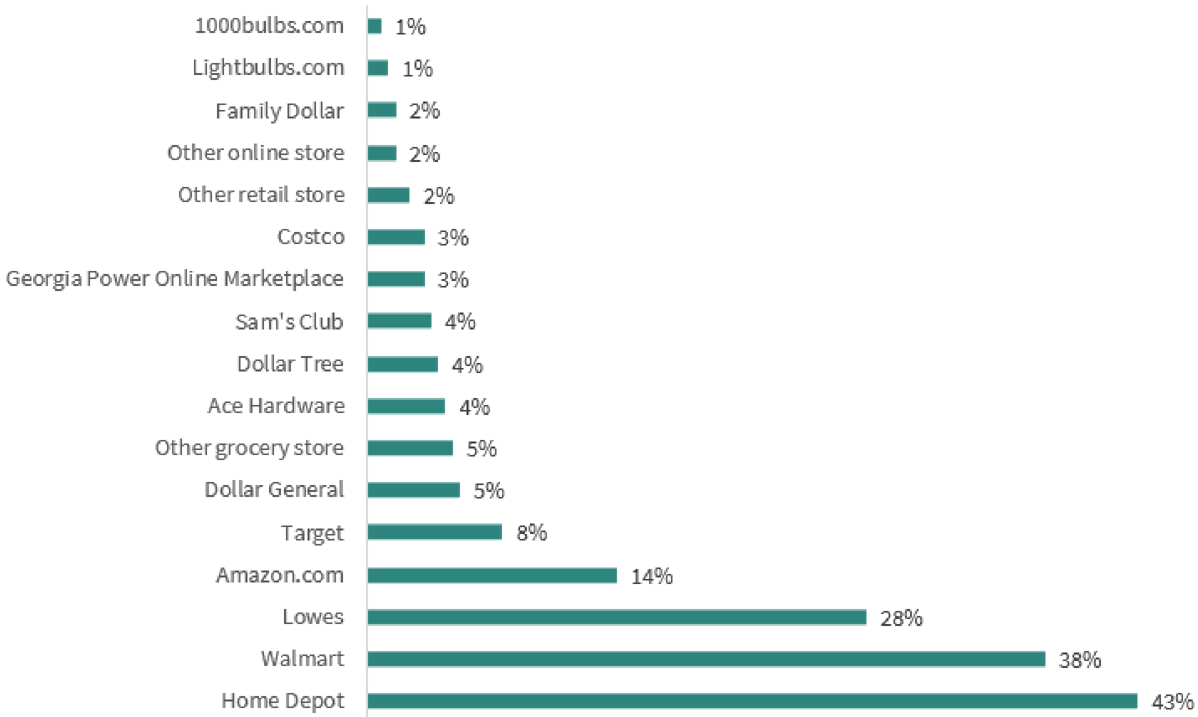
Figure 150. Lightbulbs in Use or in Storage



Source: General Population Survey. D23. We would like to know more about the mix of lights in your home. Please tell us your best guess of the percentage of each type of lightbulb you have in your home. D24. What types of lightbulbs, if any, are currently in storage in your home?

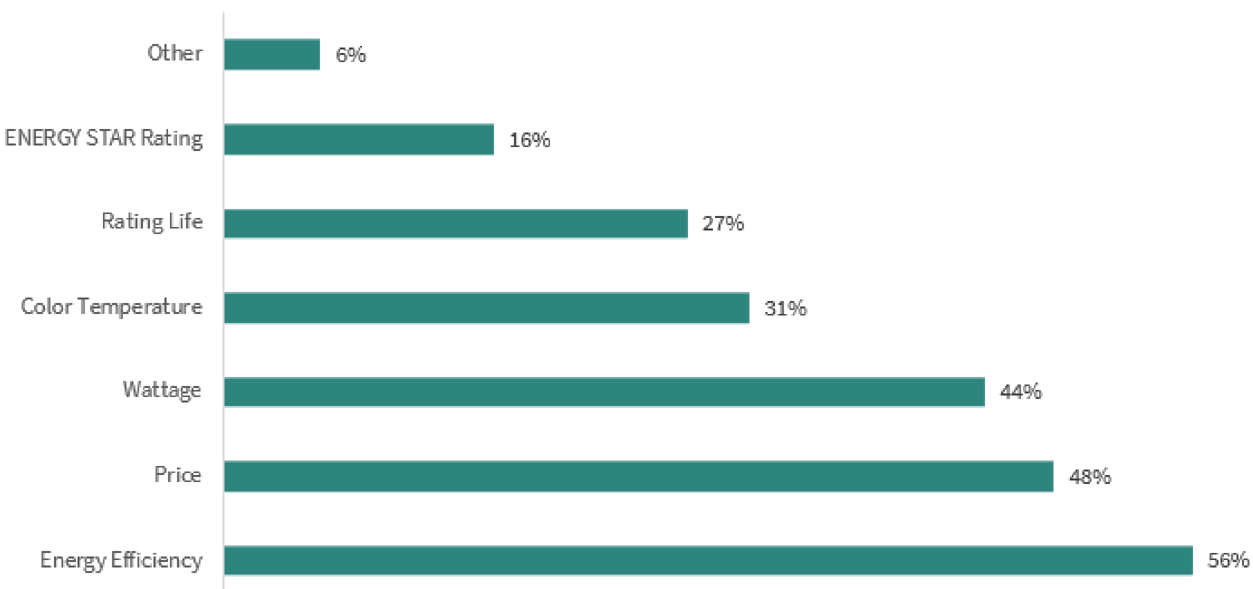
The most common places respondents purchased lightbulbs were Home Depot, Walmart, Lowes, or Amazon (Figure 151). The top three most important factors when considering purchasing lightbulbs were energy efficiency (56%), price (48%), and wattage (44%) (Figure 152).

Figure 151. Places to Buy Lightbulbs



Source: General Population Survey. D21. Where do you usually buy lightbulbs?

Figure 152. Important Factors for Purchasing Lightbulbs

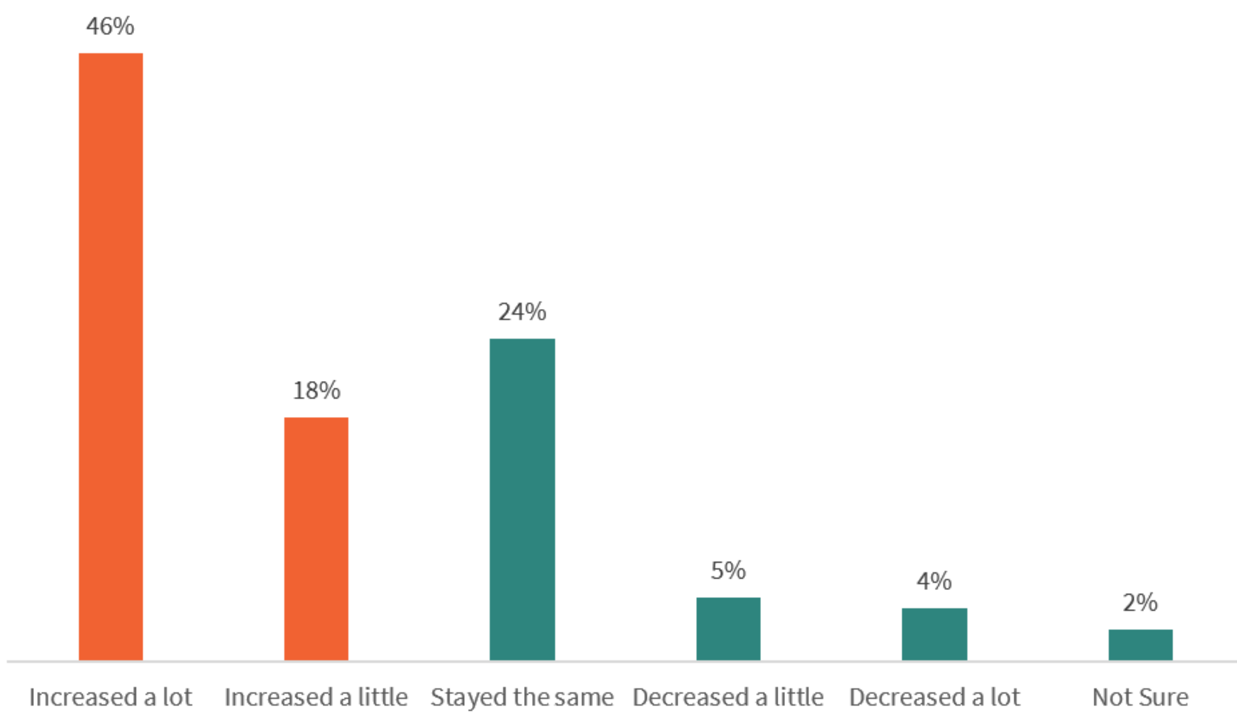


Source: General Population Survey. D22. Which of the following factors are important in your decision of which lightbulbs to buy for your home? [IF EMAIL] Please select up to 3 options below.

