414 Nicollet Mall
Minneapolis, MN 55401

February 10, 2023

—Via Electronic Filing—

Will Seuffert
Executive Secretary
Minnesota Public Utilities Commission
121 7th Place East, Suite 350
St. Paul, MN 55101

RE: COMPLIANCE FILING – PILOT COMPLETION
RESIDENTIAL TIME OF USE RATE DESIGN PILOT
DOCKET NO. E002/M-17-775

Dear Mr. Seuffert:

Northern States Power Company, doing business as Xcel Energy, submits this final pilot report in compliance with the Minnesota Public Utilities Commission's August 7, 2018 Order (Commission's Order). In its Order, the Commission set forth reporting requirements related to operations of our Residential Time-of-use (TOU) Rate Design Pilot. This Compliance Filing is being made about 27 months after the launch of the pilot in November 2020, and serves as the final report required by Order Point 4 of the Commission's Order.

As with our mid-period report, filed in February 2022, the Company has been working with a consultant, Guidehouse, to provide analysis expertise that helps us gather insights from pilot operations. Guidehouse has prepared a final assessment of pilot results. Their report, along with appendices to the report are provided as Attachments A, B, C, and D. Their report provides information in compliance with Order Points 4a-4g.[1] The balance of this Compliance Filing covers the remaining reporting requirements for this final report outlined in the Commission's Order.

<u>Order Point 3</u>

Included as Attachment E to this filing is all pilot communications and materials sent to customers since our previous mid-period report. The Company previously

[1] Table 1-1 from Guidehouse's Report (Attachment A) provides greater detail of where each Order Point is covered within the report.

provided the materials sent to customers before pilot launch with our first dashboard report filed on December 31, 2020 and the materials provided subsequent to the pilot launch as Attachment A to our February 25, 2022 Compliance Filing, both in this docket. We have also engaged the community through in-person events, radio, and social media. We have summarized these efforts and the estimated reach they had in Attachment F to this filing.

<u>Order Point 4h(i)</u>

As a part of this final pilot report, we provide information about the new capabilities of the Advanced Metering Infrastructure (AMI) meters. The Company is currently in the process of rolling out AMI throughout our Minnesota service territory.

As with previous metering technologies, the primary purpose of the AMI meters is to measure the amount of electricity used by customers for billing purposes. However, AMI meters allow us to measure electricity in ways that previous meters could not on their own, such as time-of-use energy consumption. Meters will be able to measure both consumption in kilowatt hours and demand in kilowatts.

A key aspect of the new AMI is the ability to remotely reprogram meters, rather than having to physically be connected to the meter (or replacing the meter equipment entirely). This functionality will allow the Company to reprogram meters to roll out new TOU rates in the future.

Energy consumption data for billing purposes can be recorded by AMI meters in intervals as short as five minutes, but in most cases will be configured for 15-minute intervals. The meters will also be capable of providing granular data regarding voltage, power quality, and outages. While we anticipate the meters collecting data and communicating it to the Company about every four hours, the meters are also capable of communicating on-demand. This could be used by Customer Care employees while assisting customers via phone. Customers will also be able to access near real-time energy information through the Company's MyAccount internet portals and smartphone applications. AMI meters can also transmit data when an event occurs such as a power outage, power restoration, power quality event, or a diagnostic event.

The new AMI meters will also have two-way communication capabilities, allowing meters to act as a repeater for other nearby mesh networked devices, including other meters. This will increase communication resilience of the meters and other system equipment. For example, if the signal is weak between an individual meter and the access point device, then the meters will be capable of using other nearby meters as a repeater to facilitate communication. The two-way radio in the meters can also be configured to communicate with a customer's home Wi-Fi/Home Area Network and capable in-home appliances and devices. Customers can choose this option to support energy management and efficiency functions.

AMI meters have computing capabilities, sometimes called Distributed Intelligence (DI) or "grid edge computing". This decentralized computing ability can be used to solve challenges on the grid through the meter capabilities and backend computing and management infrastructure. DI will enable the development of an ecosystem consisting of new meter data and applications running directly on the meter to facilitate grid operations, notifications, and customer service. These applications will be both customer facing and grid facing and will allow for greater computational speed and efficiency, allowing for near-real time information delivery.

Finally, AMI will allow for internal service switching which can be used to remotely connect or disconnect power to residential or small commercial customers upon command. This capability when fully implemented will drastically reduce the amount of field work currently needed to perform these activities. This will be used in a phased approach, but can allow for faster disconnections or reconnections, when needed, than field visits would necessitate.

The capabilities of the AMI system are discussed in greater detail in the petition for approval of our 2021-22 Transmission Cost Recovery (TCR) Rider.[2]

Order Point 4h(ii)

We have assessed the impact of the residential TOU rate used in the pilot on our revenue recovery, based on initial results from the pilot. As was outlined in the report prepared by Guidehouse, the average residential customer bill for participants in Eden Prairie increased by less than $0.50 per month on the pilot TOU rates when compared to the standard residential rate. The average customer in Minneapolis saved a little over $1.00 per month on the pilot rates when compared to standard residential rates.[3] Based on these averages, we estimate that the monthly revenue impact from the new TOU rates during the pilot is less than $-3,300. Table 1 below shows the calculation of this estimate.

[2] Docket No. E002/M-21-814, Attachment 4 starting at Page 11 (November 24, 2021).
[3] Savings amounts come from Tab 11 – Net Bill Impacts – Detailed of Attachment D included with this filing

Table 1
Monthly Revenue Impact from Residential TOU Rate Pilot

Location	Average Monthly Savings	Average Number of Customers[4]	Pilot Total
Eden Prairie	$0.45	4,300	$1,935
Minneapolis	$-1.10	4,700	$-5,170
Total – All Locations			$-3,235

To extrapolate out the average customer impact from the pilot population to our general residential customer population, we assumed that the average residential customer would react similarly to the average pilot participant. The average monthly revenue impact of a switch to residential TOU rates for all residential customers would be a reduction of about $0.4 million per month, or about $5.3 million per year.[5]

The Company has proposed a revenue decoupling mechanism in our pending electric general rate case. If that mechanism is approved and implemented, it would address the revenue impact from a full rollout of a residential TOU rate . This mechanism protects both customers and the Company. With a large population of residential customers, even small changes in customer behavior beyond what is expected could produce a significant revenue impact. If actual revenues are higher than expected, then customers receive a credit to account for that excess revenue. Conversely, if actual revenues are lower, the Company is made whole through the same mechanism.

<u>Order Point 4i</u>

The Commission's Order also requires the Company to provide recommendations for including net metered customers in future residential TOU rates. The Company intends to allow customers taking service under net metering tariffs to concurrently take service on a future residential TOU rate, as we will have both the metering and billing capabilities to accommodate these customers. As was mentioned in our discussion for Order Point 4h(i) above, the Company is currently in the process of rolling out AMI to all residential customers in our Minnesota service territory. The new AMI meters will have the capability to facilitate both a TOU rate and net metering at the same time. In addition, the

[4] As number of participants changed over time, an approximate average number of customers was used. Daily participant information available on Tab 7 – Date Completeness of Attachment D included with this filing.
[5] Assumes about 1.2 million residential customers in our Minnesota service territory.

Company is currently completing billing system work that will allow us to bill net metering customers on a residential TOU rate.

To facilitate the combination of net metering with a three-period TOU rate, the Company will need to make changes to the net metering tariff pages to account for three time periods for the energy delivered and other changes related to that setup. Currently the cogeneration rates for customers on a time-of-day rate features prices broken down into two periods. To align with the three-period rate we anticipate using for a future residential TOU rate offering, we will have to add a third-time period to the cogeneration pricing structure and align the period definitions with the time periods approved for the future residential TOU rate. For Section No. 9, Sheet No. 1.1[6] we will need to add the definition of mid-peak period, and change the definition of on-peak and off-peak to align with the time periods approved. For Section No. 9, Sheet Nos. 3[7], 4[8], and 4.2[9], we will need to add a new mid-peak energy payment amount, and align the payment amounts for all three time periods to align with the new residential TOU rate. Net metering pricing for three time periods will need to be developed in the future. We will file requests for Commission approval of tariff changes required to align with any future residential TOU rate proposals in a future regulatory proceeding.

<u>Order Point 5</u>

The Commission's Order required the Company to work with interested parties to develop a post-pilot transition plan for TOU Pilot participants. The Company met with several stakeholders in September 2022 to discuss our transition plan and gather feedback.[10] We implemented our transition plan, summarized in the final Dashboard Compliance Filing, submitted November 30, 2022 in this docket.

As discussed in that Compliance Filing, customers participating as a part of the pilot's treatment group may remain on the TOU rates or may elect to transition off the rate and switch to a standard residential rate at any time going forward. Customers who did not take service on the TOU rate as a part of the pilot may not opt into the TOU rate until a successor becomes available. This structure enables continuity of service for customers who desire to continue on the rate structure

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[6] Technical and Special Terms for Cogeneration and Small Power Production
[7] Sale to Company after Customer Self-use (Rate Code A52)
[8] Monthly Net Meterings (Rate Code A54)
[9] Annual Net Metering (Rade Code A56)
[10] The Company met with the Minnesota Department of Commerce Division of Energy Resources, Minnesota Office of the Attorney General, Energy CENTS Coalition, Fresh Energy, and Citizens Utility Board-Minnesota.

while facilitating the Company's broader scale transition with metering equipment and billing infrastructure.

Order Point 6

The Commission's Order also required the Company to develop a plan to fully implement a TOU rate for all residential customers after completion of the pilot. At this time, the rollout of AMI is anticipated to be complete by year end 2024. The Company plans to hold stakeholder meetings in late-spring or early-summer 2023 to discuss the results of the pilot, lay out our initial plan for a permanent residential TOU rate proposals, and gather feedback for future developments. A future successor or default TOU proposal will be informed by both the results of the pilot and our stakeholder meetings. We anticipate the development and regulatory review of a proposal prior to the completion of the AMI rollout.

Pursuant to Minn. Stat. § 216.17, subd. 3, we have electronically filed this document, and served copies on all parties on the attached service lists. If you have any questions about this filing, please contact Brandon Kirschner at brandon.m.kirschner@xcelenergy.com or 612-215-5361.

Sincerely,

/s/

HOLLY HINMAN
DIRECTOR, REGULATORY AND STRATEGIC ANALYSIS

Enclosures
cc: Service List

Xcel Energy Minnesota Time-of-Use Pilot Evaluation – Final Report

Impact and Process Evaluation

Prepared for:

Xcel Energy

Submitted by:

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Stuart Schare, Partner

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2023-01-26

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Other Appendices (Separate Files)

Filename: *“Xcel MN TOU Appendix X1 2022-11-22.pdf”*
Description: Memorandum describing the new-move-in analysis.

Filename: *“Xcel MN TOU Appendix X2 2022-12-13.pdf”*
Description: Series of figures providing average participant and control load profiles for different periods and segments of the sample.

Filename: *“Xcel MN TOU Appendix X3 2022-12-28.xlsx”*
Description: Excel workbook including the data underlying all the impact-related figures and diagrams presented in the body of the report.

List of Tables

List of Figures

Executive Summary

Since November 1, 2020, Xcel Energy has operated an innovative rate pilot in and around the Twin Cities. This pilot is intended to test the benefits and customer acceptance of an opt-out (default) time-of-use (TOU) rate that roughly doubles the standard residential cost of electricity for five hours a day on weekdays (the On-Peak period), lowers it by roughly two-thirds between midnight and 6 a.m. every day (the Off-Peak period), and leaves it approximately unchanged during the other hours (the Mid-Peak period). High level outcomes of the pilot include the following:

- **TOU pilot participants reduced their summer On-Peak demand by up to 1.6%, but impacts varied by study area and pilot year.**

  In Eden Prairie, on average participants reduced their summer On-Peak demand by approximately 1.3% of baseline demand in both years of the pilot. In Minneapolis, participants reduced their summer On-Peak demand by approximately 1.6% of baseline demand in the first summer, but on average did not reduce On-Peak demand during the second summer of the pilot. During both summers and in both study areas, participant demand during the Off-Peak period increased by 1-4%.

- **TOU pilot participants reduced their coincident peak demand up to 2.6%, but impact varied by study area.**

  TOU pilot participants in Eden Prairie reduced their coincident peak demand by approximately 2.6% (0.074 kW) on average in the second year of the pilot, but participants in Minneapolis did not reduce demand during the same hour. In the first year of the pilot, on average participants in both study areas reduced coincident peak demand by approximately 2.1% of baseline demand.

- **A small, highly engaged subset of participants account for a disproportionate share of the estimated On-Peak reductions.** Specifically, survey respondents who indicated high awareness of rates, engagement with their energy bill, knowledge of Xcel Energy resources (pilot materials, My Account), and self-reported effort to reduce peak load were identified as "high-impact participants." These high-impact participants accounted for 11% of Eden Prairie survey respondents and 8% of Minneapolis survey respondents but generated over 55% of On-Peak reductions amongst survey respondents. On average, high-impact participants in both study areas delivered summer On-Peak demand reductions greater than 10% of their baseline consumption.

- **Average net bill impacts are quite small, as would be expected given the revenue-neutral rate-setting approach.** The average impact on customer bills across all participants was less than $1.50 per month. On average, the transition from Standard to TOU rates is estimated to have reduced the average participant monthly bill in the winter months and increased the average participant monthly bill in summer months. Even amongst the most engaged participants, bill reductions are modest, amounting to less than a cup of coffee, at $4 or less per month.

- **The vast majority of respondents correctly understand that their rate depends on the time of day, but only about half have a more nuanced understanding of weekends and holidays affect their rates.** Nearly all (92%) of final survey respondents correctly stated that their electricity costs vary by time of day, which was up from 85% in the post-cooling season survey. Just over half (53% and 54%, respectively) correctly stated that there are three different prices on weekdays and that their rate depends on whether it is a weekday, weekend, or holiday. There was relatively little increase in knowledge on these two items from the post-cooling survey. In both cases, 4% more respondents correctly chose those statements to be true. Further education may help participants better understand the rate structure and help them better adjust their behaviors to concentrate load shifting away from the On-Peak periods.

- **Many participants report feeling empowered to take at least a moderate level of effort to reduce On-Peak consumption and generally appear willing to reduce their use of home appliances during the On-Peak period.** Nearly 60% of respondents reported exerting at least moderate effort to reduce On-Peak consumption over the past year, and nearly three-quarters of respondents agreed or strongly agreed with statements that they both feel capable and know what actions to take to manage their household's energy use during On-Peak periods. Survey results show a significant decline in the use of electric appliances such as dishwashers and laundry machines during On-Peak periods relative to the respondents' reported pre-pilot On-Peak period usage. In addition, Pre-Pilot and Post-Cooling survey responses indicate that participants increased their morning and early afternoon thermostat setpoints during the cooling season. Participants report little change in their heating habits, perhaps due to a prevalence of non-electric heating sources and/or less willingness to sacrifice comfort during the winter.