COVID-19 Related Questions

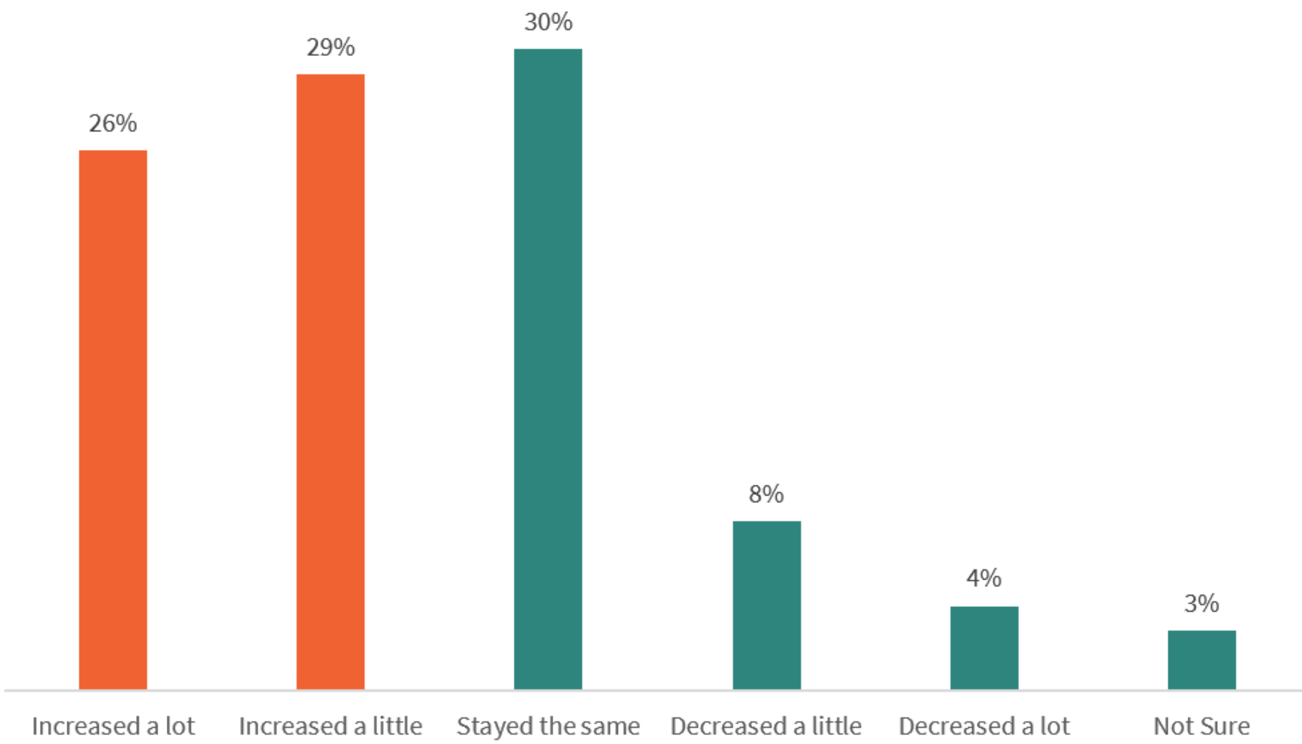
Compared to a typical week in 2019, most respondents reported that their time at home either increased a lot (46%) or increased a little (18%) (Figure 153). Nearly a quarter of respondents (24%) reported that their time at home stayed the same, while only 9% of respondents reported that their time at home either decreased a little or decreased a lot. As time at home increased significantly compared to a typical week in 2019, respondents reported that their energy use increased as well, with 26% of respondents indicating their energy use increased a lot, and 29% reporting it increased a little (Figure 154). Following the trend of time at home and energy consumption, respondents were likely to report that their electric bill increased a lot (16%) or increased a little (34%) (Figure 155).

Figure 153. Time at Home Compared to 2019



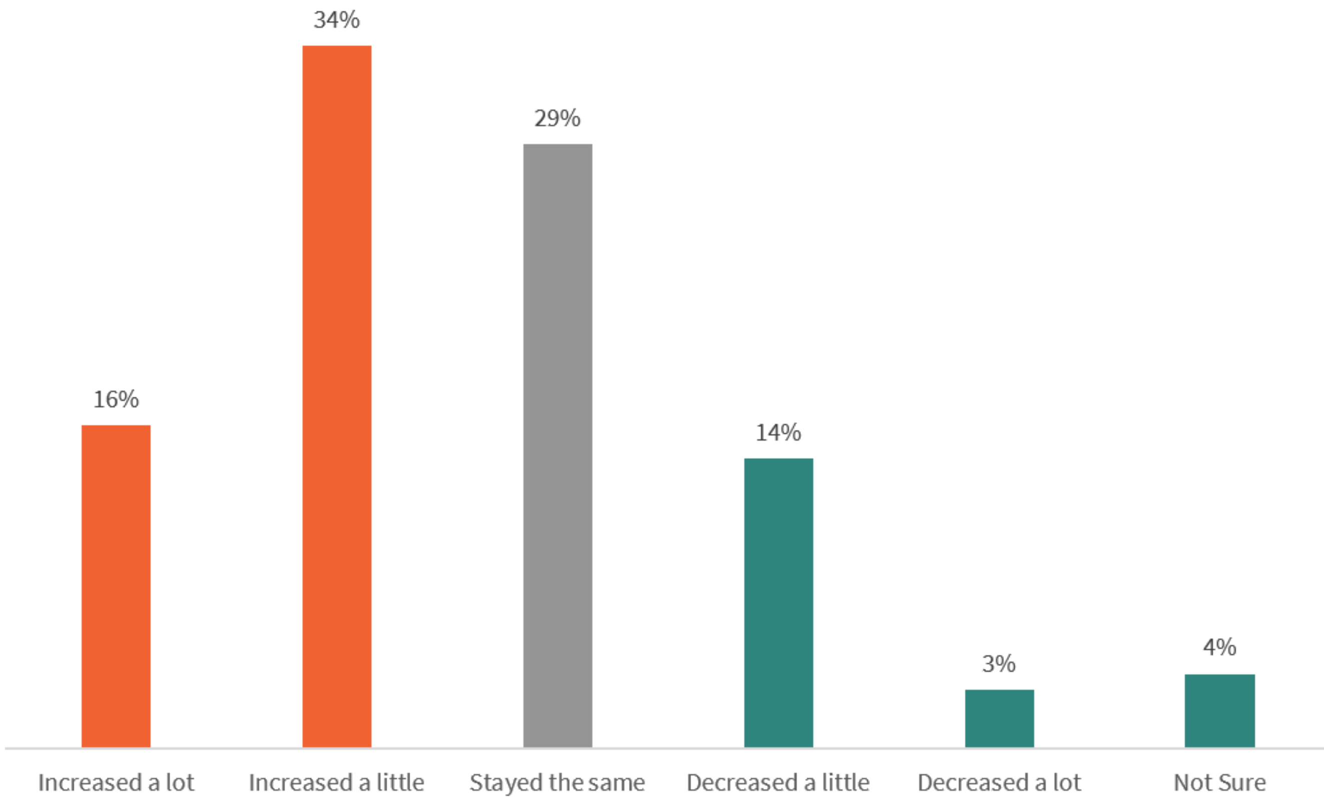
Source: General Population Survey. F1. Please think about the amount of time you spend at your home in a given week. Compared to this time in 2019, would you say the time your household spends at home has….

Figure 154. Energy Use Compared to 2019



Source: General Population Survey. F2. Please think about the amount of energy your household uses in a typical week. Compare d to 2019, would you say your household energy use has. …

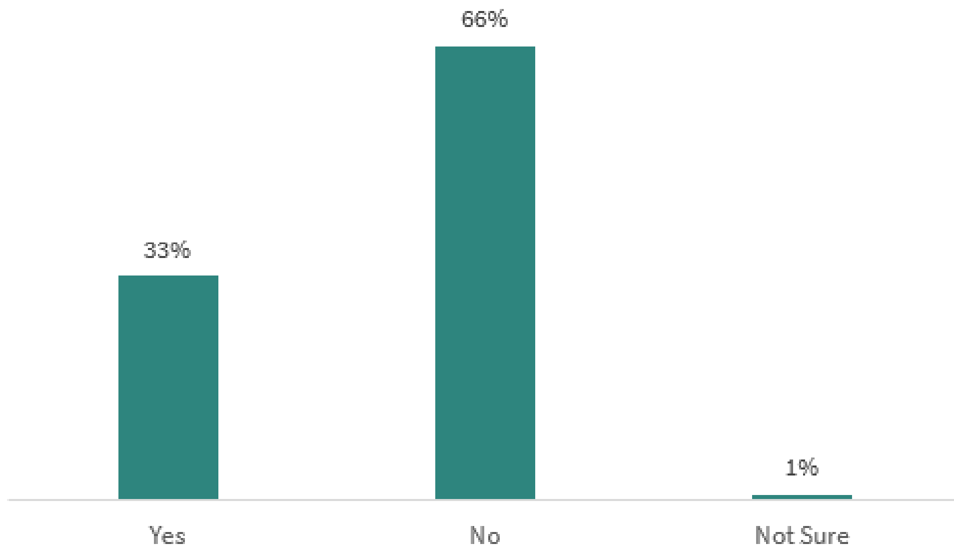
Figure 155. Monthly Electric Bill Compared to 2019



Source: General Population Survey. F3. Now, please think about your monthly electric bill. Since 2019, would you say your ele ctricity bill has…

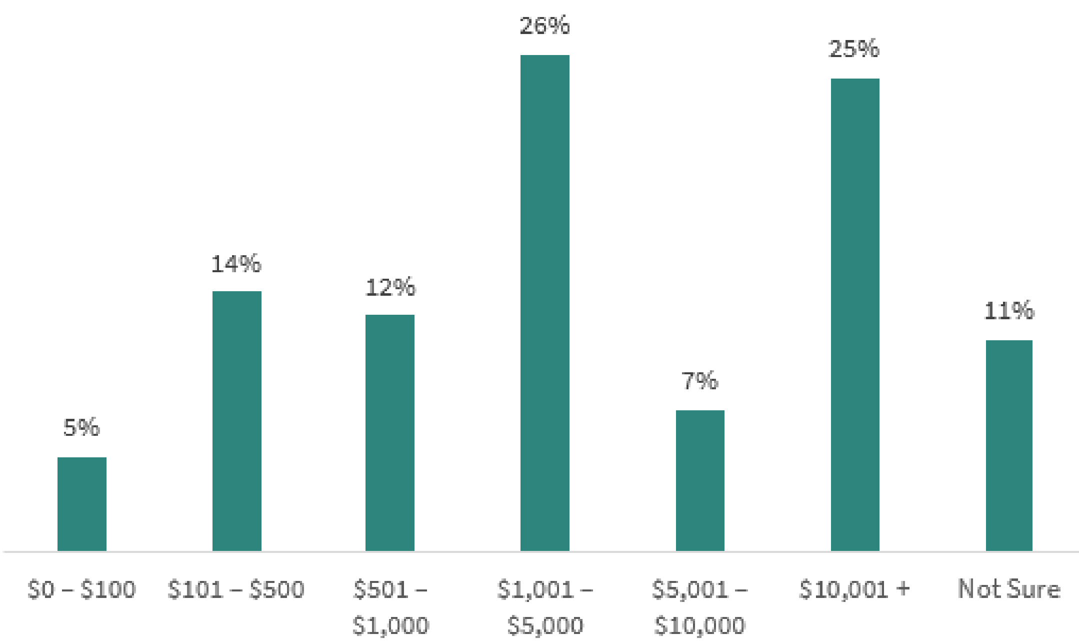
About two-thirds of survey respondents reported they did not make any improvements to their home since the beginning of 2020 (Figure 156). Of survey respondents who made home improvements since the beginning of 2020, the costs varied (Figure 157). One-quarter of the improvements cost between $1,001 – $,5000 dollars and another quarter of improvements cost over $10,000 dollars.

Figure 156. Home Improvements since 2020



Source: General Population Survey. F4. Have you made any improvements to your home since the beginning of 2020?

Figure 157. Cost of Home Improvements



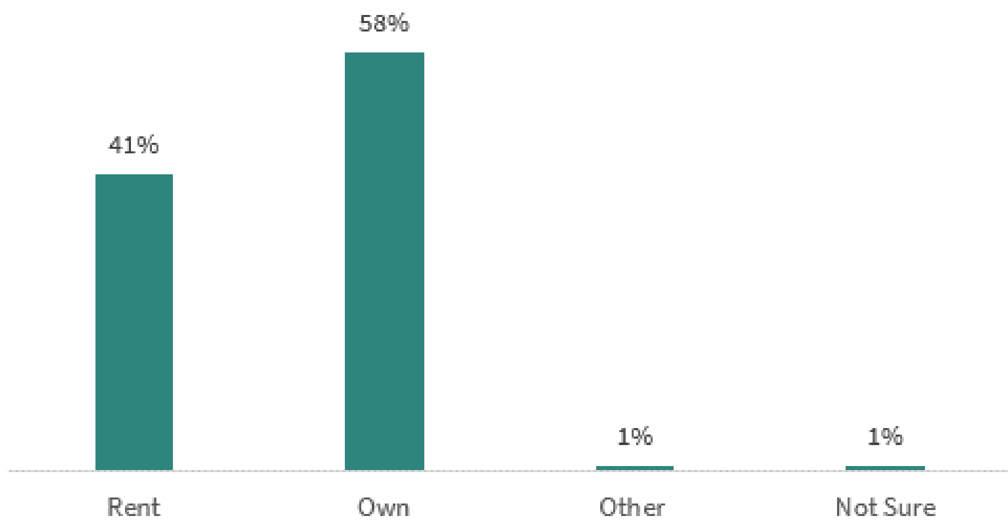
Source: General Population Survey: F5. What was the cost of the improvement(s)?

Appendix 7C. General Population Survey Demographics

Household Demographics

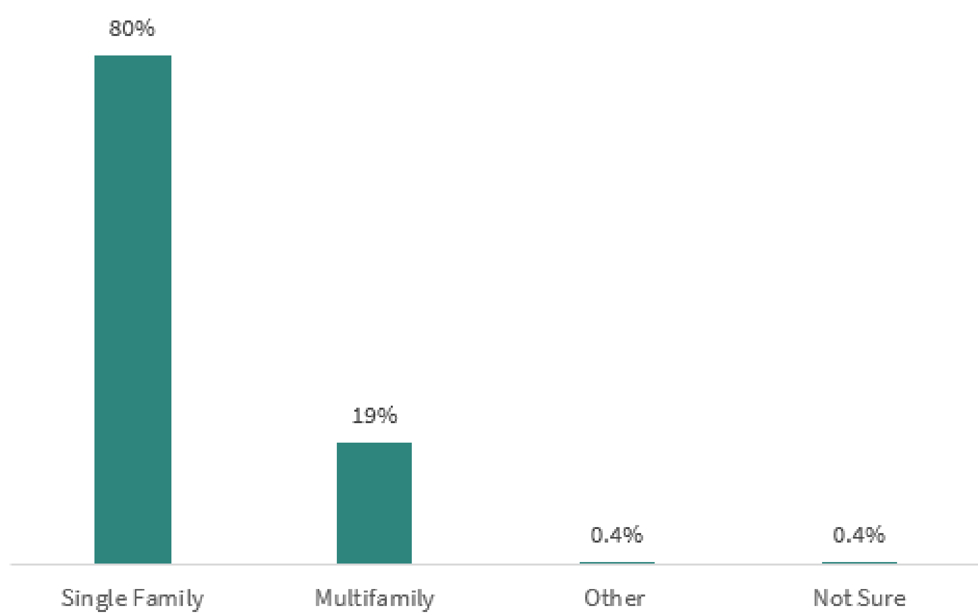
Most respondents own their home (58%) and 41% rent their home (Figure 158). By far, most survey respondents live in a single family home (80%) and 19% live in a multifamily home (Figure 159).

Figure 158. Rent or Own Home



Source: General Population Survey. G1. Do you rent or own your home?

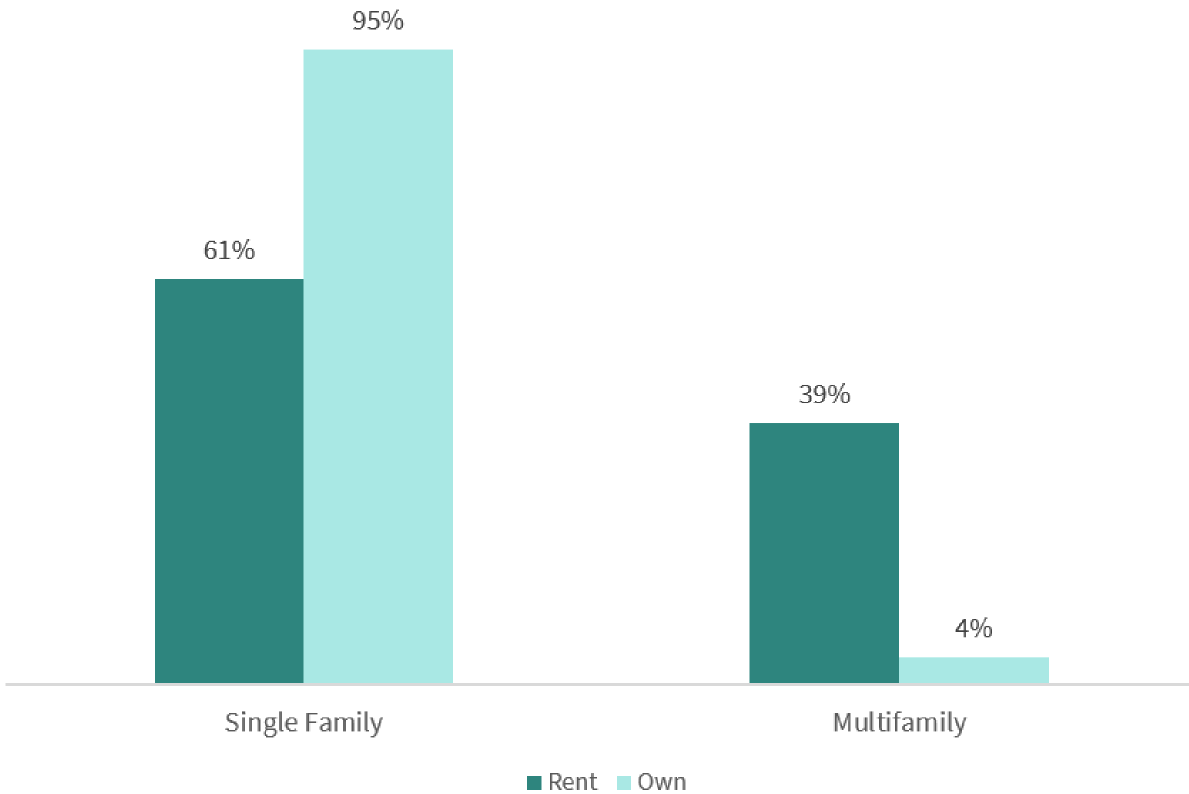
Figure 159. Single or Multifamily Home



Source: General Population Survey. G2. Do you currently live in a single family or multifamily home? Note: multifamily is defined as a building with two or more attached units.

Nearly all (95%) of respondents who own their home live in a single family home (Figure 160). Most renters live in a single family home, too, although the difference is not as drastic with 61% in single family and 39% in multifamily (Figure 160).