This document is the final report for this pilot and provides a summary of findings included in the interim report (year one of the pilot) and detailed findings from the period subsequent to that included in the interim report (year two of the pilot). The evaluation covers a period of analysis from November 1, 2020, through September 30, 2022.[1] Detailed findings from the first winter and first summer of the pilot, from November 1, 2020, through September 30, 2021, can be found in the interim report.[2]

E.1. Pilot Overview

On August 7, 2018, under docket numbers E-002/M-17-775 and E-002/M-17-776,[3] the Minnesota Public Utilities Commission (MPUC) issued an Order approving Xcel Energy's opt-out TOU pilot along with the applicable tariff fully spelled out in Xcel Energy's Rate Book.[4] As part of its Order, the MPUC required Xcel Energy to file both an interim report (after the pilot had

[1] Although the pilot extended through October 31, 2022, the analysis period was truncated by one month to allow sufficient time to conduct the analysis based on the report filing schedule.

[2] Xcel Energy, *Compliance Filing: Residential Time of Use Rate Design* Pilot, Date Filed: February 25, 2022, Docket No. E-002/M-17-775,
https://efiling.web.commerce.state.mn.us/edockets/searchDocuments.do?method=showPoup&documentId={D0CA327F-0000-C130-B92D-0CF55C38B2F4}&documentTitle=20222-183193-02.
See Attachment C: *Xcel Energy Minnesota Time-of-Use Pilot Evaluation – Interim Report*.

[3] Minnesota Public Utilities Commission, *ORDER APPROVING PILOT PROGRAM, SETTING REPORTING REQUIREMENTS, AND DENYING CLARIFICATION REQUEST*, Issue Date: August 7, 2018, Docket No. E-002/M-17-775 and Docket No. E-002/M-17-776,
https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={103F1565-0000-C21D-B43D-24C097C567A3}&documentTitle=20188-145582-01.

[4] PDF Page 8 of 203,
Xcel Energy, *Electric Rate Book – Section 5 – Rate Schedules*, Date Filed: December 14, 2019,
https://www.xcelenergy.com/staticfiles/xe-responsive/Company/Rates%20&%20Regulations/Me_Section_5.pdf.

been in the field for approximately 15 months) and a final report (after the pilot had been in the field for approximately 27 months).

Geography and Timeline

Xcel Energy deployed advanced metering infrastructure (AMI) in two geographic areas to be included in the pilot: the area served by the Hiawatha West/Midtown substation in Minneapolis and the area served by the Westgate substation in Eden Prairie, a suburb approximately 12 miles southwest of downtown Minneapolis. For the purposes of this evaluation, these two areas are referred to as "Minneapolis" and "Eden Prairie," respectively. AMI meters began collecting 5-minute-frequency data from participant and control premises in February 2020, and on November 1, 2020, participants first became subject to TOU prices.

Figure ES-1. Participant Locations

Eden Prairie   Minneapolis

Source: Guidehouse analysis

Pilot Pricing

All participants enrolled in the pilot were drawn from customers subject to the residential Standard rate, including A01 - overhead connections, and A03 - underground connections. The status quo Standard rate is a flat rate that varies by season[5] with an unvarying energy charge.

The piloted TOU rate includes three periods across two seasons, exposing participants to six different energy charges. The timing of these periods, the energy charges applied, and the ratio of these charges to the seasonal Off-Peak price as well as the Standard seasonal energy charge are shown Table ES-1. The On-Peak energy charge is slightly more than twice the Standard energy charge, the Mid-Peak energy charge is nearly the same as the Standard charge, and the Off-Peak energy charge is approximately one-third of the Standard charge.

[5] Xcel Energy, *Electric Rate Book – Section 5 – Rate Schedules*, Date Filed: December 14, 2019, **https://www.xcelenergy.com/staticfiles/xe-responsive/Company/Rates%20&%20Regulations/Me_Section_5.pdf.**

Table ES-1. Residential TOU Rate Energy Charges and Ratios

Season	Months	Period Name	Non-Holiday Weekday Times	Weekend and Holiday Times	Energy Charge ($/kWh)	Ratio of Charge to Seasonal Off-Peak	Ratio of Charge to Standard Charge
Summer	June through September	On-Peak	3pm - 8pm	N/A	$0.22576	8.1	2.2
		Mid-Peak	6am - 3pm, 8pm - Midnight	6am - Midnight	$0.09013	3.2	0.9
		Off-Peak	Midnight - 6am	Midnight - 6am	$0.02784	1.0	0.3
Winter	October through May	On-Peak	3pm - 8pm	N/A	$0.19266	6.9	2.2
		Mid-Peak	6am - 3pm, 8pm - Midnight	6am - Midnight	$0.07515	2.7	0.9
		Off-Peak	Midnight - 6am	Midnight - 6am	$0.02784	1.0	0.3

Source: Guidehouse analysis

Enrollment and Segmentation

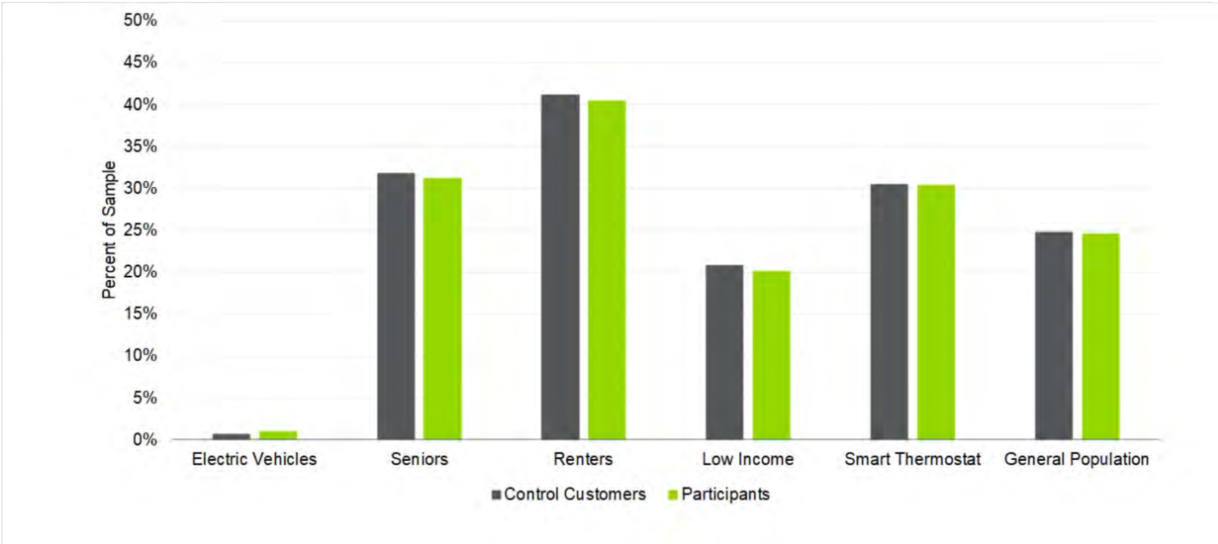
Xcel Energy adopted an opt-out enrollment approach for this pilot, with approximately 10,000 customers enrolled as participants and 7,500 customers enrolled as control customers. Participants may belong to as many as five different participant segments, with many customers belonging to multiple segments. Segments indicated whether customers owned an electric vehicle, were senior citizens, were renters, were low income[6], or owned a smart thermostat. Customers belonging to none of the segments are referred to as belonging to the "General Population."

Figure ES-2 compares the distribution of participants with that of control customers across the segments. An individual participant may be assigned to multiple segments, so the total of the percentage values will exceed 100%. The figure below represents the distribution of all participants and controls included in the impact estimation, which excludes some customers dropped from the analysis due to issues of incomplete or outlier data.[7] Altogether, the impact analysis included the data for 9,024 participants and 6,959 control customers.

[6] Customers belonging to the low income segment were assigned to that segment if: their survey responses indicated that they were eligible for LIHEAP, Xcel Energy's data indicated they were participating in LIHEAP, or they were assigned to that segment based on the SVM machine learning algorithm described in Section 1.4.2.

[7] Due to incomplete or outlier data, 0.9% of control customers and 2.4% of participant customers were removed.

Figure ES-2. Distribution of Participants and Controls by Segment[8]



Source: Guidehouse analysis

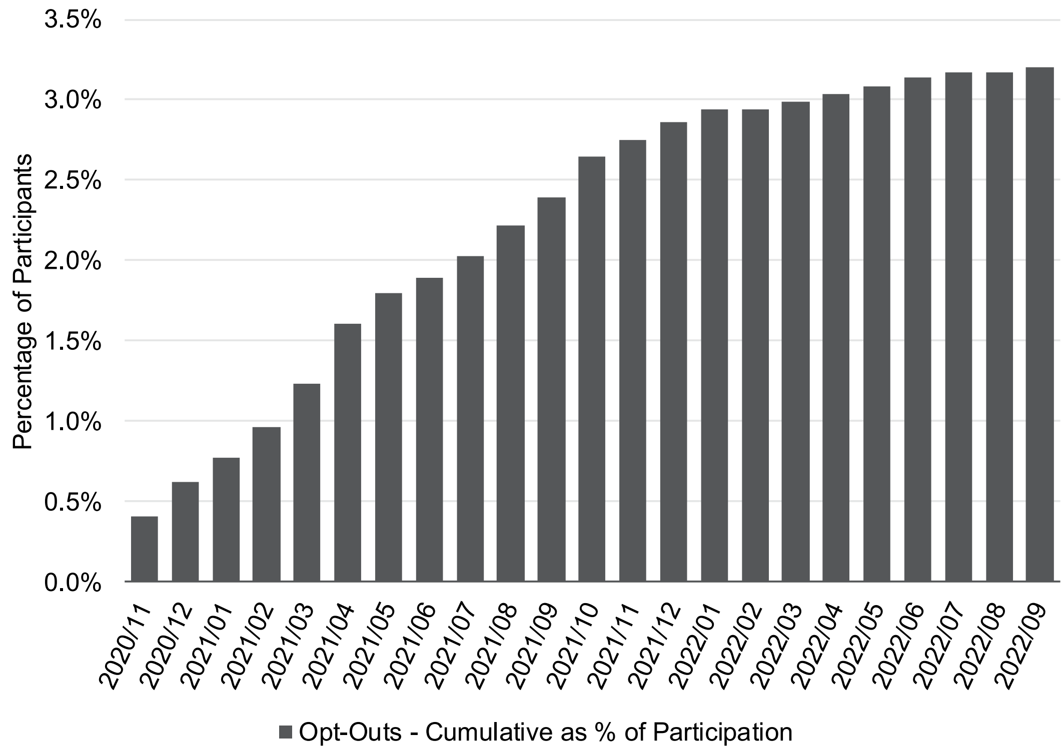
Opt-Outs

Evaluations of TOU pilots and programs typically tie impacts to individual customers, and attrition statistics usually include both participants who have opted out of the pilot and those who have moved out of their premise. The Xcel Energy Minnesota pilot differs from the norm in this respect: the TOU rate is tied to the premise and not the customer. Thus, when a customer moves out of their premise without opting out of the piloted rate, the next customer to occupy that premise will continue to be subject to the TOU rates. This design choice means that pilot attrition is only driven by opt-outs, though Guidehouse has also tracked move-outs to control for the impact of changes in occupancy of premises.

Attrition in the pilot has been modest, despite the involuntary nature of participation (in which participants are assigned to the pilot rather than asking to volunteer). After 23 months of the pilot (from November 1, 2020, to September 30, 2022), slightly more than 3% of participants had opted out. Figure ES-3 shows cumulative opt-outs as a percentage of total participants included in the impact analysis over the period in which pilot prices have been in effect. Participants who opted-out of the pilot were removed from the analysis after the opt-out date.

[8] The distribution of participants and controls across each segment is calculated after applying corrections based upon survey responses and LIHEAP data, as described in Section 1.4.2.

Figure ES-3. Cumulative Opt-Outs as a Percent of Participants



Source: Guidehouse analysis

The rate of opt-outs in this pilot is relatively modest compared with that reported by a meta-analysis conducted by the U.S. Department of Energy[9] (DOE). The meta-analysis found that retention rates in year 1 of opt-out pilots ranged from 62% to approximately 99%, with an average retention rate around 90% (see Figure 3a of the DOE meta-analysis). Observed year 2 retention rates ranged from approximately 77% to 99%, also with an average slightly above 90%. This implies an average overall retention rate since pilot launch of approximately 80%.[10]

Note that the low rate of opt-outs in this pilot may be a result of how individual premises, rather than customers, are treated. In most evaluations, the convention is to treat the individual customers rather than the premises as the participants. Any participants who have *moved* out of their premise would be counted in attrition statistics. Because of the high rate of premise turnover (particularly in the Minneapolis study area), it was important for Xcel Energy that these

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[9] U.S. Department of Energy, Electricity Delivery & Energy Reliability, *American Recovery and Reinvestment Act of 2009: Customer Acceptance, Retention, and Response to Time-Based Rates from the Consumer Behavior Studies*, Smart Grid Investment Program, November 2016, **https://www.energy.gov/sites/prod/files/2016/12/f34/CBS_Final_Program_Impact_Report_Draft_20161101_0.pdf.**

[10] The overall retention rate is calculated as the product of the year 1 and year 2 retention rate (e.g., 0.90 x 0.90 = 0.81).

premises remain included in the analysis. By retaining premises with participant turnover, this reduces the number of participants who are considered to have left the pilot.

E.2. Evaluation Approach

Demand Impacts

Demand impacts (by TOU period and at the time of Xcel Energy's 2021 and 2022 system peaks) were estimated using regression analysis. The evaluation team estimated a series of lagged dependent variable (LDV) models applied to participant and control demand data that delivered incremental segment-specific impacts and overall average participant demand impacts for each of the two study areas.

The opt-out design selected by Xcel Energy facilitated the experimental design of the pilot, which was deployed as a randomized control trial (RCT). The Uniform Methods Project[11] notes, "*The optimal evaluation scenario for a consumption data analysis is a randomized control trial (RCT) experimental design.*" An RCT is an experimental design in which a sample drawn from a known population is randomly assigned to various treatment groups (usually a treatment group and a control group). This ensures against selection bias.

The combination of the RCT design (which eliminates selection bias) and the LDV approach (which controls for non-program effects impacting participants and control customers) means that the estimated impacts are accurate and robust to a variety of model specifications. Most importantly, this combination of factors ensures that major non-program effects, such as weather or periodic changes in customer behavior due to the COVID-19 pandemic, are controlled for and do not bias results. Though COVID-19 will not *bias* estimated impacts, it will affect them. Estimated impacts will reflect—accurately and without bias—the TOU response of a population with (for example) a relatively high proportion of customers who work from home, compared to three years ago, and they may not reflect a possible future state where more customers work from a non-home office. This factor must be considered by planners working with these results.