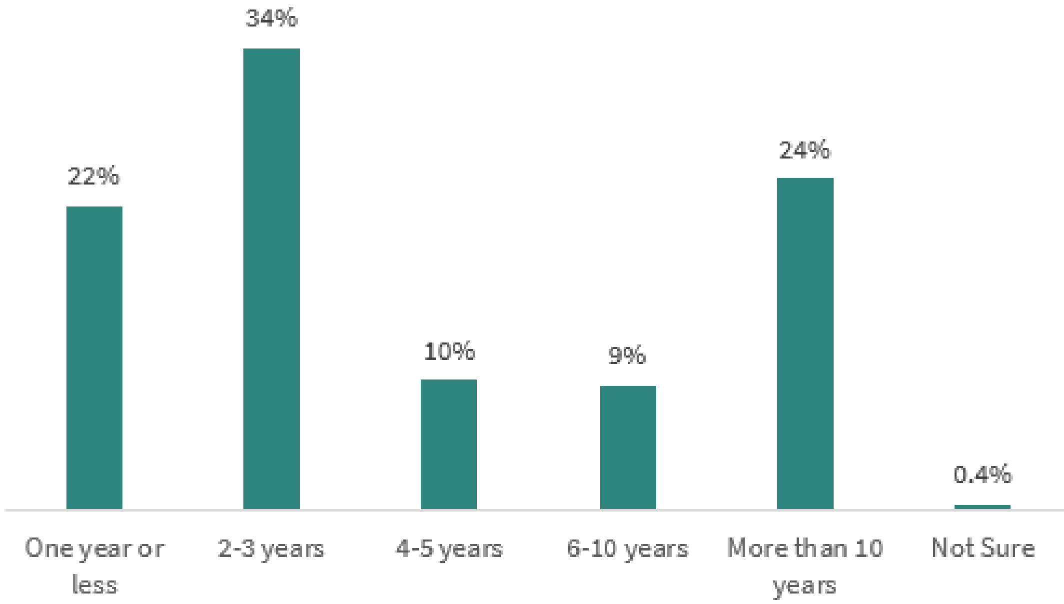
Figure 160. Home Type by Home Occupancy Type



Source: General Population Survey. G2. Do you currently live in a single family or multifamily home? Note: multifamily is defined as a building with two or more attached units.

Many respondents (34%) reported that they have lived in their current home for two to three years and some (22%) that they have lived in their home for one year or less (Figure 161). Nearly a quarter of respondents have lived in their home for more than ten years (24%).

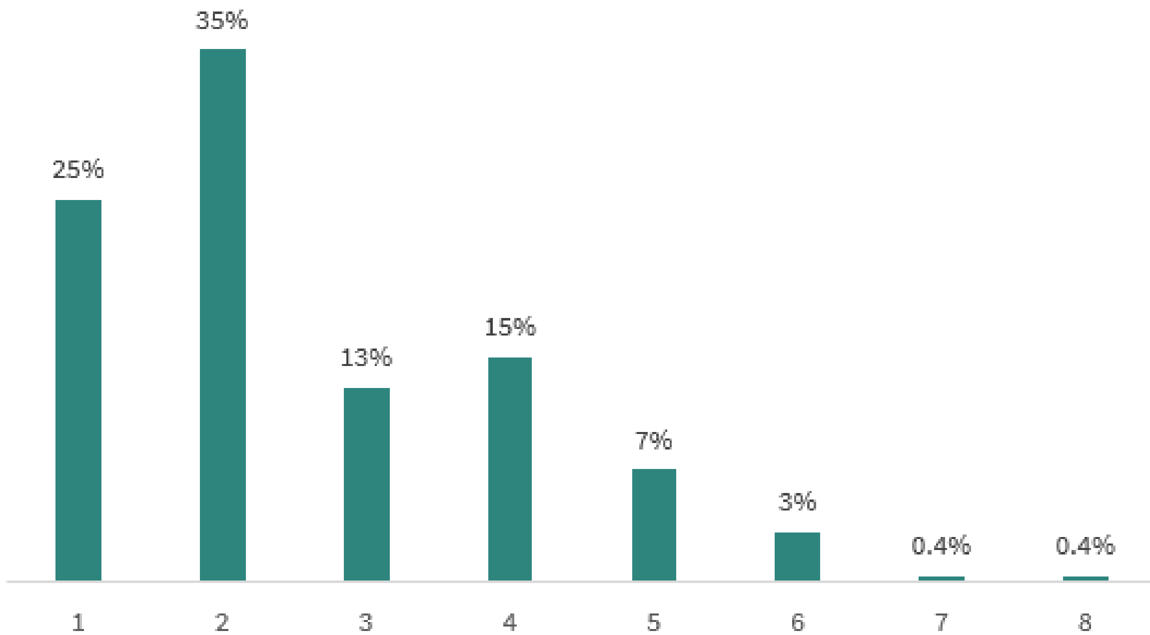
Figure 161. Years Lived in Current Home



Source: General Population Survey. G3. How many years have you lived in your current home?

The most common household size consists of two year-round members (35%) (Figure 162). A quarter of respondents live alone. Some respondents have a household size of three (13%), four (15%), or five (7%). Very few (3.8%) respondents have a household of six members or more.

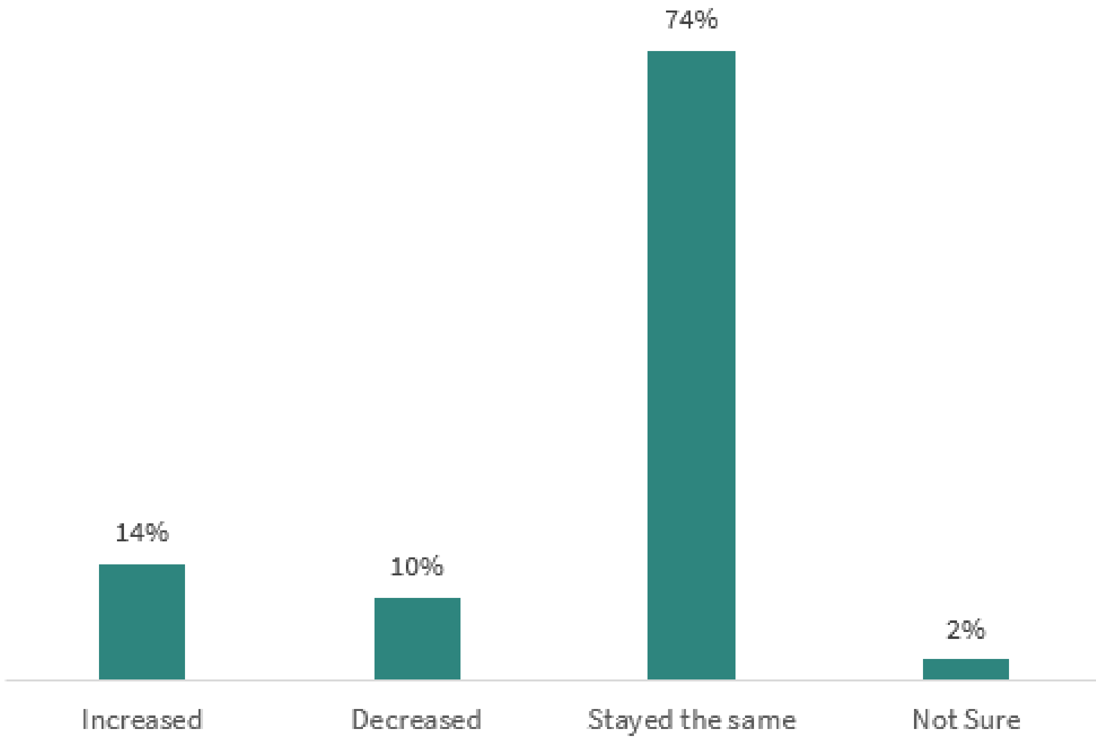
Figure 162. Household Size



Source: General Population Survey. G4. Including you, how many people are currently living in your home year-round? Include all members of your household whether they are related to you, but do not include anyone who is just visiting, or children who may be away at college or in the military.

Since 2019, most respondents reported that their household size has not changed (74%) (Figure 163). Some reported that their household size has increased since 2019 (14%) and some report that it has decreased (10%).

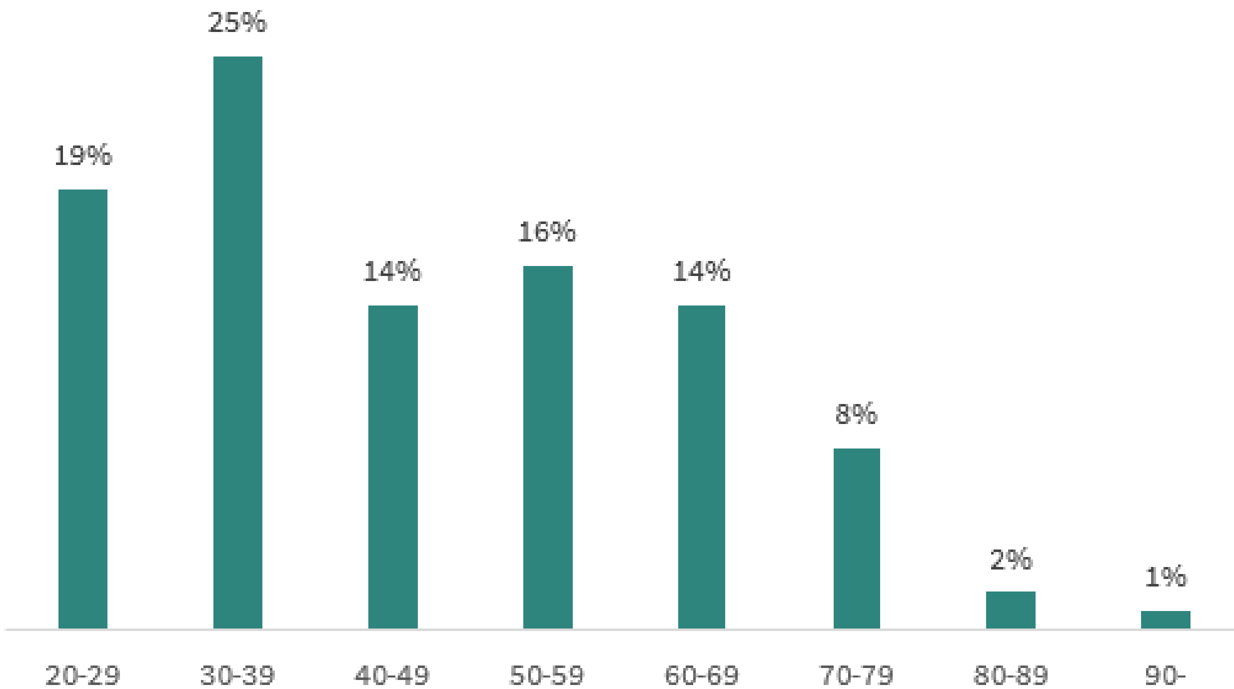
Figure 163. Household Size Compared to 2019



Source: General Population Survey. G5. Since 2019, has the number of people living in your home…

About a quarter of survey respondents are in their thirties (25%) (Figure 164). The next most common age range is twenties (19%). There are similar amounts of respondents in their 40s, 50s, and 60s (14%, 16%, and 14% respectively). The 70s age range and above are the least common (11%).

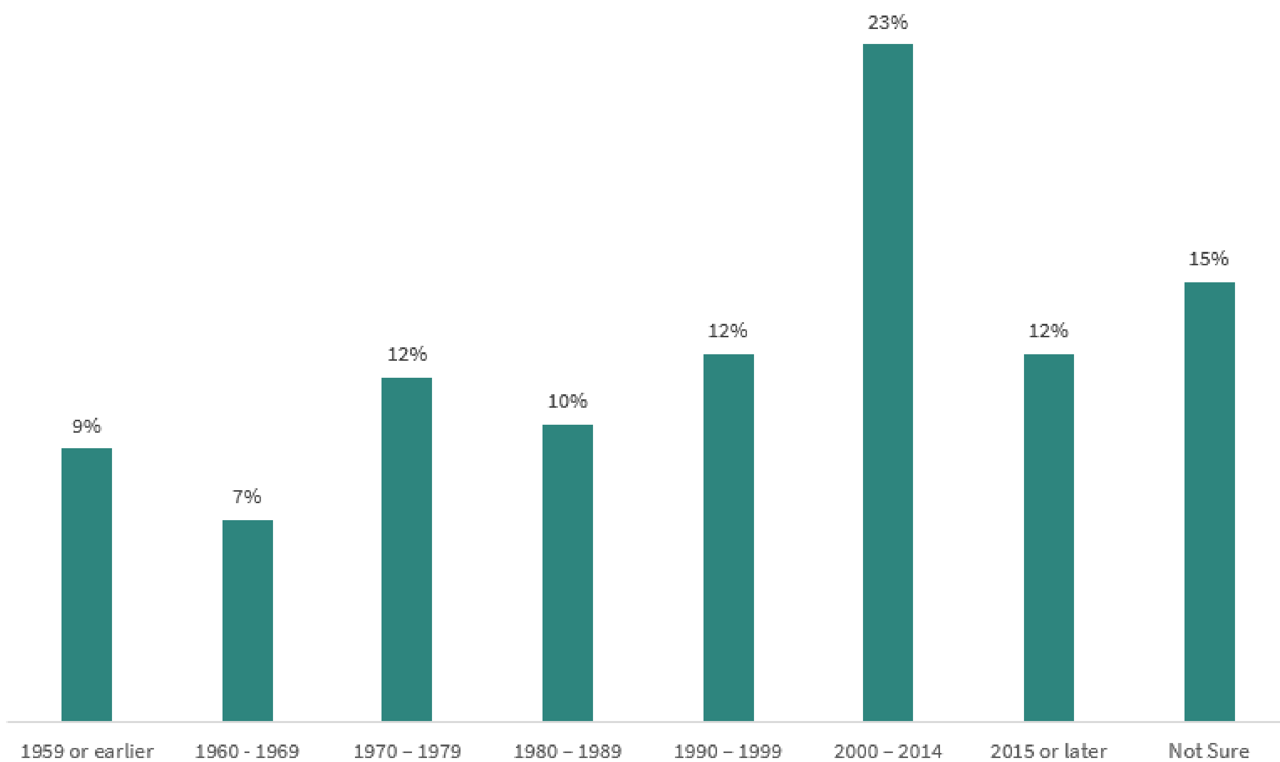
Figure 164. Survey Respondent Age



Source: General Population Survey. G6. In what year were you born?

Nearly a quarter of respondents reported that their home was built between 2000 – 2014 (24%) (Figure 165). Aside from that, three other home age ranges had the same amount (12%) of survey responses: 1970 – 1979, 1990 – 1999, and 2015 or later.

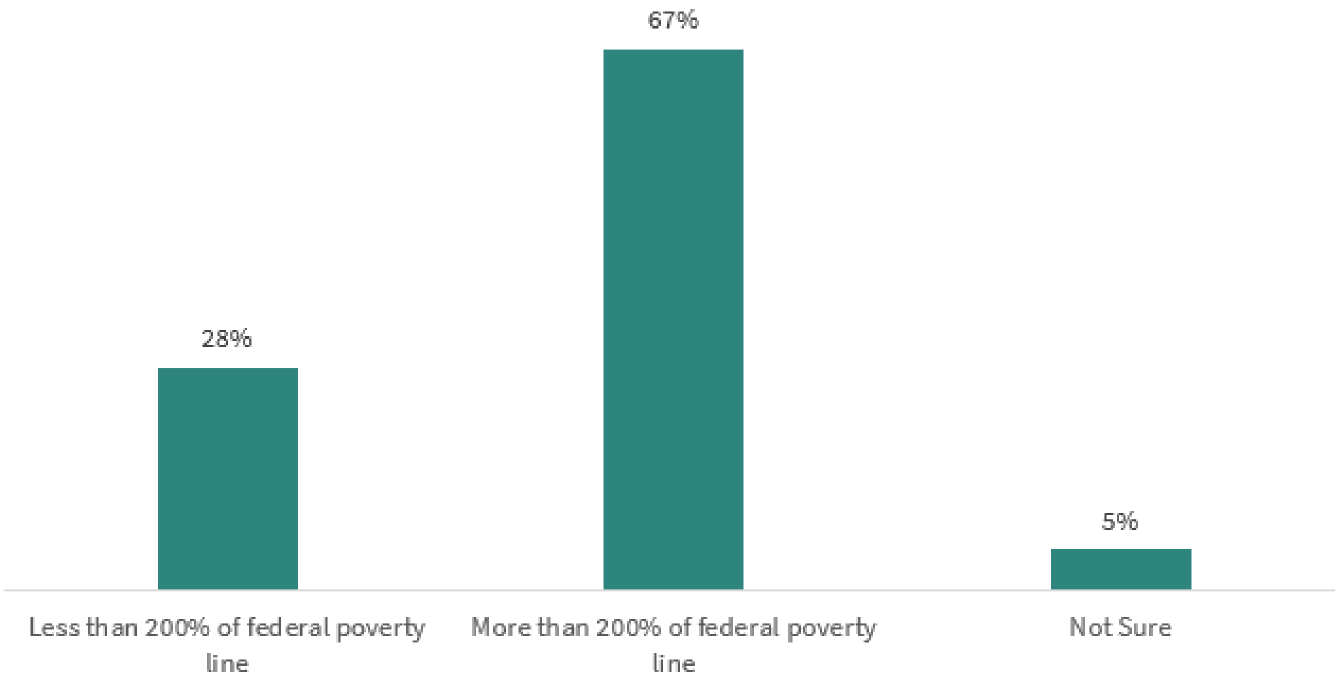
Figure 165. Year Home Built



Source: General Population Survey. G7. About when was your home built? Your best guess is fine.

Over two-thirds of survey respondents reported that their annual income is greater than 200% of the federal poverty line (67%) (Figure 166). Less than a third of survey respondents reported that their income is below the 200% of federal poverty line (28%).

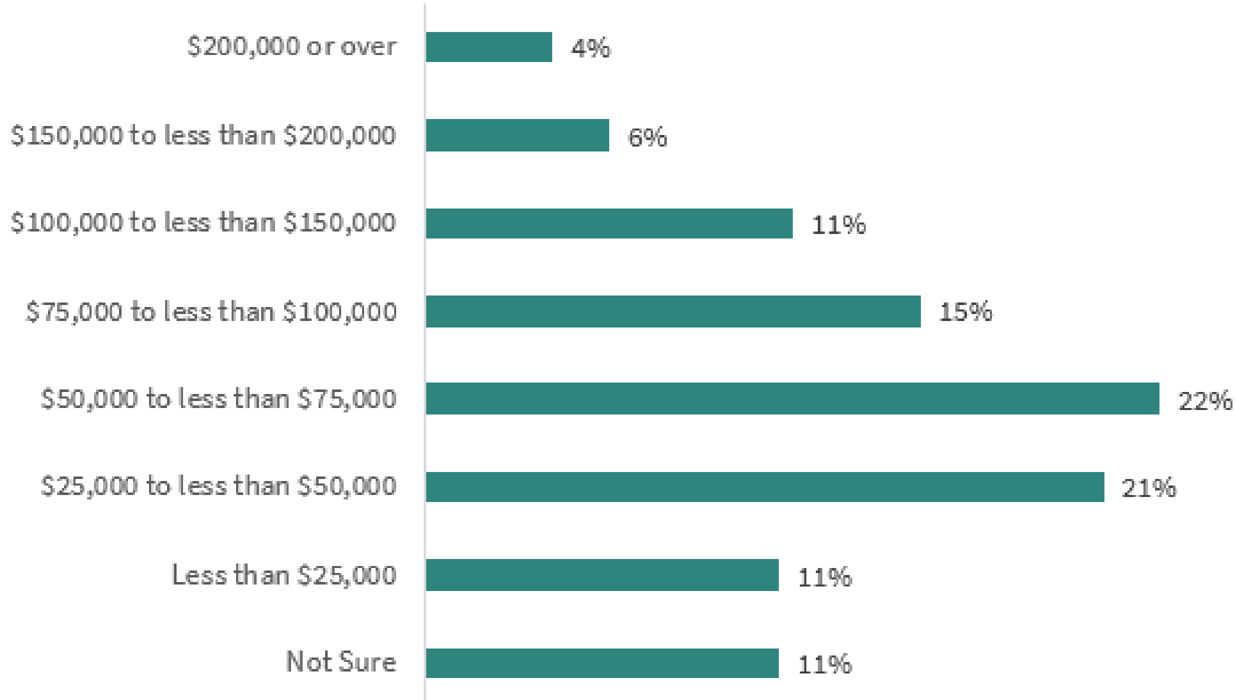
Figure 166. Income Related to 200% of Federal Poverty Line



Source: General Population Survey. G8. Is your annual household income more or less than [200% FEDERAL POVERTY LINE (FPL) BASED ON NUMBER OF HOUSEHOLD MEMBERS]?