Bill Impacts

Bill impacts estimated in this evaluation include behavioral bill impacts and net bill impacts. Both types of impacts are calculated by applying the average demand impacts to the TOU rates or Standard rates.

The behavioral bill impact is the estimated average impact on the bill of a customer subject to TOU rates stemming from their response to that TOU rate.This bill impact reflects the difference between what the average participant would have paid under TOU rates had they made no changes to their behavior and what they actually paid. Behavioral bill impacts therefore compare two conditions:

- The average participant bill calculated with TOU rates applied to observed average hourly consumption under the TOU pilot, and

[11] National Renewable Energy Laboratory, *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures – Section 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol*, April 2013,
https://www1.eere.energy.gov/wip/pdfs/53827-8.pdf.

- The average participant bill calculated with TOU rates applied to estimated baseline hourly consumption.

Net bill impacts are the estimated average bill impacts of switching from the residential Standard rate to the TOU rate. Net bill impacts consider the base case as the average participant bill when participants are subject to the Standard residential rate and participants continue to consume electricity according to their pre-TOU patterns. The net bill impacts therefore compare two conditions:

- The average participant bill calculated with TOU rates applied to observed average hourly consumption under the TOU pilot, and
- The average participant bill calculated with the Standard residential rate applied to estimated baseline hourly consumption during the same period.

As such, the net bill impacts capture both the behavioral bill impacts stemming from the average customer response to the TOU rate, and the structural bill impacts stemming from moving from one rate structure to another.

Customer Experience

Guidehouse conducted a series of five surveys to collect data on customers' demographics, home characteristics, energy-related attitudes and behaviors, understanding of the pilot, behavior changes during the pilot, and overall satisfaction.

E.3. Impact Findings

Key findings related to demand and bill impacts include the following:

- **Demand Impacts**
    - **TOU pilot participants reduced their summer On-Peak demand by up to 1.6%, but impacts varied by study area and pilot year.**

      In Eden Prairie, on average participants reduced their On-Peak demand by approximately 1.3% of baseline demand in both summers of the pilot. In Minneapolis, participants reduced their On-Peak demand by approximately 1.6% of baseline demand in the first summer, but on average did not reduce On-Peak demand during the second summer of the pilot. During both summers and in both study areas participant demand during the Off-Peak period increased by 1-4%.
    - **TOU pilot participants reduced their coincident peak demand up to 2.6%, but impacts varied by study area and pilot year.**

      TOU pilot participants in Eden Prairie reduced their coincident peak demand by approximately 2.6% (0.074 kW) on average in the second year of the pilot, but participants in Minneapolis did not reduce demand during the same hour. In the first year of the pilot, on average participants in both study areas reduced coincident peak demand by approximately 2.1% of baseline demand.
- **Drivers of Demand Impacts**
    - **A small, highly engaged subset of participants account for a disproportionate share of the estimated On-Peak reductions.** Participants identified as highly engaged were survey respondents who indicated high awareness of rates,

engagement with their energy bill, knowledge of Xcel Energy resources (pilot materials, My Account), and self-reported effort to reduce peak load. These high-impact participants accounted for 11% of Eden Prairie survey respondents and 8% of Minneapolis survey respondents. On average, high-impact participants in both study areas delivered summer On-Peak demand reductions greater than 10% of their baseline consumption. Summer On-Peak impacts are more than five times the magnitude of those estimated for the full sample of participants, as a percentage of baseline consumption, and approximately ten times the absolute magnitude of reductions estimated for the full sample of participants. During summer Off-Peak periods, high-impact participants increased load by up to 9.5% of baseline consumption, in response to the low electricity price during this period. High impact participants also contribute greater demand reductions than the full sample of participants during winter, with On-Peak period demand reductions of 7.5% of baseline demand in Eden Prairie and 5.6% of baseline demand in Minneapolis, on average.

- **Segment-level demand impacts have low statistical precision, but usage analysis suggests that smart thermostat owners drive the Minneapolis area On-Peak reductions. In Eden Prairie, there is no single segment that is clearly driving On-Peak demand reductions, but seniors and renters are both major contributors during summer.** The standard errors of estimated segment-level impacts are relatively high, meaning that these estimates are less precise than those for the sample of participants as a whole.
- **Premises with changes in occupancy do not contribute to On-Peak reductions.** On average, new premise occupants do not contribute to On-Peak demand reductions in either season or study area. While it is possible that new occupants would eventually respond to TOU prices over time, this effect is not apparent over the evaluation period.

- **Energy Impacts**
  - **Average net energy impacts are small, as might be expected given the revenue-neutral rate design.** On average, annual energy consumption increased by 0% to 0.5%, with some minor variation across study areas and pilot years. This corresponds to an annual increase in energy consumption of 30 kWh or less, on average.
- **Bill Impacts**
  - **Average bill impacts resulting from participant behavior changes are quite modest and reflect TOU period demand impacts.**

    Compared to what their bills would have been had they not changed their behavior (but still been enrolled in the TOU rate), Eden Prairie participants achieved an average savings of approximately $0.23 per month across the entire pilot period. Off-Peak demand increases in Minneapolis motivated by the very low price in that time period resulted in an average behavioral bill increase of $0.02 per month across the entire pilot period. Behavioral bill impacts vary somewhat by season and study area, but do not exceed $0.50 per month, on average.

- **Average net bill impacts are quite small, as would be expected given the revenue-neutral rate-setting approach.**

  On average, the transition from Standard to TOU rates is estimated to have reduced the average participant monthly bill in the winter months and increased the average participant monthly bill in summer months. This small increase in summer bills is driven by the higher proportion of summer energy consumed during the On-Peak period. The average bill impact for Minneapolis participants is a reduction of approximately $1.10 (2.2%) per month during the pilot period. The average bill impact for Eden Prairie participants is an increase of approximately $0.40 (0.5%) per month during the pilot period.

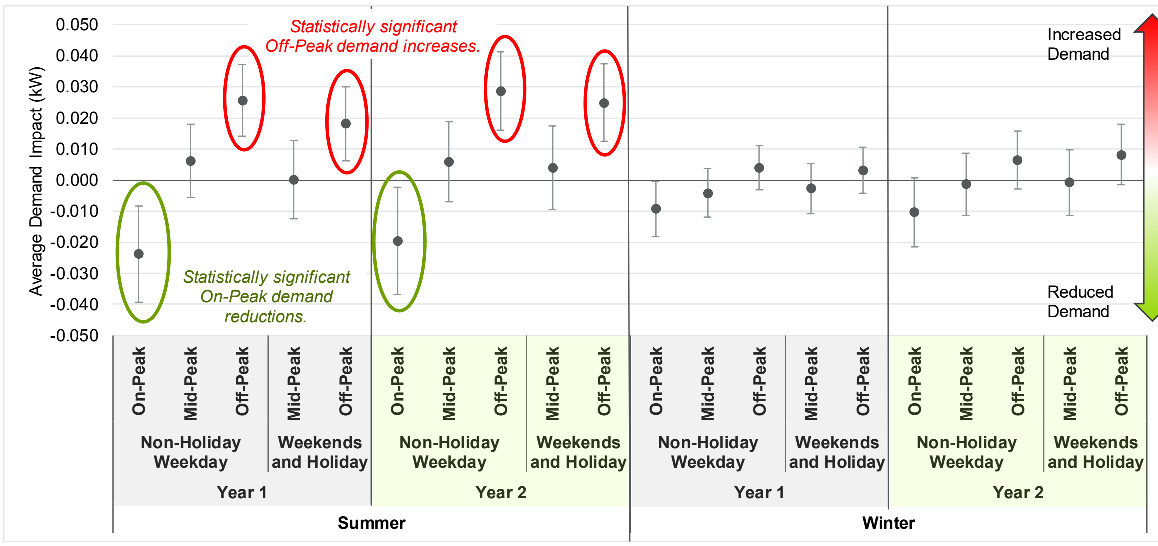
Seven types of impacts are discussed in this Executive Summary:

- TOU Period Demand Impacts
- TOU Period Demand Impacts – New Move-Ins
- TOU Period Demand Impacts – High-Impact Participants
- Coincident Peak Demand Impacts
- Energy Impacts
- Net Bill Impacts
- Demand Side Management (DSM) Impact Results

TOU Period Demand Impacts

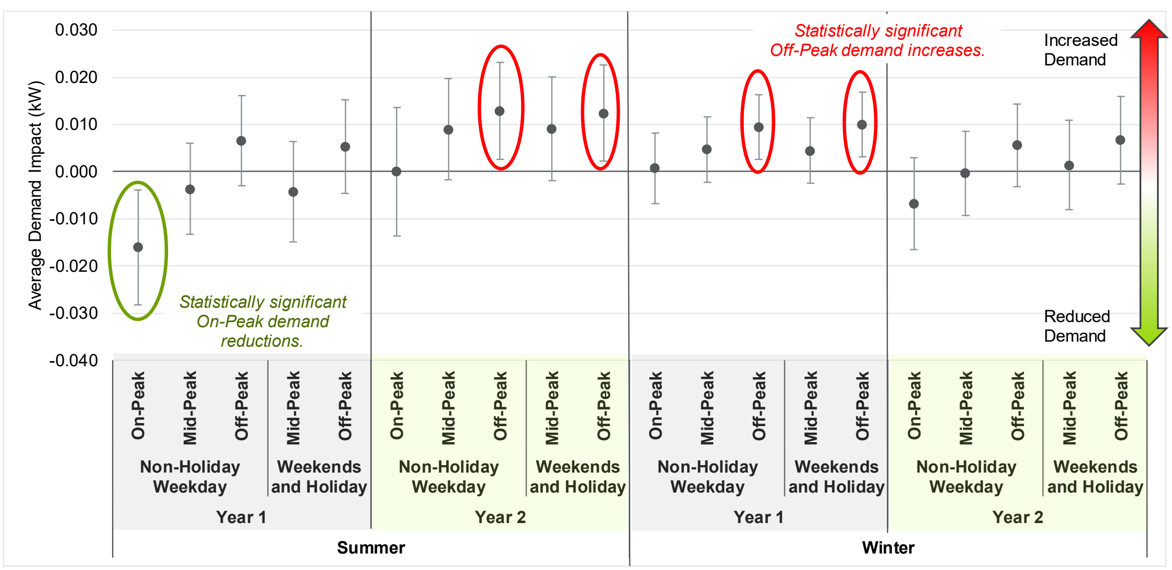
The two figures below show the average estimated demand impact—represented by the dots—by TOU period, season, day-type, and year of the pilot for Eden Prairie (Figure ES-4) and Minneapolis (Figure ES-5). Estimated demand reductions are represented as negative values and increases in demand as positive values. The 90% confidence interval (derived from cluster-robust standard errors) is represented as the set of whiskers bracketing each estimate. Where the whiskers cross the zero line (e.g., summer weekday Mid-Peak), the estimated impacts are not statistically significant at the 90% level. The statistically significant TOU period impacts are highlighted with green and red circles, corresponding to the direction of the impact. For Eden Prairie, there were no statistically significant changes in demand during winter months.

Figure ES-4. Estimated Demand Impacts by TOU Period – Eden Prairie



Source: Guidehouse analysis

Figure ES-5. Estimated Demand Impacts by TOU Period – Minneapolis



Source: Guidehouse analysis

In Eden Prairie, estimated On-Peak reductions are approximately 1% of estimated baseline demand for both seasons (winter and summer) and both years of the pilot. Except for the On-Peak impact in the winter of 2022, these reductions are statistically significant. In addition, the highly discounted overnight Off-Peak rate resulted in estimated statistically significant increase in demand during the summer months.

In Minneapolis, a statistically significant On-Peak demand reduction was estimated for the first summer of the pilot, which amounted to approximately 1.6% of baseline demand. Estimated winter On-Peak demand reductions in the first year of the pilot were near zero and not statistically significant. However, in the second year of the pilot, estimated summer On-Peak demand reductions fell to approximately zero and winter On-Peak demand reductions rose to approximately 1.1% of baseline demand; neither impact was statistically significant in year two. In addition, the highly discounted overnight Off-Peak rate resulted in summer demand in that period increasing in a statistically significant manner in year two of the pilot.

TOU Period Demand Impacts – New Move-Ins

A separate analysis was conducted for customers who moved into the premise since the pilot began, finding little or no evidence that new premise occupants respond to the TOU rate. While it is possible that new occupants would eventually respond to TOU prices over time, this effect is not apparent over the evaluation period. Moreover, the inclusion of a regression model term to capture tenure of new movers yielded no evidence of increasing savings over time – in most cases, it suggested the opposite effect.

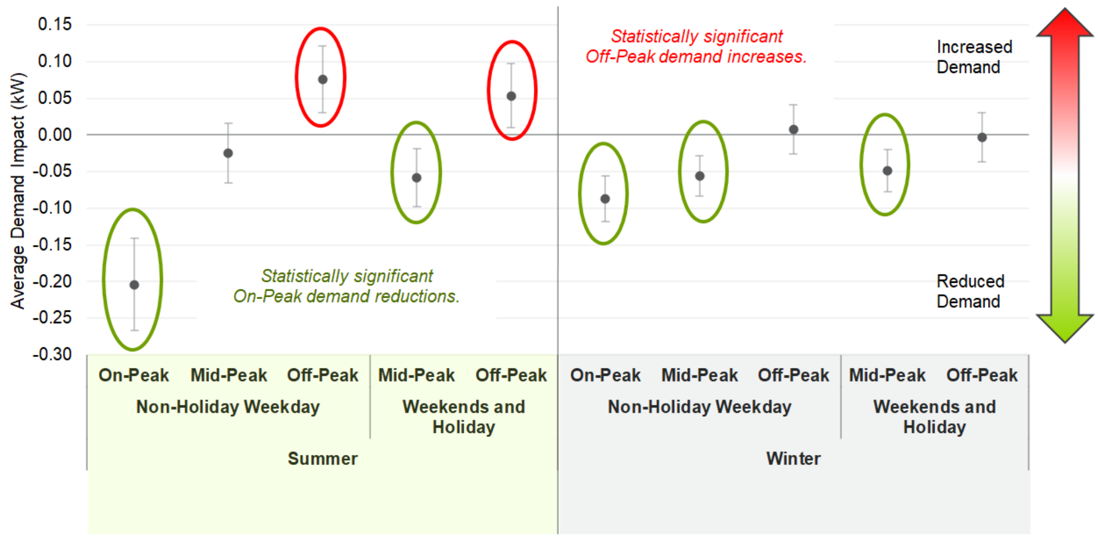
Looking at data for move-in and move-out dates, participants and controls in the pilot exhibit high turnover. Premises with turnover have an average length of occupancy of 9 months. At the time of the final evaluation, most new occupants have not or do not remain in their premise for a sufficiently long period to detect a statistically significant effect from the TOU rate. When comparing usage patterns for previous and current occupants, noticeable differences exist in the magnitude and shape of the load that may be obfuscating impacts where they do occur.

These findings do not support the hypothesis that longer-term exposure to the TOU rate will increase impacts. Furthermore, despite receiving similar information from Xcel Energy via the Welcome Kit, new occupants are not responding to the TOU rate on average. New occupants are included in the core analysis, with the effect of reducing overall on-peak impacts.

TOU Period Demand Impacts – High-Impact Participants

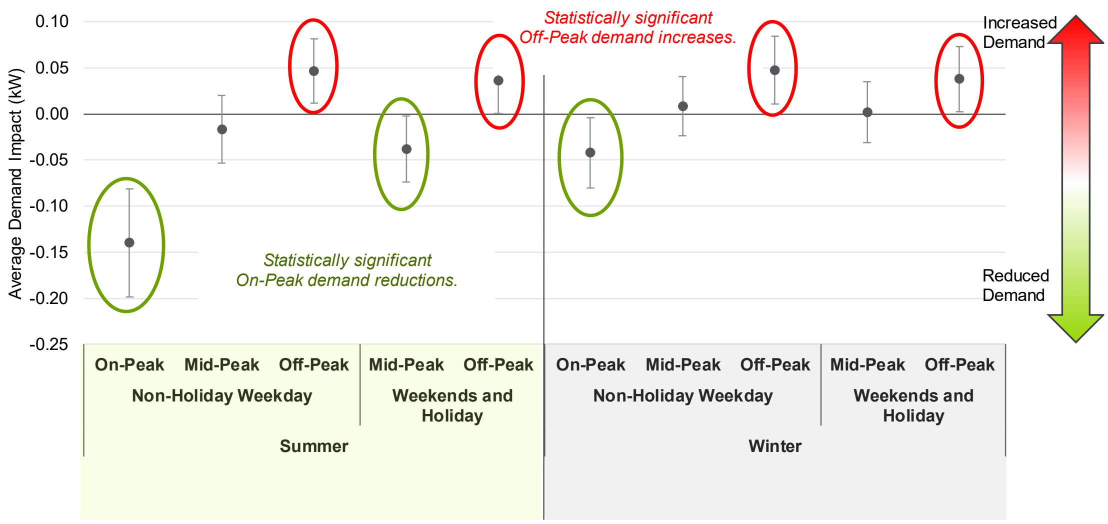
The two figures below show the average estimated demand impact—represented by the dots—by TOU period, season, and day-type across both years of the pilot for Eden Prairie (Figure ES-6) and Minneapolis (Figure ES-7). Estimated demand reductions are represented as negative values and increases in demand as positive values. The 90% confidence interval (derived from cluster-robust standard errors) is represented as the set of whiskers bracketing each estimate. Where the whiskers cross the zero line (e.g., weekday Mid-Peak in summer), the estimated impacts are not statistically significant at the 90% level. The statistically significant TOU period impacts are highlighted with green and red circles, corresponding to the direction of the impact.

Figure ES-6. Estimated Demand Impacts by TOU Period – Eden Prairie, High-Impact Participants



Source: Guidehouse analysis

Figure ES-7. Estimated Demand Impacts by TOU Period – Minneapolis, High-Impact Participants



Source: Guidehouse analysis

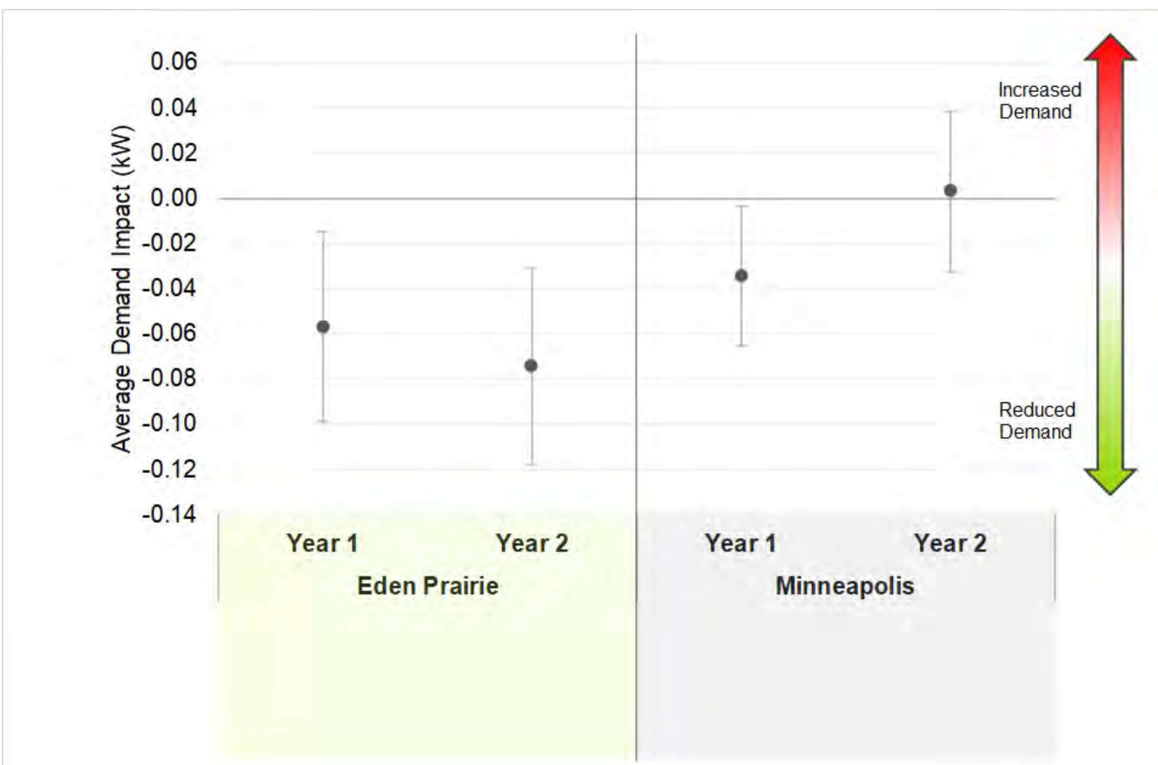
High-impact participants were identified via a two stage high-impact analysis detailed further in Appendix 5.A.4. High-impact participants are defined as participants with characteristics including high awareness of rates, engagement with their energy bill, knowledge of Xcel Energy resources (pilot materials, My Account), and self-reported effort to reduce peak load. Demand reductions for the summer On-Peak and weekend Mid-Peak periods are statistically significant for this group and are more than double the magnitude of the impacts estimated for the full sample of participants. Summer On-Peak period impacts in Minneapolis and Eden Prairie are 11.8% and 10.8% of estimated baseline demand, respectively. In addition, the discounted Off-Peak rate in summer is estimated to have resulted in a statistically significant increase in demand in that period for both study areas. During winter, On-Peak demand reductions are greater than 5% of baseline demand for both study areas.

Of the pilot participants, approximately 3% from Eden Prairie and 2% from Minneapolis were identified as high-impact. However, high-impact participants were selected from a subset of participants – that is, those participants who had responded to at least one survey throughout the pilot period. As a proportion of survey respondents, high-impact participants represent 11% of Eden Prairie respondents and 8% of Minneapolis respondents.

Coincident Peak Demand Impacts

The impact of the TOU rate on coincident peak demand is the impact of TOU rate at the time when Xcel Energy experienced its highest load in each year. The system peaks in 2021 and 2022 occurred on June 9 and June 20 between 4 p.m. and 5 p.m., respectively. Figure ES-8 shows the estimated coincident peak demand impact for each year of the pilot and study area. The estimated coincident peak demand impacts in the summer of 2021 are statistically significant for both study areas. In the summer of 2022, estimated coincident peak demand impacts are only statistically significant for Eden Prairie. Further, in Eden Prairie, coincident peak demand impacts were greater in magnitude in 2022 than in 2021. For Minneapolis, the coincident peak impact in 2022 was near zero.

Figure ES-8. Coincident Peak Demand Impacts



Source: Guidehouse analysis

Energy Impacts

Estimated average (per participant) annual energy impacts are calculated by taking the product of the estimated demand[12] impact in each of the periods (e.g., summer On-Peak, summer Mid-Peak weekends, summer Mid-Peak weekdays, etc.) and the number of hours in the year during which those periods apply.

Eden Prairie participants increased their energy consumption in the summer by 21 kWh on average. Reduced energy consumption in the winter did not fully offset the summer increase, resulting in an annual increase of 19 kWh (0.2%) on average. Minneapolis participants increased their energy consumption in both the summer and winter seasons, resulting in an annual increase of 29 kWh on average (0.6%).

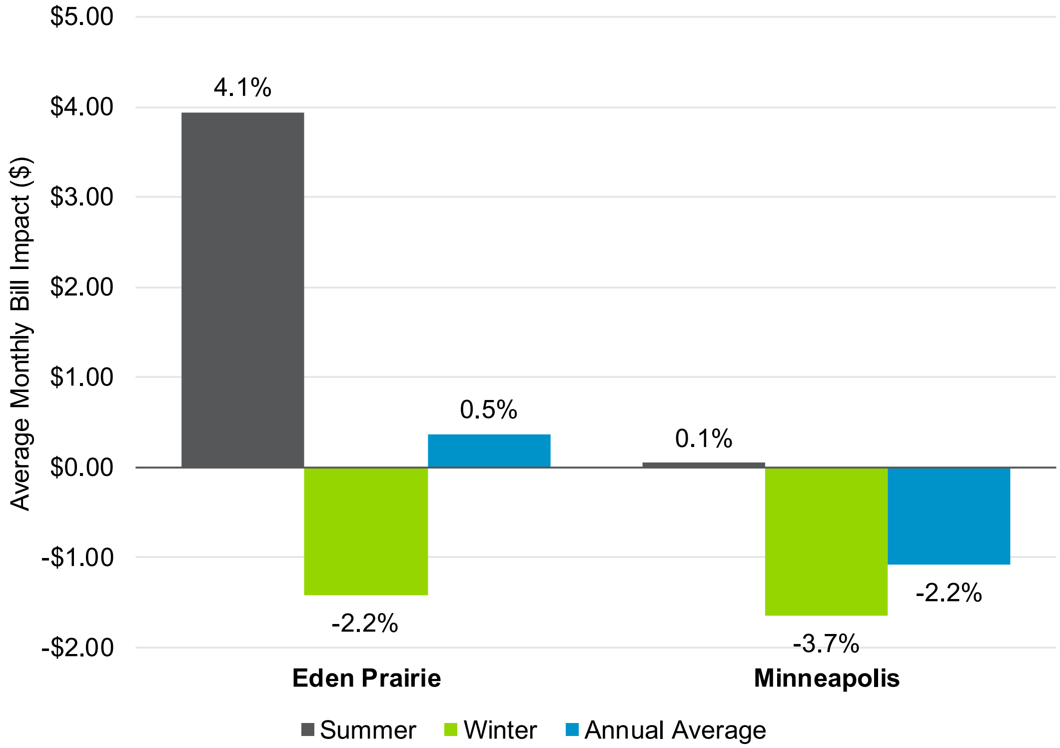
Net Bill Impacts

Net bill impacts consider the base case as the average participant bill when participants are subject to the Standard residential rate and participants continue to consume electricity according to their pre-TOU patterns. As such, the net bill impacts capture both the behavioral bill impacts from changes in consumption patterns and the structural bill impacts, which reflect deviations between the assumptions used to set the revenue-neutral TOU rate (e.g., weather and load profile forecasts) and the observed weather and actual pilot behavior.

Figure ES-9 displays the overall average monthly bill impact values by season for the final 12 months of the pilot. This figure also includes the percentage increase (positive numbers) or savings (negative numbers) as a label at the end of each bar. Net bill impacts for year two of the pilot are similar to those estimated for year one of the pilot.

[12] Energy impacts are derived from the results of the regression model used to determine TOU Period Demand Impacts (provided in Section 3.1). These impacts measure changes to average demand in each TOU period, which is equivalent to average hourly consumption.

Figure ES-9. Average Monthly Net Bill Impacts by Season and Study Area – Year 2



Source: Guidehouse analysis

In most cases, the difference in average monthly net bill impact between the first year of the pilot and the second year of the pilot is less than $0.55. However, for Minneapolis participants in summer, the average impact increased from $1.30 in savings to a $0.05 bill increase. This reflects the increase in demand estimated during the summer of 2022 for Minneapolis participants.

DSM Analysis

Little relationship exists between participation in the TOU pilot and participation in other downstream DSM programs.[13] This is expected, as the TOU pilot was focused primarily on customer education rather than increased adoption of DSM programs to manage TOU usage. The proportion of participants and controls participating in downstream DSM programs varies moderately by segment and study area, but in aggregate participants and controls participate in downstream DSM programs at similar rates, as illustrated in Table ES-2.

For this analysis, the evaluation team used DSM program data to identify what proportion of participants and control customers participated in downstream DSM programs both before and during the pilot period. The difference-in-difference (DID) statistic is a measure of the

[13] While Guidehouse could map downstream DSM participation to Eden Prairie and Minneapolis participants and controls, the same could not be accomplished for upstream and midstream DSM programs.

incremental DSM participation by TOU pilot participants, over and above what would have happened absent the TOU pilot.

Table ES-2. DSM Participation by Customer Group and Period

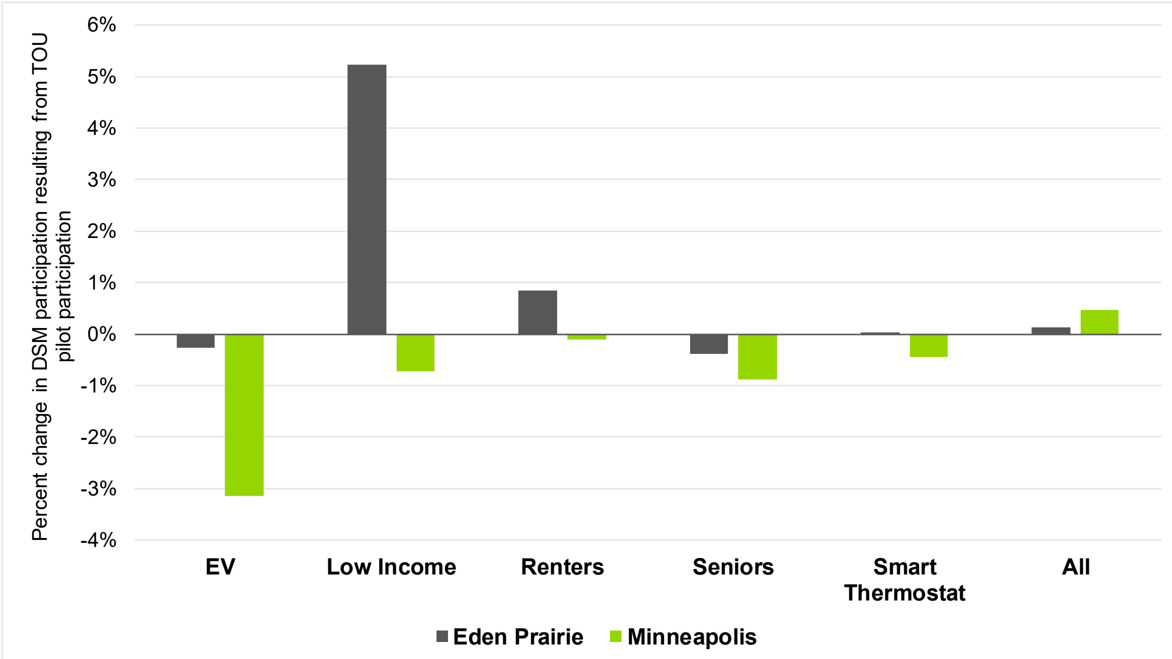
	Segment	Eden Prairie		Minneapolis	
		Controls	Participants	Controls	Participants
Pre-Period	EV	11%	14%	0%	3%
	Low Income	10%	9%	3%	3%
	Renters	4%	4%	3%	3%
	Seniors	10%	11%	3%	4%
	Smart Thermostat	10%	11%	3%	5%
	All	**10%**	**10%**	**4%**	**4%**
Post-Period	EV	19%	21%	9%	8%
	Low Income	10%	14%	5%	5%
	Renters	3%	4%	5%	5%
	Seniors	13%	13%	6%	6%
	Smart Thermostat	13%	14%	8%	10%
	All	**12%**	**12%**	**6%**	**7%**
DID	**All**	**0%**		**0%**	

Note: DID references the difference-in-differences, which is equal to the difference between the change in DSM participation within one group and the change in DSM participation within another group. For example, for two groups that changed their DSM program participation by the same amount between the pre-period and post-period, the DID is zero.