Many respondents reported that their total household income before tax is between $50,000 and $75,000 (22%) or between $25,000 and $50,000 (21%) (Figure 167). The next most common bracket is $75,000 to $100,000 (15%).

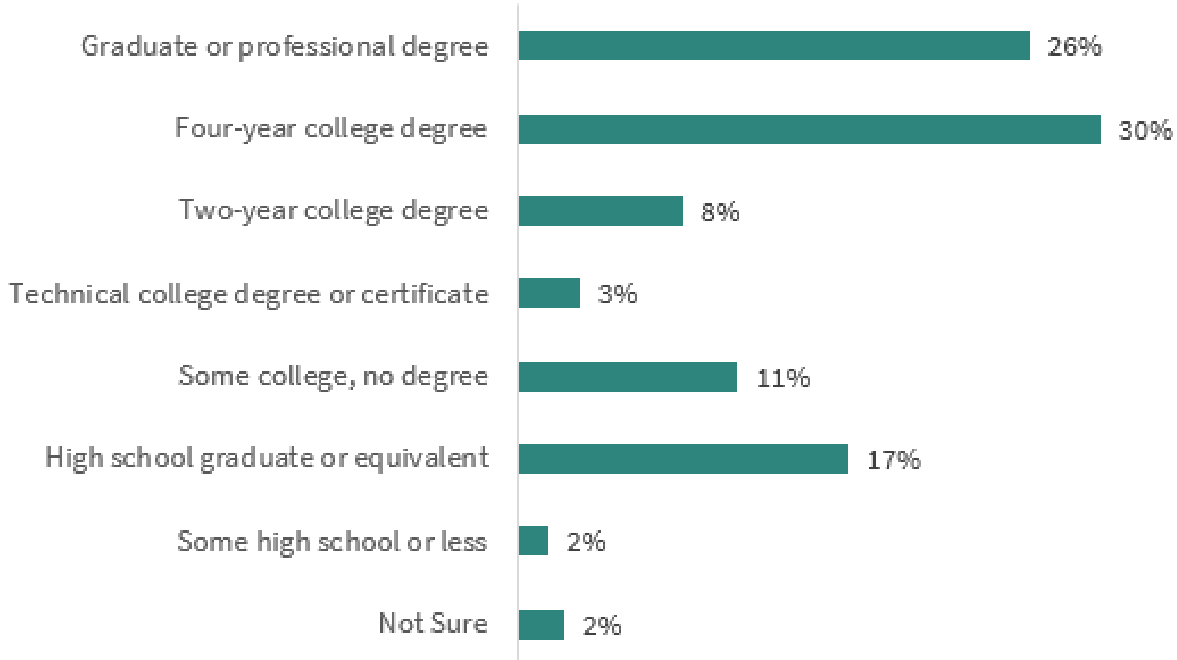
Figure 167. Household Income



Source: General Population Survey. G9. Which of the following categories best represents your total annual household income b efore taxes?

Most respondents reported that they have either a four-year college degree (30%) or a graduate/professional degree (26%) (Figure 168). The next most common is high school completion (17%).

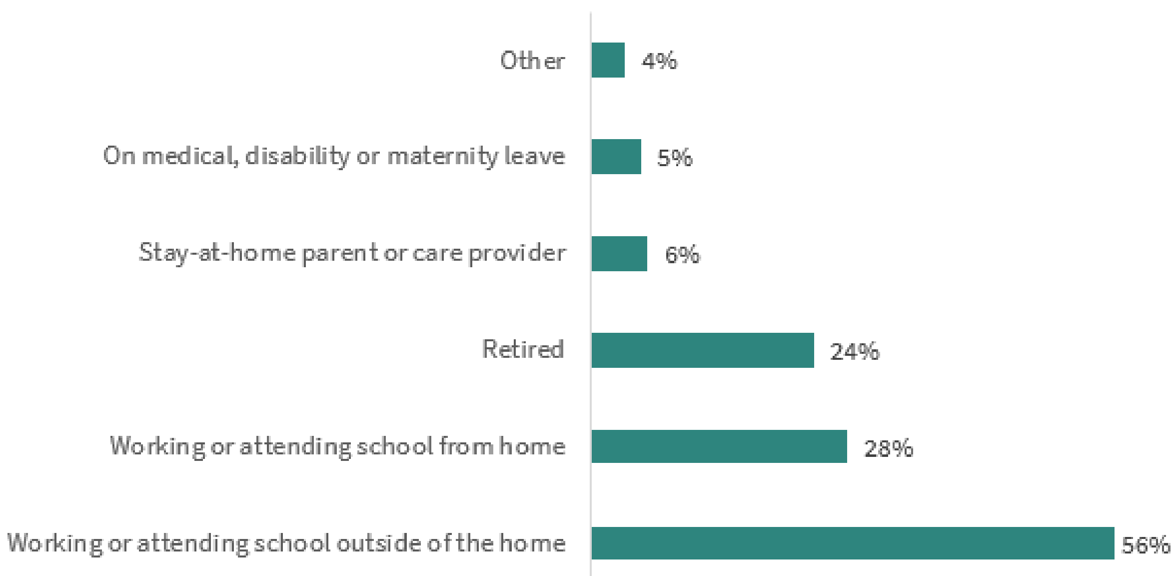
Figure 168. Highest Education Completed



Source: General Population Survey. G10. What is the highest level of education you have completed?

Most respondents reported that their household is either working or attending school outside of the home (56%) (Figure 169). Many reported that their household is working or attending school from home (28%), and almost a quarter reported that the adults in their household are retired (24%).

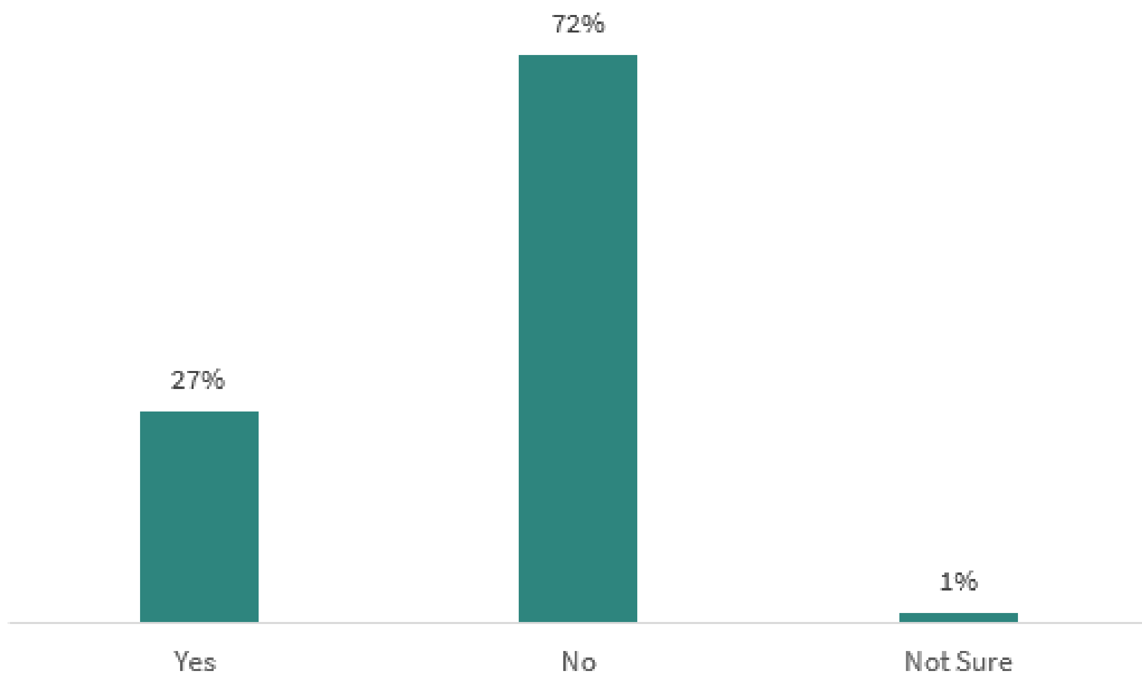
Figure 169. Household Employment



Source: General Population Survey. G11. Which of the following describe the employment situation of the adults in your household (including yourself)?

Compared to 2019, most respondents have not had a change in their employment situation (72%) (Figure 170). Over a quarter of respondents, however, have experienced a change in their employment situation since 2019 (27%).

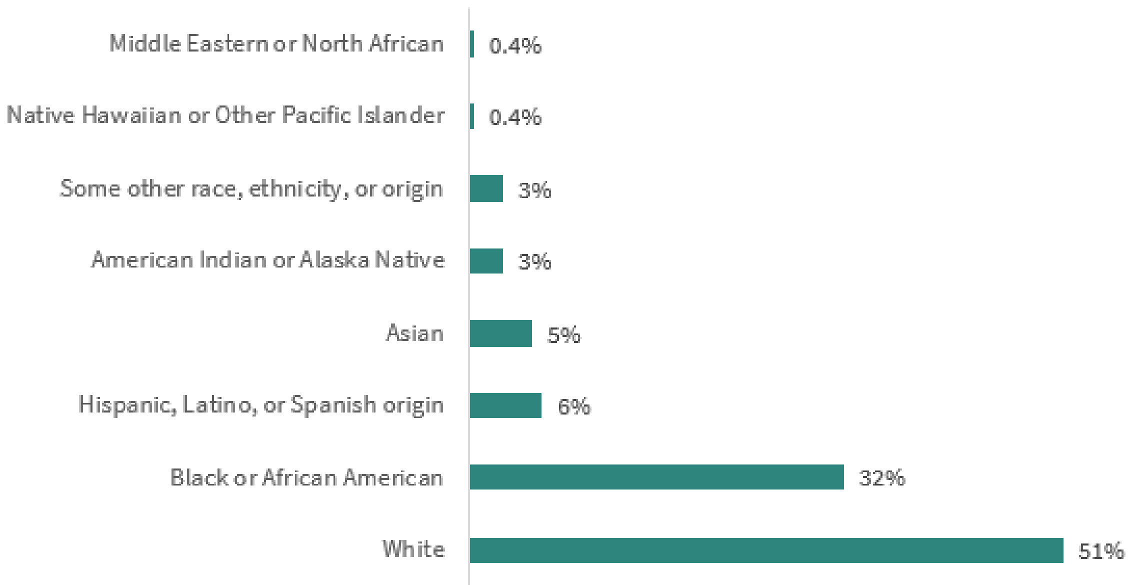
Figure 170. Change in Employment Compared to 2019



Source: General Population Survey. G12. Has your employment situation changed since 2019?

White was the most common ethnicity selected by respondents (51%), followed by Black/African American (32%), Hispanic/Latino/Spanish (6%), and Asian (5%) (Figure 171).

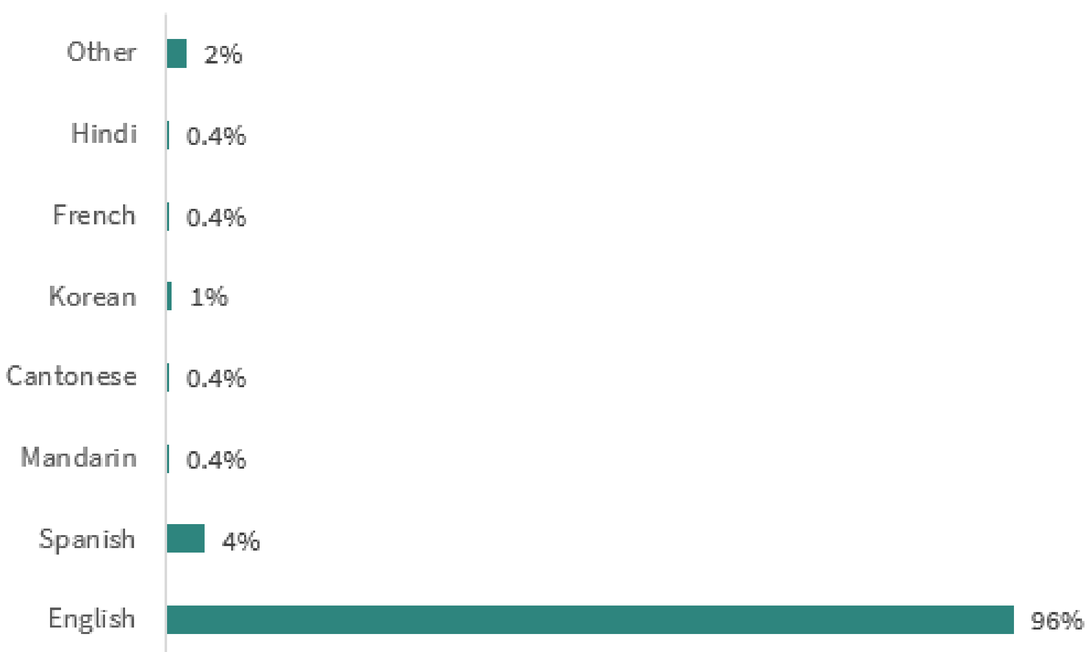
Figure 171. Race, Ethnicity, or Origin



Source: General Population Survey. G13. Which categories describe you?

Nearly all respondents reported that they speak English primarily at home (96%) (Figure 172). Some speak Spanish (4%), and a few speak other languages (2%).

Figure 172. Primary Language Spoken at Home



Source: General Population Survey. G14. What language(s) do you primarily speak at home?

General Population Conclusions and Recommendations

Conclusion 1: General population respondents reported that most of the lightbulbs they have installed or in storage are LEDs.

Aligned with findings from the Specialty Lighting program evaluation, these results directionally support evaluation findings that the lighting market has rapidly transformed in recent years. These results align relatively closely with the shelf stocking and net-to-gross results, which indicate that most lighting stock available in stores is comprised of LEDs.

Conclusion 2: As of the time of the survey (mid 2021), 46% of general population respondents said the time they have spent at home compared to 2019 has "increased a lot" and 18% said it "increased a little."

The COVID-19 pandemic changed customer behavior across the country, and the world, and increased the proportion of customers who work or complete school virtually from home. It is unclear if these patterns will persist long-term, as well as the magnitude to which they have impacted various metrics and inputs that would affect energy savings for specific measures (such as number of people per home, hours of use for various measures, etc.).

Recommendation:

- For future cycles, monitor trends in customer behavior and stay-at-home patterns, and consider whether energy savings inputs and assumptions should be updated.

Conclusion 3: One-third of homeowners said that they had a smart thermostat, but only 14% of renters said they did.

Over half of general population respondents who rented their home said their home still had a manual thermostat, compared to 29% of homeowners who said they did. Replacing a manual thermostat with a smart thermostat yields the highest savings.

Recommendation:

- Consider how to increase efforts to retrofit thermostats in rental homes. Both the Home Energy Improvement Program and the Home Energy Efficiency Assistance Program serve the multifamily segment but given that many homes in Georgia are rentals (36% as of 2019), there may be significant opportunity in this market.

Conclusion 4: Customers reported being relatively engaged with Georgia Power, with 86% reporting that they had interacted with or viewed content from Georgia Power via phone, web, or email at least once in the past year.

Almost two-thirds of respondents indicated that they used the online account dashboard in the past year, and 46% had visited the website. Additionally, 43% said they had read emails from Georgia Power specifically about saving energy. This indicates that Georgia Power's outreach have been effective in engaging customers.

Conclusion 5: A little over one-third of all respondents were aware of Georgia Power energy efficiency programs, although it varied across renters and homeowners.

Homeowners were most commonly aware of the Online Marketplace and Refrigerator Recycling programs (approximately one-third of all homeowner respondents aware of each). Renters, however, were most commonly aware of the Home Energy Improvement Program and the Home Energy Efficiency Assistance Program (about one-fifth of rental respondents were aware of each).

Recommendations:

- If not already doing so, consider leveraging the online account dashboard to market energy efficiency offerings to customers. Most participants utilized the online account dashboard in the past year, which may be an effective way to spread energy efficiency messaging.

Appendix 7D. Refrigerator Recycling Program Participant Survey Demographics

Table 165 provides the full demographic breakdown of survey respondents.

Table 165. Refrigerator Recycling Participant Survey Demographic Data

VARIABLE	PROPORTION
HOUSEHOLD INCOME	
Less than $25,000	9%
$25,000 to less than $50,000	21%
$50,000 to less than $75,000	15%
$75,000 to less than $100,000	14%
$100,000 to less than $150,000	18%
$150,000 to less than $200,000	10%
$200,000 or over	12%
AGE	
Less than 30	2%
30 - 39	6%
40 - 49	19%
50 - 59	23%
60 - 69	30%
70+	21%
EDUCATION	
Some high school or less	1%
High school graduate or equivalent	8%
Some college, no degree	9%
Technical college degree or certificate	11%
Two-year college degree	10%
Four-year college degree	26%
Graduate or professional degree	35%
RACE/ETHNICITY	
American Indian or Alaska Native	2%
Asian	2%
Black or African American	19%
Hispanic, Latino, or Spanish origin	2%
White	76%
OWNERSHIP STATUS	
Own	94%
Rent	6%
HOUSE TYPE	
Single Family	95%

Multifamily	5%
HOME TENURE	
3 years or less	14%
4 - 10 years	18%
More than 10 years	67%
HOUSING AGE	
Before 1980	37%
After 1980	63%
HOUSEHOLD SIZE	
1 person	14%
2 people	44%
3 people	18%
4 people	14%
5+ people	10%

APPENDIX 8. – COST-EFFECTIVENESS

This section considers program cost-effectiveness in terms of the Total Resource Cost test (TRC), the Ratepayer Impact Test (RIM), the Program Administrator Cost test (PAC), and the levelized program delivery costs.

Appendix 8A: Methodology

The evaluation team completed a benefit-cost analysis to compare the value of the gross verified savings impacts resulting from the DSM programs to the costs incurred by the programs. The evaluation team utilized net verified energy and demand savings for the calculation of avoided cost benefits, consistent with the values from the most recent DSM program filing.[92] The calculation of cost-effectiveness components including additional resource savings, incremental equipment and installation costs, program administrative costs, incentive payments, and bill savings, were generated by Georgia Power with review by the evaluation team.

Table 166 summarizes the allocation of cost-effectiveness components as a cost or benefit to each cost-effectiveness test consistent with the California Standard Practice Manual (SPM).

[92] https://psc.ga.gov/search/facts-docket/?docketId=42311

Table 166. Cost-Effectiveness Component Inputs

COMPONENT	PARTICIPANT COST TEST (PCT)	PROGRAM ADMINISTRATOR COST TEST (PACT)	RATEPAYER IMPACT MEASURE (RIM)	TOTAL RESOURCE COST (TRC)
Energy & Capacity Related Avoided Costs		Benefit	Benefit	Benefit
Additional Resource Savings				Benefit
Incremental Equipment and Installation Costs	Cost			Cost
Program Admin Costs		Cost	Cost	Cost
Incentive Payments	Benefit	Cost	Cost	
Bill Savings/Lost Revenues	Benefit		Cost	

Benefits and costs are stated in present value terms, using the appropriate discount and inflation rates.