Source: Guidehouse analysis

In aggregate, there is little to no evidence of increased participation in downstream DSM programs associated with participation in the pilot. Looking at individual segments, Guidehouse found the DID between pre- and post-pilot participation for the participant and control groups was less than 1% for all but one segment. The exception was the low-income segment in Eden Prairie, where participation in the pilot was associated with an approximately 5% increase in DSM participation compared to the control group. However, fewer than 50 low-income premises from Eden Prairie participated in a downstream DSM program during the pre- or post-pilot period. The increase in DSM participation estimated relative to that of other segments likely reflects the small sample size.

Figure ES-10. DSM Difference in Differences



Source: Guidehouse analysis

E.4. Customer Experience Results

This section summarizes findings on customers' experience with the pilot, including changes in energy-related attitudes and behaviors, understanding of the pilot, and overall satisfaction. Guidehouse assessed overall participant experience as well as differences by study area and segment when applicable. The research is based on five surveys: the pre-launch survey (2019 Q2), the pre-pilot survey (2019 Q4), the post-heating season survey (2021 Q2), the post-cooling season survey (2021 Q4), and the final survey (2022 Q4).

Most participants report being home on weekday afternoons and exerting moderate effort to reduce consumption during the On-Peak period, favoring low-frequency, structural changes, such as using only LED lightbulbs, rather than higher-frequency, behavioral changes, such as air-drying laundry or unplugging electronics when not in use.

Key findings related to the customer experience include the following:

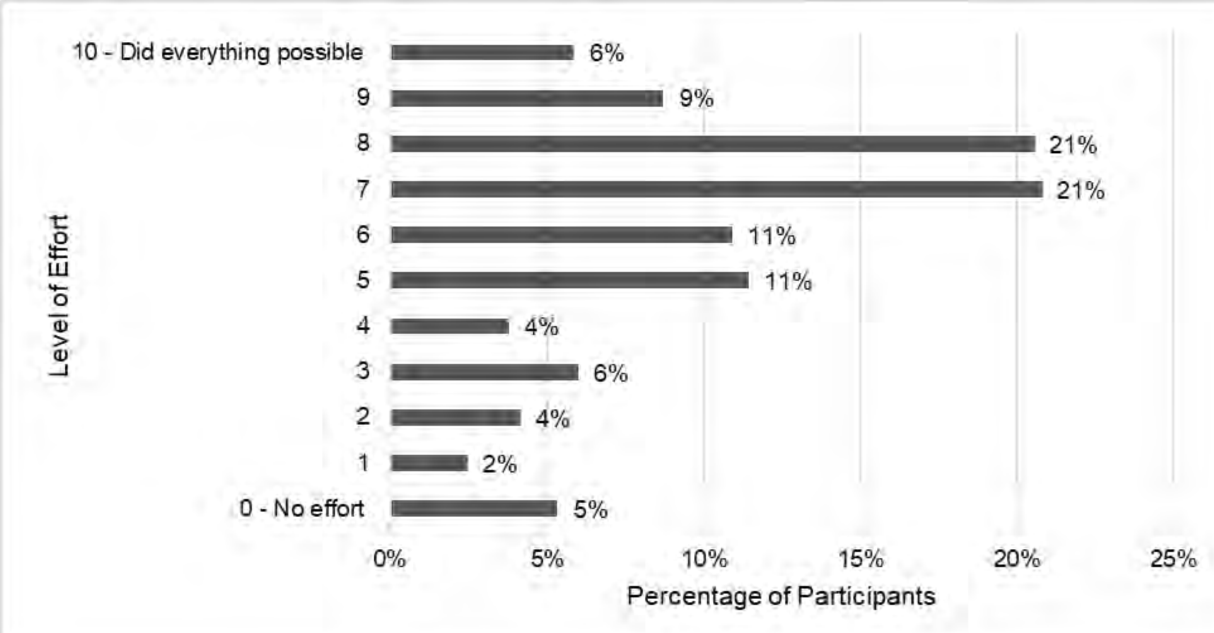
The majority of participants are home during weekday afternoons, driven in part by the COVID-19 pandemic. Almost a quarter (23%) of final survey respondents are retired, and over a quarter (29%) are primarily working from home, accounting for almost half (44%) of working participants. Prior to the pandemic, 6.5% of Minnesotans primarily worked from home, so this is a drastic difference in household occupancy that may have affected decisions regarding HVAC usage and other end uses during peak periods.[14] This represents only a 16% change from the post-cooling season survey, during which 60% of working participants reported doing so from home. In line with broader trends, the number of participants working outside the home is increasing, but may not return to pre-pandemic levels, pointing to new patterns of HVAC usage that may persist if most participants continue to be home on weekday afternoons.

The vast majority of respondents correctly understand that their rate depends on the time of day, but only about half have a more nuanced understanding of weekends and holidays affect their rates. Nearly all (92%) of final survey respondents correctly stated that their electricity costs vary by time of day, which was up from 85% in the post-cooling season survey. Just over half (53% and 54%, respectively) correctly stated that there are three different prices on weekdays and that their rate depends on whether it is a weekday, weekend, or holiday. There was relatively little increase in knowledge on these two items from the post-cooling survey. In both cases, 4% more respondents correctly chose those statements to be true. Further education may help participants better understand the rate structure and help them better adjust their behaviors to concentrate load shifting away from the On-Peak periods.

Many participants report feeling empowered to take at least a moderate level of effort to reduce On-Peak consumption and generally appear willing to reduce their use of home appliances during the On-Peak period. Nearly 60% of respondents reported exerting at least moderate effort to reduce On-Peak consumption over the past year, and nearly three-quarters of respondents agreed or strongly agreed with statements that they both feel capable and know what actions to take to manage their household's energy use during On-Peak periods. Survey results show a significant decline in the use of electric appliances such as dishwashers and laundry machines during On-Peak periods relative to the respondents' reported pre-pilot On-Peak period usage. In addition, Pre-Pilot and Post-Cooling survey responses indicate that participants increased their morning and early afternoon thermostat setpoints during the cooling season. Participants report little change in their heating habits, perhaps due to a prevalence of non-electric heating sources and/or less willingness to sacrifice comfort during the winter.

[14] Cameron Macht, "Teleworking During the Pandemic," Minnesota Department of Employment and Economic Development, March 2021, **https://mn.gov/deed/newscenter/publications/trends/march-2021/telework-during-pandemic.jsp**

Figure ES-11. Level of Effort to Reduce Peak Consumption



Source: Guidehouse final survey (n=739)

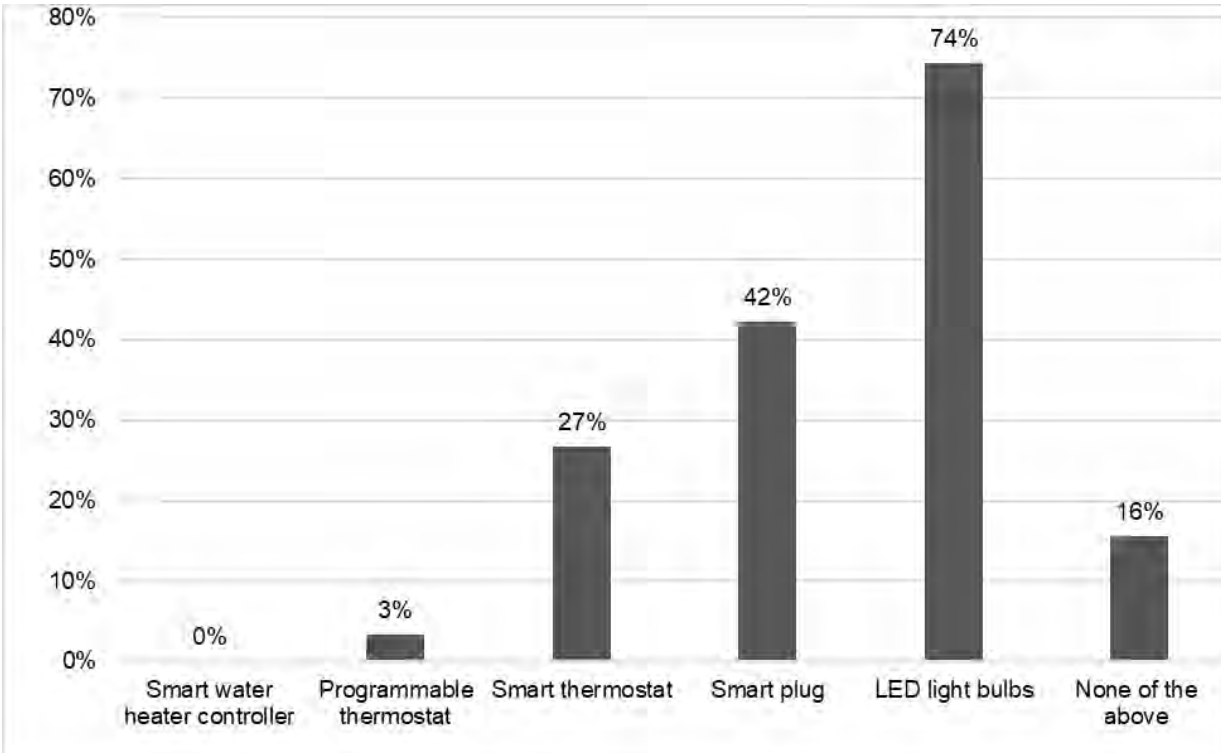
When asked their perceptions of their electricity bills, most participants report not knowing if their bills were the same, higher than expected, or lower than expected than the prior winter and summer. However, customers who felt that their bills were the same or lower than the previous summer or winter were more likely to highly rate their satisfaction with the pilot. The opposite is also observed, customers who felt their bills were higher than the previous season report lower levels of satisfaction, suggesting participant perception of relative magnitude of electricity bills in comparison to previous years may be a contributing factor to overall satisfaction.

Participants overall have limited awareness of tools meant to increase pilot engagement however, those who utilize those resources find them helpful. Only 44% of final survey participants were aware that Xcel Energy offered an energy efficiency kit for pilot participants, and of that segment, only 17% reported receiving a kit.[15] The most frequently installed items from the kit were LED light bulbs, rather than items that could enable structural changes, such as smart thermostats or smart water heater controllers. Customers may need additional assistance installing and setting up items such as smart thermostats. Additionally, overall participant engagement with educational resources decreased from the post-cooling season survey to the final survey. Final survey respondents' most frequently utilized educational item was "Emails from Xcel Energy" (55%). Email (55%) also was in the top three most frequently used educational items for high-impact participants along with information included with the bill (56%), and the summer rate reminder postcard (51%). Overall, high-impact participants reported higher utilization of the educational resources, with the starkest difference between the number of participants reporting using none of the available resources (24% of all participants vs. 3% of high-impact participants). Overall, of the participants who did utilize available

[15] Energy efficiency kits were distributed based on request and on a first-come, first-serve basis. Participants were notified about kit availability via a direct email campaign, community engagement tabling events, and door knocking conversations.

educational resources, they found them at least moderately helpful (at least 7 out of 10, where 10 is very helpful).

Figure ES-12. Most Installed Items from Pilot Kit



Source: Guidehouse final survey (n=739). Participants only asked if they had reported receiving a kit (n=90).

Most participants are satisfied with or neutral about their pilot experiences to date. In the post-cooling season survey, 86% of participants rated their satisfaction with the pilot as a 5 or higher on a 0 to 10 scale. Final survey respondents reported nearly identical levels of overall satisfaction, with 85% rating their satisfaction as 5 or higher. However, wherein the post-cooling season survey respondents were relatively evenly distributed between 5 and 10, in the final survey there was an increase in respondents choosing 5 (29% vs. 15%), indicating neutral feelings towards the pilot. This shift towards neutral does not persist in the high-impact participants, with 57% rating their satisfaction at 8 or higher, Eden Prairie residents have significantly higher average levels of satisfaction (6.30 of 10) than their counterparts in Minneapolis (5.96 of 10), supporting the drop in impact seen in year two of the pilot in Minneapolis. This is somewhat expected as participants are now two years into the pilot and may reflect some fatigue or feelings that levels of effort exerted are not manifesting in what participants feel like to be commensurate returns. Customer satisfaction with the TOU pilot is correlated with their expectations about energy bills. A plurality of participants (37%) did not know how the TOU rate impacted their bill, while customers who felt that their bills were the same or lower than in the prior year were more likely to be highly satisfied with the pilot. Further education on the rate neutral design of this pilot may help participants feel more satisfied.

E.5. Recommendations

This evaluation of Xcel Energy's TOU pilot found that the TOU rate successfully impacted residential customer demand patterns. In aggregate, the TOU rate delivered statistically significant summer On-Peak and coincident peak demand reductions, although the magnitude of the response varied by study area, season, and year of the pilot.

The following recommendations may help to make the wider deployment of a default (opt-out) TOU rate even more effective at achieving the desired outcomes. Additional information supporting these recommendations is available in Section 5.