Total Resource Cost

The TRC test measures the net costs of a program as a resource option based on the total costs of the program, including both the participants' and the utility's costs. In general, it is the ratio of the discounted total benefits of the program to the discounted total costs over a specified time. A benefit-cost ratio greater than one indicates that the program is beneficial to the utility and its ratepayers on a total resource cost basis.

The benefits calculated in the TRC test are the avoided supply costs, the reduction in transmission, distribution, generation, and energy costs valued at marginal cost for the periods when there is a load reduction. The costs associated with this test are the net program costs paid by both the utility and the participants; this includes administration costs and equipment costs.

In algebraic form:

$$Benefits = \sum_{t=1}^{n} \frac{UAC_t}{(1+d)^{t-1}}$$

$$Costs = \sum_{t=1}^{n} \frac{PRC_t + PCN_t}{(1+d)^{t-1}}$$

$$TRC\ Ratio = \frac{Benefits}{Costs}$$

Where:

UACt = *Utility (electric and gas) net avoided supply costs in year t*

PRCt = *Program administrator program costs in year t*

PCNt = *Net participant costs (equipment costs) in year t*

d = *Nominal discount rate*

Program Administrator Cost

The PAC test measures the net costs of a program as a resource option based on the costs incurred by the program administrator and excluding any net costs incurred by the participant. A benefit-cost ratio above one indicates that the program would benefit the administrator's cost environment.

Like the TRC test, the benefits calculated in the PAC test are the avoided supply costs of energy and demand. However, the net avoided supply costs for the PAC test include only the avoided costs of supplying electricity, not the avoided societal costs of natural gas, propane, or water. The costs associated with this test are the program costs incurred by the administrator and the incentives paid to the customers.

In algebraic form:

$$Benefits = \sum_{t=1}^{n} \frac{UAC_t}{(1+d)^{t-1}}$$

$$Costs = \sum_{t=1}^{n} \frac{PRC_t + INC_t}{(1+d)^{t-1}}$$

$$PAC\ Ratio = \frac{Benefits}{Costs}$$

Where:

UACt = *Utility net avoided supply costs in year t*

PRCt = *Program administrator program costs in year t*

INCt = *Incentives paid to participants in year t*

d = *Nominal discount rate*

Ratepayer Impact Measure Test (RIM)

The RIM test measures what happens to customer bills or rates due to changes in utility revenues and operating costs caused by the program. This test adopts the perspective of all ratepayers, including program participants and nonparticipants. In general, the test is the ratio of the discounted total benefits of the program to the discounted total costs over a specified time. A benefit-cost ratio above one indicates that the program is beneficial to the customers.

The benefits calculated in the RIM test are the avoided supply costs, and the reduction in transmission, distribution, generation, and energy costs valued at marginal cost for the periods when there is a load reduction. The costs associated with this test are the gross incentive costs of the program, the net bill reductions experienced by participants (which can be thought of as the lost revenue to the utility from implementing the conservation program), and the program administration costs.

In algebraic form:

$$Benefits = \sum_{t=1}^{n} \frac{UAC_t}{(1+d)^{t-1}}$$

$$Costs = \sum_{t=1}^{n} \frac{RL_t + PRC_t + INC_t}{(1+d)^{t-1}}$$

$$RIM\ Ratio = \frac{Benefits}{Costs}$$

Where:

UACt = *Utility avoided supply costs in year t*

RLt = *Revenue loss from reduced sales in year t*

PRCt = *Program administrator program costs in year t*

INCt = *Incentives paid to participants in year t*

d = *Nominal discount rate*

Levelized Delivery Cost

Leveling the delivery costs of each initiative is a useful way to express the program delivery costs per unit of energy or capacity savings. Levelized delivery costs are useful when comparing programs within a demand-side management portfolio.

Initiative delivery costs are the sum of program administrator costs and incentives paid to the participants. To level these costs for energy and demand savings, the following formula is used:

$$Levelized\ Delivery\ Costs = \frac{Delivery\ Costs}{\sum_{t=1}^{n} \frac{Qt}{(1+d)^{t-1}}}$$

Where:

Qt	=	Energy or capacity savings in year t
d	=	Nominal discount rate

Appendix 8B: Energy Efficiency Program Cost-Effectiveness

The following tables summarize the results of the residential energy efficiency program cost-effectiveness analysis. This analysis only focuses on energy efficiency (kWh) savings; the Temp✓ (Thermostat Demand Response) program's cost-effectiveness is not assessed as part of this analysis.

Table 167. Behavioral Program Cost-Effectiveness

COST-EFFECTIVENESS	BEHAVIORAL
Program Administrator Cost (PAC)	
PAC Costs	($1,856,939)
PAC Benefits	$1,380,710
PAC Net Benefits ($)	($476,229)
PAC Net Benefit (Ratio)	0.7
Ratepayer Impact Measure (RIM)	
RIM Costs	($6,998,711)
RIM Benefits	$1,380,710
RIM Net Benefits ($)	($5,618,001)
RIM Net Benefit (Ratio)	0.2
Total Resource Cost (TRC)	
TRC Costs	($1,856,939)
TRC Benefits	$1,380,710
TRC Net Benefits ($)	($476,229)
TRC Net Benefit (Ratio)	0.74
Levelized Delivery Cost	
$/MWh	$9.68

Table 168. Specialty Lighting Program Cost-Effectiveness

COST-EFFECTIVENESS	SPECIALTY LIGHTING
Program Administrator Cost (PAC)	
PAC Costs	($4,557,881)
PAC Benefits	$9,972,219
PAC Net Benefits ($)	$5,414,338
PAC Net Benefit (Ratio)	2.2
Ratepayer Impact Measure (RIM)	
RIM Costs	($23,445,242)
RIM Benefits	$9,972,219
RIM Net Benefits ($)	($13,473,023)

COST-EFFECTIVENESS	SPECIALTY LIGHTING
RIM Net Benefit (Ratio)	0.4
Total Resource Cost (TRC)	
TRC Costs	($5,566,778)
TRC Benefits	$6,626,234
TRC Net Benefits ($)	$1,059,455
TRC Net Benefit (Ratio)	1.19
Levelized Delivery Cost	
$/MWh	$61.44

Table 169. HEIP Cost-Effectiveness

COST-EFFECTIVENESS	HEIP
Program Administrator Cost (PAC)	
PAC Costs	($7,669,560)
PAC Benefits	$4,500,090
PAC Net Benefits ($)	($3,169,470)
PAC Net Benefit (Ratio)	0.6
Ratepayer Impact Measure (RIM)	
RIM Costs	($22,611,964)
RIM Benefits	$4,500,090
RIM Net Benefits ($)	($18,111,874)
RIM Net Benefit (Ratio)	0.2
Total Resource Cost (TRC)	
TRC Costs	($8,651,780)
TRC Benefits	$9,083,835
TRC Net Benefits ($)	$432,055
TRC Net Benefit (Ratio)	1.05
Levelized Delivery Cost	
$/MWh	$121.72

Table 170. HEEAP Cost-Effectiveness

COST-EFFECTIVENESS	HEEAP
Program Administrator Cost (PAC)	
PAC Costs	($1,343,618)
PAC Benefits	$3,710,460
PAC Net Benefits ($)	$2,366,841

COST-EFFECTIVENESS	HEEAP
PAC Net Benefit (Ratio)	2.8
Ratepayer Impact Measure (RIM)	
RIM Costs	($7,169,713)
RIM Benefits	$3,710,460
RIM Net Benefits ($)	($3,459,253)
RIM Net Benefit (Ratio)	0.5
Total Resource Cost (TRC)	
TRC Costs	($5,699,585)
TRC Benefits	$6,647,228
TRC Net Benefits ($)	$947,644
TRC Net Benefit (Ratio)	1.17
Levelized Delivery Cost	
$/MWh	$57.03

Table 171. Refrigerator Recycling Program Cost-Effectiveness

COST-EFFECTIVENESS	REFRIGERATOR RECYCLING
Program Administrator Cost (PAC)	
PAC Costs	($1,356,205)
PAC Benefits	$416,511
PAC Net Benefits ($)	($939,695)
PAC Net Benefit (Ratio)	0.3
Ratepayer Impact Measure (RIM)	
RIM Costs	($2,624,686)
RIM Benefits	$416,511
RIM Net Benefits ($)	($2,208,175)
RIM Net Benefit (Ratio)	0.2
Total Resource Cost (TRC)	
TRC Costs	($1,228,630)
TRC Benefits	$410,775
TRC Net Benefits ($)	($817,855)
TRC Net Benefit (Ratio)	0.33
Levelized Delivery Cost	
$/MWh	$316.00

Table 172. Overall Residential Energy Efficiency Program Cost-Effectiveness (Excluding Thermostat Demand Response)

COST-EFFECTIVENESS	RESIDENTIAL ENERGY EFFICIENCY
Program Administrator Cost (PAC)	
PAC Costs	($16,784,204)
PAC Benefits	$19,979,990
PAC Net Benefits ($)	$3,195,786
PAC Net Benefit (Ratio)	1.2
Ratepayer Impact Measure (RIM)	
RIM Costs	($62,850,315)
RIM Benefits	$19,979,990
RIM Net Benefits ($)	($42,870,325)
RIM Net Benefit (Ratio)	0.3
Total Resource Cost (TRC)	
TRC Costs	($23,003,713)
TRC Benefits	$24,148,783
TRC Net Benefits ($)	$1,145,070
TRC Net Benefit (Ratio)	1.05
Levelized Delivery Cost	
$/MWh	$56.34