1. **Consider a general awareness campaign to accompany a wider deployment of the residential TOU rate.** Emphasize the revenue-neutral rate design to mitigate potential backlash from customers. Messaging to customers can highlight that on average, bills will be similar on the Standard and TOU rates for customers who do not change their usage patterns.
2. **Fine-tune customer messaging and develop tools to help customers set realistic expectations about the potential for bill impacts.** Focus on high-impact, low-effort actions, such as programming a thermostat schedule or adjusting thermostat setpoints. Develop customer-facing tools that provide realistic expected bill impacts for recommended actions (e.g., action A could save $X on average).
3. **Coordinate DSM program offerings and educational materials with the TOU rate design to deliver deeper impacts.** Ensure DSM program offerings and educational materials address the benefits they offer under the TOU rate.
4. **Target EV owners.** Add language to the EV website landing page about the potential for substantial bill savings when customers are on a TOU rate (or TOU-aligned EV rate) and EV charging occurs during the Off-Peak period.
5. **Conduct focus groups with key subsets of participants to learn more about their motivations, barriers to making structural changes, and preferred communication channels.** Additional qualitative research on high impact and standard participants, renters, and new movers may reveal opportunities to modify the program design and increase impacts.
6. **Further education may help participants better understand the rate structure and help them better adjust their behaviors to concentrate load shifting away from the On-Peak periods.**

1. Introduction

On August 7, 2018, under docket numbers E-002/M-17-775 and E-002/M-17-776,[16] the Minnesota Public Utilities Commission (MPUC) issued an Order approving Xcel Energy Minnesota's (Xcel Energy's) time-of-use (TOU) pilot along with the applicable tariff fully spelled out in Xcel Energy's Rate Book.[17]

Xcel developed the pilot under evaluation with the goals of:

- Sending adequate price signals to customers to encourage them to reduce peak demand (via a set of TOU prices, the highest of which are observed on non-holiday weekdays from 3 p.m. to 8 p.m. in June through September[18])
- Identifying effective customer engagement strategies
- Understanding customer impacts by segment (see segment definitions in Section 1.4)
- Supporting Xcel Energy's demand response goals

As part of its Order, the MPUC required Xcel Energy to file both a mid-point report (after the pilot had been in the field for approximately 15 months) and a final report (after the pilot had been in the field for approximately 27 months).[19] Results from the mid-point analysis are available in the "interim" report, completed in February 2022 by Guidehouse. [20]

This document is the final report, which provides:

- **Impact Evaluation:** An evaluation of the pilot's impacts on average participant demand and bills during the period from November 1, 2020, through September 30, 2022, using advanced metering infrastructure (AMI) data collected from a group of participants and non-participating control customers. This report provides more detail on impacts for the second year of the pilot (October 1, 2021 through September 30, 2022); detailed impacts for the first year of the pilot were included in the interim report.
- **Customer Experience Evaluation:** An analysis of data obtained from participant surveys to understand participant satisfaction, preferences, attitudes, acceptance, and comprehension

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[16] Minnesota Public Utilities Commission, *ORDER APPROVING PILOT PROGRAM, SETTING REPORTING REQUIREMENTS, AND DENYING CLARIFICATION REQUEST*, Issue Date: August 7, 2018, Docket No. E-002/M-17-775 and Docket No. E-002/M-17-776,
https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={103F1565-0000-C21D-B43D-24C097C567A3}&documentTitle=20188-145582-01.

[17] PDF Page 8 of 203,
Xcel Energy, *Electric Rate Book – Section 5 – Rate Schedules*, Date Filed: December 14, 2019,
https://www.xcelenergy.com/staticfiles/xe-responsive/Company/Rates%20&%20Regulations/Me_Section_5.pdf.

[18] The complete schedule of TOU charges to which participants are subject may be found in Section 1.3.

[19] Interim and final reporting periods of analysis were defined by the delayed start date of the pilot and the regulatory filing deadlines for reporting of Feb 28, 2022 and Feb 1, 2023, respectively.

[20] Xcel Energy, *Compliance Filing: Residential Time of Use Rate Design* Pilot, Date Filed: February 25, 2022, Docket No. E-002/M-17-775,
https://efiling.web.commerce.state.mn.us/edockets/searchDocuments.do?method=showPoup&documentId={D0CA327F-0000-C130-B92D-0CF55C38B2F4}&documentTitle=20222-183193-02.
See Attachment C: *Xcel Energy Minnesota Time-of-Use Pilot Evaluation – Interim Report*.

related to the TOU pilot. Findings may be used to assist in understanding the drivers of active customer participation and responsiveness to TOU prices.

This report is divided into five sections:

1. **Introduction.** This section provides an overview of the pilot participants, the prices to which they have been subject, pilot attrition via opt-outs, and pilot participant turnover due to move-outs.[21]
2. **Evaluation Approach.** This section provides an overview of the approach used to estimate impacts and conduct the survey analysis. A high-level description of the quantitative approach used to estimate impacts is provided in the report body, with more detail of Guidehouse's econometric approach in Appendix A.
3. **Impact Findings.** This section presents the estimated demand impacts by TOU period, at the time of Xcel Energy's system peak (coincident peak demand impacts), as well as a set of average estimated participant bill impacts reflective of TOU period demand impacts. Estimated demand impacts by TOU period for new move-ins and "high-impact" participants—those whose survey responses indicated a high degree of engagement—are also included in this section.
4. **Customer Experience Findings.** This section summarizes findings on customers' experience with the pilot, including changes in energy-related attitudes and behaviors, understanding of the pilot, and overall satisfaction. Guidehouse assessed overall customer experience as well as differences by study area and demographics when applicable.
5. **Review and Recommendations.** This section reiterates key findings from the evaluation of the TOU pilot and lays out recommendations for Xcel Energy to consider as part of any wider deployment of TOU rates in its Minnesota service territory.

The remainder of this introductory section includes the following subsections:

- **Commission Required Metrics.** A summary of the interim and final reporting metrics required in the MPUC Order approving the TOU pilot, accompanied by a mapping of the required metric's location in the report.

- **Pilot Geography and Timeline.** A summary of pilot geographies and the timeline for planning, implementation, and evaluation of the pilot.

- **Pilot Pricing.** A summary of the pilot and Standard rates to which customers are exposed.

- **Enrollment and Segmentation.** A discussion of the segmentation applied for this pilot evaluation.

- **Opt-Outs and Move-Outs.** Quantitative metrics related to participant opt-outs and move-outs.

[21] One element that distinguishes this pilot from many other TOU pilots is that participation is tied to a premise rather than an individual—when a customer occupying a premise subject to TOU moves out, the next customer to occupy that premise becomes subject to the TOU rate. See Section 1.5 for more details.

1.1 Commission Required Metrics

As part of its Order approving Xcel Energy's Residential TOU Rate Pilot, the MPUC identified that interim and final reporting must include a specific set of metrics. In Table 1-1, each of the itemized metrics from the Order is listed, along with its location and some clarifying or explanatory notes. Unless explicitly noted otherwise, all locations listed refer to sections of this report.

Table 1-1: MPUC Reporting Metrics Map

MPUC Metric	Location	Notes
Participant metrics, including the number of customers who have opted out of the TOU rate.	Section 1.5.1	In addition to opt-outs (in the section identified at left), move-outs, average demand values, and the number of customers included in the analysis may be found in Sections 1.5.2 and 2.1.2.
Customer bill impacts	Section 3.6	The average impacts on participants' bills from behavior changes due to the TOU rate as well as the average overall impact (including both behavioral and structural elements) on participants' bills of converting to the TOU rate are provided.
Customer satisfaction indicators including: i. Quantification of the relative impacts of the TOU rate on customers' bills compared to the current residential rate. ii. Identification of groups that are disproportionally impacted either positively or negatively.	Section 3.6.2	The average net bill impacts presented in this section compare the average participant bill under TOU with what it would have been under the Standard rate and estimated baseline consumption patterns. Segment-specific net bill impacts are also presented.

MPUC Metric	Location	Notes
Total peak demand savings achieved by participating customers, and incremental load curve data at an hourly or sub-hourly level by: i. Assessing how various groups within the Residential class change their consumption behavior during peak times in response to the proposed [piloted] rate structure. ii. Analyzing how certain household characteristics impact responsiveness to peak price signals.	Sections 3.1, 3.4, and 3.5	Estimated average demand impacts by TOU period are presented by geography and segment, as are estimated coincident peak demand impacts and average annual energy impacts.
Track customers who self-identify as LIHEAP eligible separately from customers who are LIHEAP recipients, and preserve the data for analysis;	These data have been shared with Xcel Energy for when they are required.	Two files have been provided to Xcel Energy by Guidehouse: • “Xcel MN Task B – Hourly AMI Data.xlsx” • “Xcel MN Task B – LIHEAP - Data Dictionary.xlsx” The first of these files includes hourly average demand values for participants who responded to a survey, indicated through their survey responses that their family income would qualify them for LIHEAP assistance, and were not included in the list of LIHEAP customers provided by Xcel Energy to the evaluation team.
Customer satisfaction engagement by: i. Measuring and tracking customer satisfaction, preferences, attitudes, acceptance, and comprehension; and ii. Understanding drivers for active customer participation.	Sections 4.2, 4.3, 4.4 and 4.5	Survey data are used to measure and track the evolution of survey respondents’ satisfaction with the pilot over time, their understanding of the pilot and their bills, and self-reported changes in energy usage behavior that they used to drive active participation in the pilot.

MPUC Metric	Location	Notes
Energy usage changes by: i. Measuring how various customer groups within the Residential class change their overall consumption patterns in response to the proposed rate structure; and ii. Determining how consumption changes during off-peak (high renewable hours).	Sections 3.1, 3.4, and 3.5	Estimated average demand impacts by TOU period are presented by geography and segment, as are estimated coincident peak demand impacts and average annual energy impacts, including those in Off-Peak hours.

Source: Guidehouse

1.2 Pilot Geography and Timeline

AMI deployment was required to support the pilot. AMI meters were deployed in two geographic areas to be included in the pilot: the area served by the Hiawatha West/Midtown substation in Minneapolis, and the area served by the Westgate substation in Eden Prairie, a suburb approximately 12 miles southwest of downtown Minneapolis.

For the purposes of this evaluation, these two areas are referred to as “Minneapolis” and “Eden Prairie,” respectively. The approximate location of participants in the Eden Prairie area is shown in Figure 1-1, and the approximate location of participants in Minneapolis is shown in Figure 1-2.

Figure 1-1. Participant Locations - Eden Prairie

Source: Guidehouse analysis

Figure 1-2. Participant Locations - Minneapolis

Source: Guidehouse analysis

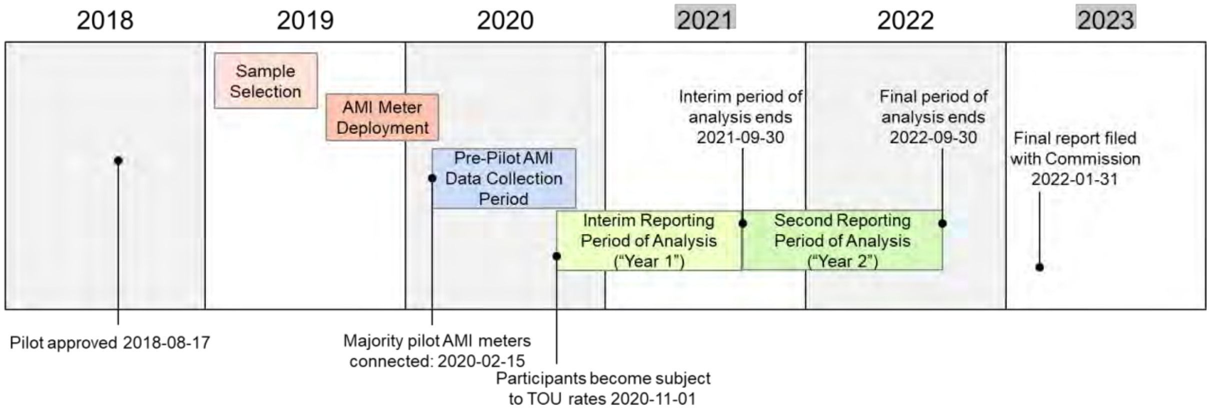
The pilot was formally approved in August 2018. Premises for potential inclusion (i.e., premises where AMI meters were to be deployed) were selected by Xcel Energy in June of 2019. AMI deployment began in October of the same year and was completed by February of 2020. Guidehouse was engaged by Xcel Energy to support the pilot effort at the beginning of 2019. In July 2019, Guidehouse identified which customers should be assigned to the participant group (and opted into the TOU rate) and which should be assigned to the control group.

AMI meters began collecting data from participant and control premises in February 2020, and on November 1, 2020, participants first became subject to TOU prices. The pilot was active for 24 months, beginning November 1, 2020 and ending October 31, 2022. This evaluation covers a period of analysis from November 1, 2020, through September 30, 2022.[22] This evaluation includes the average TOU period response and coincident peak impacts from the first winter and first summer of the pilot, and detailed impacts from the second winter and second summer of the pilot. The interim report includes more comprehensive results covering the first year of the pilot, from November 1, 2020 through September 30, 2021.[23] While the evaluation period covers 23 months, the two periods of analysis – November 1, 2020 through September 30, 2021 (addressed in the interim report), and October 1, 2021 through September 30, 2022 – are referred to as "year 1" and "year 2" throughout this report. The pilot timeline is summarized in Figure 1-3.

[22] The analysis period ends one month prior to the pilot end date to allow sufficient time to conduct the analysis based on the report filing schedule.

[23] Xcel Energy, *Compliance Filing: Residential Time of Use Rate Design* Pilot, Date Filed: February 25, 2022, Docket No. E-002/M-17-775, **https://efiling.web.commerce.state.mn.us/edockets/searchDocuments.do?method=showPoup&documentId={D0CA327F-0000-C130-B92D-0CF55C38B2F4}&documentTitle=20222-183193-02**.
See Attachment C: *Xcel Energy Minnesota Time-of-Use Pilot Evaluation – Interim Report*.

Figure 1-3. Pilot and Evaluation Timeline



Source: Guidehouse analysis

1.3 Pilot Pricing

All participants enrolled in the pilot were drawn from customers currently subject to the residential Standard rate, including A01 - overhead connections, and A03 - underground connections.

The status quo Standard rate is a flat rate that varies by season[24] with an unvarying energy charge, as shown in Table 1-2. Beginning January 1, 2019, an 8.92% Interim Rate Surcharge was applied to the energy charge shown in the table below.

Table 1-2. Standard (Status Quo) Rate Energy Charge

Season	Months	Energy Charge ($/kWh)
Summer	June through September	$0.10301
Winter	October through May	$0.08803

Source: Xcel Energy, Electric Rate Book

For the purposes of this pilot, the principal difference between customers with overhead and underground connections is the monthly customer charge: A01 (Overhead) customers pay $8 per month, and A03 (Underground) customers pay $10 per month. The split of participants included in the analysis by these two groupings is provided in Table 1-3.

Table 1-3. Distribution of Participants by Rate Group

Rate Group	Eden Prairie	Minneapolis
A01 - Overhead	25%	95%
A03 - Underground	75%	5%

Source: Guidehouse analysis

[24] Xcel Energy, *Electric Rate Book – Section 5 – Rate Schedules*, Date Filed: December 14, 2019, **https://www.xcelenergy.com/staticfiles/xe-responsive/Company/Rates%20&%20Regulations/Me_Section_5.pdf.**

The piloted TOU rate includes three periods across two seasons, exposing participants to six different energy charges. The timing of these periods, the energy charges applied, and the ratio of these charges to the seasonal Off-Peak price as well as the Standard seasonal energy charge (i.e., those shown in Table 1-2) are shown in Table 1-4. The On-Peak energy charge is slightly more than twice the Standard energy charge, the Mid-Peak energy charge is nearly the same as the Standard charge, and the Off-Peak energy charge is approximately one-third of the Standard charge. Beginning January 1, 2019, an 8.92% Interim Rate Surcharge was applied to the energy charge shown in the table below.

Table 1-4. Residential TOU Rate Energy Charges and Ratios

Season	Months	Period Name	Non-Holiday Weekday Times	Weekend and Holiday Times	Energy Charge ($/kWh)	Ratio of Charge to Seasonal Off-Peak	Ratio of Charge to Standard Charge
Summer	June through September	On-Peak	3pm - 8pm	N/A	$0.22576	8.1	2.2
		Mid-Peak	6am - 3pm, 8pm - Midnight	6am - Midnight	$0.09013	3.2	0.9
		Off-Peak	Midnight - 6am	Midnight - 6am	$0.02784	1.0	0.3
Winter	October through May	On-Peak	3pm - 8pm	N/A	$0.19266	6.9	2.2
		Mid-Peak	6am - 3pm, 8pm - Midnight	6am - Midnight	$0.07515	2.7	0.9
		Off-Peak	Midnight - 6am	Midnight - 6am	$0.02784	1.0	0.3

Source: Guidehouse analysis

Participants subject to the TOU rate remain subject to the same customer charge (based on whether they are Overhead or Underground distribution customers) as under the Standard rate.

As per the Xcel Energy rate book, participants in the pilot are provided with some bill protection. Any pilot program billing charges in excess of 10% of the corresponding charge that would have been applied had the customer not been a program participant is credited to the customer's account. The Xcel Energy rate book indicates that bill protection is only provided for customers who have been participants at the same location for the first 12 months of the program and that no bill protection will be available after the first 12 months of program participation. Customers that receive LIHEAP assistance are eligible for additional bill protection.

1.4 Enrollment and Segmentation

This section of Section 1 is divided into two subsections and reports on (1) the enrollment strategy used to populate the pilot participant and control group sample and (2) the methods used by Guidehouse to assign all of the eligible customers to the relevant segments.

1.4.1 Enrollment Approach

Xcel Energy adopted an opt-out enrollment approach for this pilot. There are typically two approaches to pilot enrollment for time-varied pricing adopted by North American utilities: opt-in and opt-out enrollment. Opt-in enrollment is purely voluntary, while opt-out enrollment involves participants and control customers being assigned to their respective groups by the utility or its contractor. Participants may choose to exit the program (i.e., opt-out), but non-participating customers cannot volunteer to enroll.

The enrollment approaches typically yield different results. A meta-analysis of a set of TOU pilots conducted by the U.S. Department of Energy (DOE) in 2016[25] concluded that opt-out TOU enrollment was typically less costly than opt-in enrollment, though it tended to yield considerably smaller impacts per customer. However, the ability of an opt-out enrollment design to acquire a much larger number of customers was found to compensate for smaller per-customer impacts in aggregate yielding larger total impacts. Further, the DOE reported that opt-out enrollment programs do not tend to experience significantly higher opt-out rates than voluntary (opt-in) enrollment programs. A more recent meta-analysis of TOU pilots conducted in Ontario, Canada,[26] reported similar findings.

One benefit of an opt-out design (from an evaluation perspective) is that it allows for a true experimental design (as in the case of this Xcel Energy pilot). That is, it allows for the creation of a randomized control trial (RCT), generally regarded as the gold standard approach to evaluating the impacts of experimental behavioral treatments because of the elimination of selection bias.

Altogether, approximately 10,000 customers were enrolled as participants, and 7,500 customers were enrolled as control customers. These customers were all drawn from a pool of approximately 20,000 customers located in the service area of the two substations of interest. This larger pool was surveyed to identify segmentation, after which a stratified random assignment, based on the evaluation segmentation needs, was used to allocate the participant and control customer groups. AMI was then deployed to the identified participants and control customers.

1.4.2 Segmentation

A key goal for the pilot was to understand how different segments of the population respond to TOU rates. As part of the pilot development, Guidehouse assisted Xcel Energy with segmenting pilot participants and controls. The purpose of this segmentation was to identify participant and control customer segments to allow for segment-specific demand and bill impacts to be estimated for these groups. This segmentation ensured that the distribution of segments across the participant and control groups was approximately balanced (e.g., to ensure that seniors are approximately the same proportion of participants as they are of control customers).

Segmentation was performed using pre-pilot survey data for the pool of 20,000 customers[27] identified above, rental property license data, and a machine learning technique known as Support Vector Machines (SVM). The SVM algorithm was used to make probabilistic segment assignments based on the data in hand to assign each customer included in the study to some - or none - of the segments. The details of the segmentation approach are described in Appendix

[25] U.S. Department of Energy, Electricity Delivery & Energy Reliability, *American Recovery and Reinvestment Act of 2009: Customer Acceptance, Retention, and Response to Time-Based Rates from the Consumer Behavior Studies*, Smart Grid Investment Program, November 2016,
https://www.energy.gov/sites/prod/files/2016/12/f34/CBS_Final_Program_Impact_Report_Draft_20161101_0.pdf.

[26] Guidehouse, prepared for the Ontario Energy Board, *Regulated Price Plan Pilot Meta-Analysis – Final Report*, December 2020,
https://www.oeb.ca/sites/default/files/report-RPP-Pilot-Meta-Analysis-20211110.pdf.

[27] Twenty-two percent of the 20,000 surveyed customers responded to surveys.

X1 of the interim report, a memorandum first submitted to Xcel Energy in July of 2019. The evaluation team updated the estimated segment assignments with each customer survey fielded.

Xcel Energy defined five segments:

- Electric Vehicles
- Low Income
- Renters
- Seniors
- Smart Thermostat (owners)

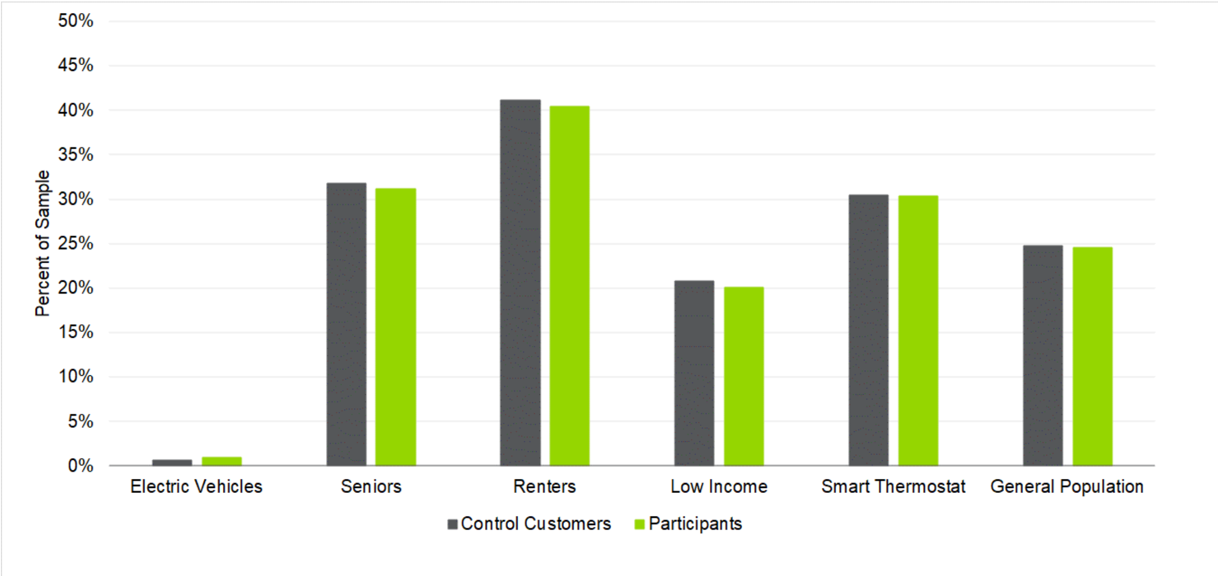
A customer could belong to more than one of these segments. Customers belonging to none of these segments are referred to as belonging to the general population segment. Customers belonging to the low income segment were assigned to that segment if: their survey responses indicated that they were eligible for LIHEAP, Xcel Energy's data indicated they were participating in LIHEAP, or they were assigned to that segment based on the SVM machine learning algorithm described above (prior to the pilot).

For electric vehicle owners, Guidehouse chose to not use the segmentation assigned by the SVM algorithm and assigned this segment to only those participants and controls who explicitly identified on a survey that they had an electric vehicle. For all other segments, Guidehouse used the SVM defined assignments for each premise and updated them using survey responses, if applicable. Additional detail on survey-based updates to segmentation assignments is described in Appendix B.

Figure 1-4 compares the distribution of participants and control customers across the segments.[28] The grey bar and the green bar indicate the percentage of control customers and participants assigned to a given segment following a series of updates based on survey data collected during the pilot. The distribution represents participants and controls included in the impact estimation, so it excludes some customers dropped from the analysis due to issues of incomplete or outlier data. Altogether, the impact analysis included the data for 9,024 participants and 6,959 control customers. An individual participant may be assigned to multiple segments, so the total of the percentage values presented exceed 100%. Figure B-4 in Appendix B provides the distribution of unique segment combinations.

[28] For Electric Vehicle participants, only those participants and controls who explicitly identified that they had an EV were assigned to this segment. This more restrictive approach was used for this segment given the limited market penetration of EVs.

Figure 1-4. Distribution of Participants and Controls by Segment



Source: Guidehouse analysis

1.5 Opt-Outs and Move-Outs

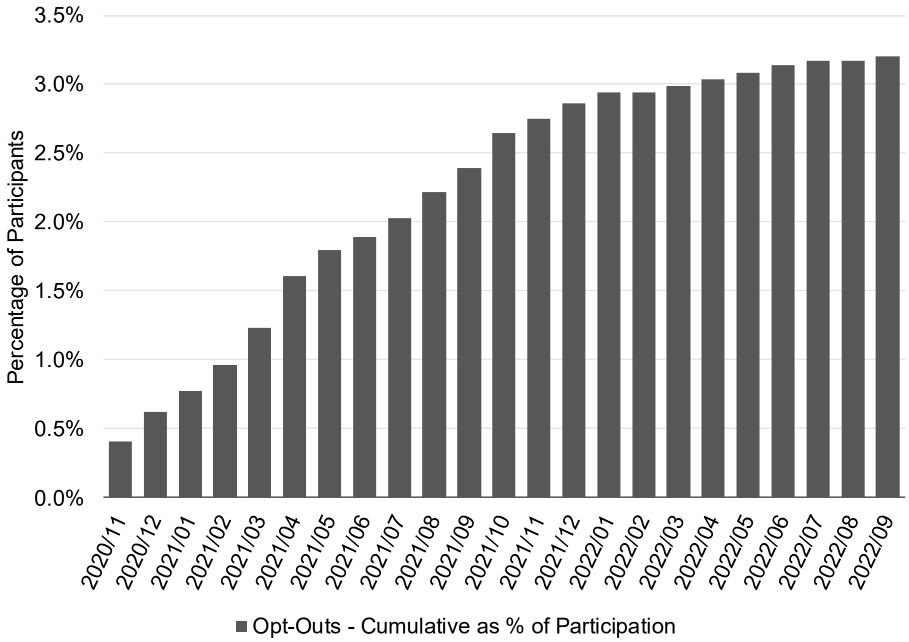
Evaluations of TOU pilots and programs typically tie impacts to customers rather than premises. Attrition statistics usually include both participants who have opted out and those who have moved out. The Xcel Energy Minnesota pilot differs from the norm in this respect: the TOU rate is tied to the premise and not the customer. Thus, when a customer moves out of their premise without also opting out of the piloted rate, the next customer to occupy that premise will be subject to the TOU rate. This is a design choice driven primarily by the fact that the AMI network in place has been installed specifically to enable this pilot and to help Xcel Energy identify (in its planning) to what degree customer turnover might impact TOU response in a wider rollout of a default (opt-out) TOU rate. As part of the impact analysis, the evaluation team conducted an additional analysis for premises with new move-in customers. The findings are summarized in Section 3.1.2, with details in Appendix X1 of this report.

The evaluation team has tracked opt-outs and move-outs separately. This section is divided into two subsections addressing both factors. As in the discussion of segmentation, the figures below present only those participants included in the analysis (both in the numerator and the denominator of the percentages presented), so they exclude some participants dropped from the analysis due to issues of incomplete or outlier data.

1.5.1 Opt-Outs

Attrition in the TOU pilot has been modest. After 23 months of the pilot (from November 1, 2020, through September 30, 2022), slightly more than 3% of participants had opted out. Figure 1-5 below shows cumulative opt-outs as a percentage of total participants included in the impact analysis over the period in which pilot prices have been in effect.

Figure 1-5. Cumulative Opt-Outs as a Percentage of Participants



Source: Guidehouse analysis

The rate of opt-outs in this pilot is modest compared to those reported by a meta-analysis conducted by the U.S. Department of Energy[29] (DOE). That meta-analysis found that retention rates in year one of opt-out pilots ranged from 62% to approximately 99%, with an average retention rate around 90% (see Figure 3a of the DOE meta-analysis). Additionally, an Ontario meta-analysis showed typically higher levels of participant opt-outs, with year one pilot opt-outs between 6% and 10% once move-out attrition was accounted for (for pilots where this was tracked).[30]

Observed year two retention rates ranged from approximately 77% to 99% in the DOE meta-analysis, with an average slightly above 90%. This implies an average overall retention rate since pilot launch of approximately 80%.[31] With fewer than 4% of TOU pilots opting out during the two years of the pilot, Xcel Energy's pilot is experiencing lower opt-out rates than is typical.

[29] U.S. Department of Energy, Electricity Delivery & Energy Reliability, *American Recovery and Reinvestment Act of 2009: Customer Acceptance, Retention, and Response to Time-Based Rates from the Consumer Behavior Studies*, Smart Grid Investment Program, November 2016, **https://www.energy.gov/sites/prod/files/2016/12/f34/CBS_Final_Program_Impact_Report_Draft_20161101_0.pdf.**

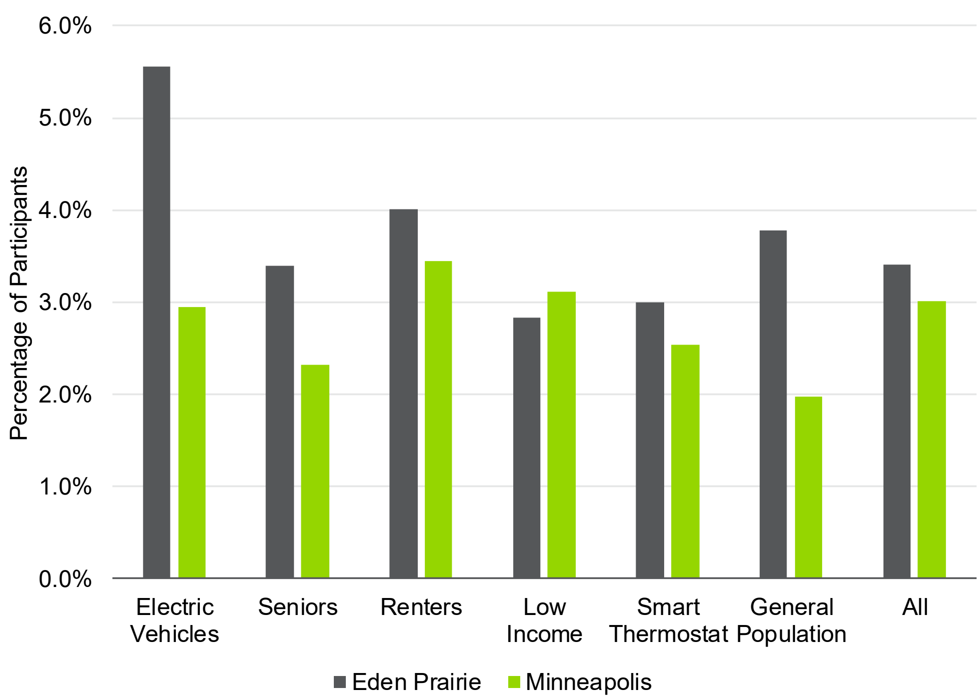
[30] Guidehouse, prepared for the Ontario Energy Board, *Regulated Price Plan Pilot Meta-Analysis – Final Report*, December 2020, **https://www.oeb.ca/sites/default/files/report-RPP-Pilot-Meta-Analysis-20211110.pdf.**
Details of opt-out versus move-out attrition may be found in the *Output Data Sheets* for this report, found here: **https://www.oeb.ca/sites/default/files/report-RPP-Output-Data-Sheets-20211110.pdf.**

[31] The overall retention rate is calculated as the product of the year 1 and year 2 retention rate (e.g., 0.90 x 0.90 = 0.81).

However, the DOE meta-analysis likely reflects customer move-outs in addition to opt-outs. As discussed in the following section, our analysis includes premises where customers have moved out (and a new customer has moved in). Accounting for move-outs, the overall retention rate for the Xcel Energy TOU pilot is approximately 74%.

Figure 1-6 shows opt-outs as a percentage of each segment in each study area. Each column shows the number of opt-outs over the period of analysis by segment and study areas a percentage of the participants in that segment. With the exception of EV owners, no obvious segment-driven pattern is apparent. However, there is slight variation by study area, with a slightly higher proportion of Eden Prairie (3.4%) participants appearing to have opted out as compared to Minneapolis (3.0%). Note that the number of EV owners participating in the pilot is very small, and so the number of EV owners who opted out of the pilot is even smaller (3 in Eden Prairie, 1 in Minneapolis).

Figure 1-6. Opt-Outs by Study Area and Segment



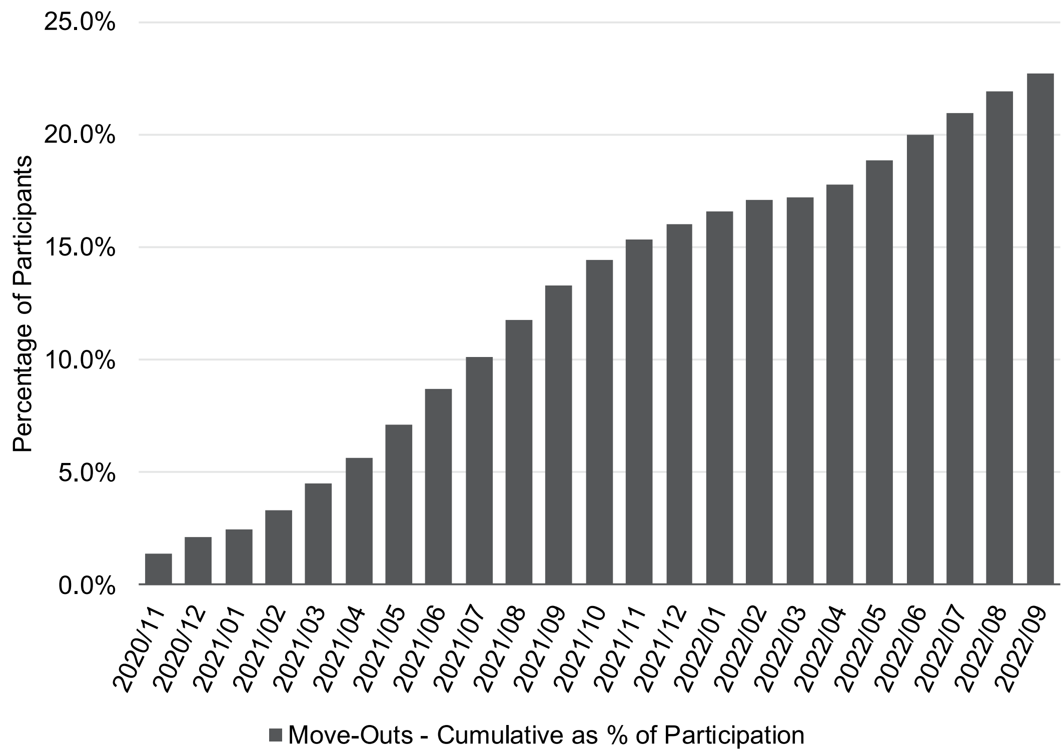
Source: Guidehouse analysis

1.5.2 Move-Outs

In most TOU impact evaluations, move-outs and opt-outs would be grouped together as “attrition” and excluded from the analysis in those periods after they opted or moved out. However, in this evaluation, the individual unit of analysis is the premise, so move-outs are not considered part of program attrition, though Guidehouse has tracked move-outs to aid the interpretation of the estimated impacts presented in Section 3.

Figure 1-7 presents cumulative move-outs as a percentage of the participants included in the impact analysis. Only the first move-out is counted in this figure: if a customer moves out of a participating premise in January, and a new customer moves in the next month and then moves out again in April, this is only counted as a single “move-out” for the purpose of developing the figure below. Appendix A.3 contains additional information on premises with turnover, including the average number of occupancy changes per premise and length of occupancy per customer.

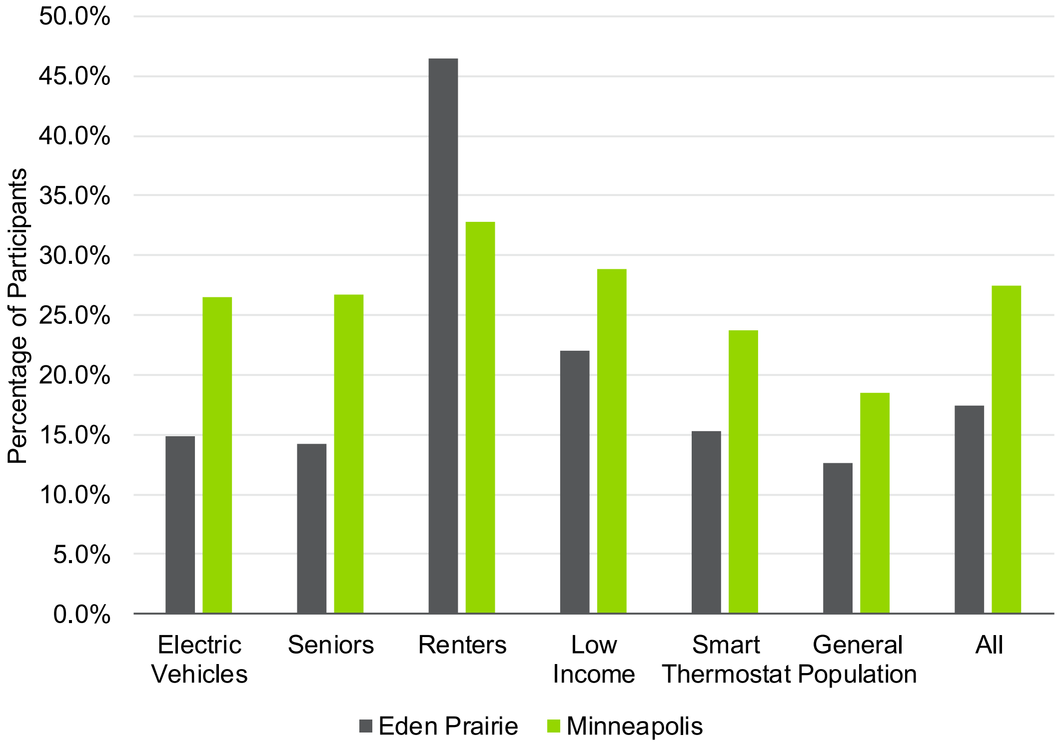
Figure 1-7. Cumulative Move-Outs as a Percentage of Participants



Source: Guidehouse analysis

The move-out rate is relatively high compared with those observed in other similar evaluations, although this appears to be driven in large part by renters (as seen in Figure 1-8). In general, residential customers in Eden Prairie appear less likely to move than those in Minneapolis, likely driven by the fact that a very high percentage of Minneapolis participants (35%) are renters as compared to Eden Prairie (3%).

Figure 1-8. Move-Outs by Study Area and Segment



Source: Guidehouse analysis

2. Evaluation Approach

This section describes the approaches used by the Guidehouse evaluation team to estimate the pilot's impacts and to collect and analyze the survey data used for the customer experience analysis. It is divided into two sections:

- Impact Approach
- Customer Experience Approach

2.1 Impact Approach

The core outputs of the impact evaluation – estimated TOU period demand impacts, coincident peak demand impacts, and average participant bill impacts – are all derived from the results of a series of regression analyses. The manner in which these regressions were estimated, and the robustness of the results, are tied directly to the input data used in the Guidehouse evaluation. Understanding how these data were collected (i.e., the experimental design applied) and used to estimate impacts is a vital contextual component for interpreting the results of the analysis.

This section of Section 2 is divided into six subsections:

- Experimental Design
- Data
- Demand Impact Estimation Approach
- Bill Impact Calculations
- DSM Analysis
- The Effects of COVID-19 on TOU Impacts

2.1.1 Experimental Design

The Uniform Methods Project[32] notes, *"The optimal evaluation scenario for a consumption data analysis is a randomized control trial (RCT) experimental design."* An RCT is an experimental design in which a sample drawn from a known population is randomly assigned to various treatment groups (usually a treatment group and a control group). This ensures that the expected value of the treatment effect is equal to the true value in the population from which the sample is drawn.

Put more simply, the key reason that an RCT is the gold standard of evaluation designs is that when deployed correctly, it effectively eliminates any question of selection bias in the estimated impacts. "Selection bias" refers to the phenomenon whereby impacts may be attributed to a program (treatment effect) that are due to some other unobserved factor that is common in the participant sample but not the control group. More formally, selection bias is bias in the

[32] National Renewable Energy Laboratory, *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures – Section 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol*, April 2013,
https://www1.eere.energy.gov/wip/pdfs/53827-8.pdf.

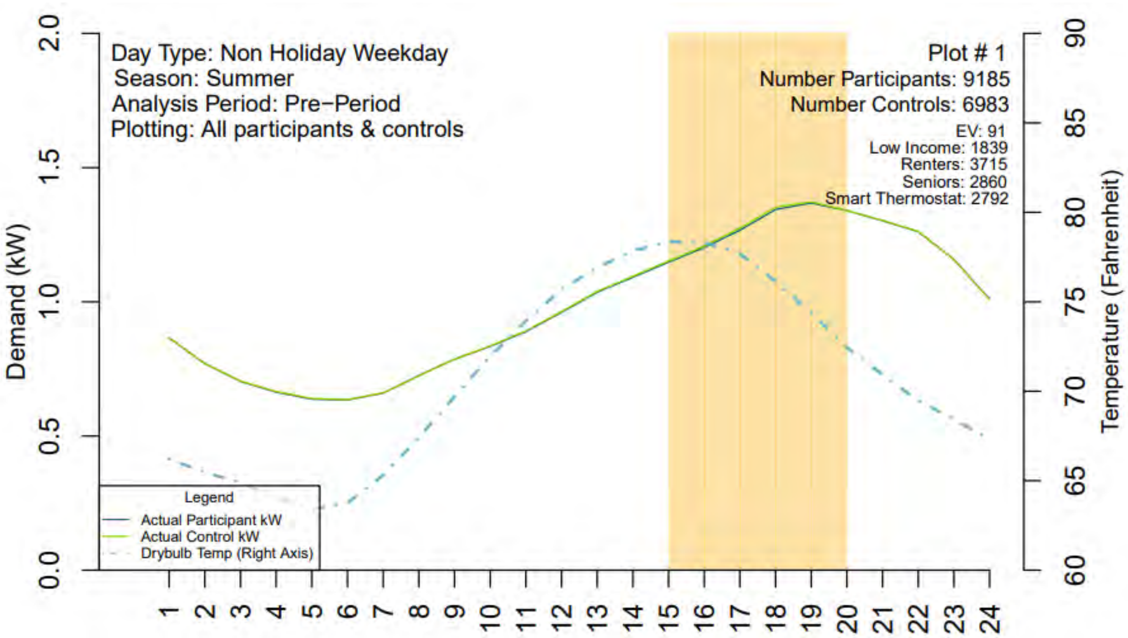
estimated parameters of interest driven by correlations between the variable associated with the parameter of interest and some other unobserved covariate.

When RCT assignments are made (i.e., putting customers into the participant or control groups), some form of stratification or segmentation is typically applied to ensure balance across the segments of most interest. However, with a sufficiently large sample size, simple random assignment should deliver a balanced participant and control group without additional interventions, in most cases. For this pilot, Guidehouse supported the RCT assignment and segmentation. The approach to segmentation is described in both Section 1.4.2 and (in more detail) in Appendix X1 of the interim report, a memorandum first submitted to Xcel Energy in July 2019.

The validity of a random assignment can be assessed at a high level with a few basic checks: for example, by comparing the distribution of participants and control customers by segments (as in Figure 1-4 of Section 1.4.2) or by comparing the load profiles of the two groups in the pre-pilot period, as in Figure 2-1 (Summer) and Figure 2-2 (Winter). These two figures show average participant (blue line, left axis) and control customer (green line, left axis) demand on non-holiday weekdays in summer and winter, respectively. The dot-dashed light blue line presents the average hourly temperature (right axis), and the transparent vertical green bars identify the On-Peak TOU period.

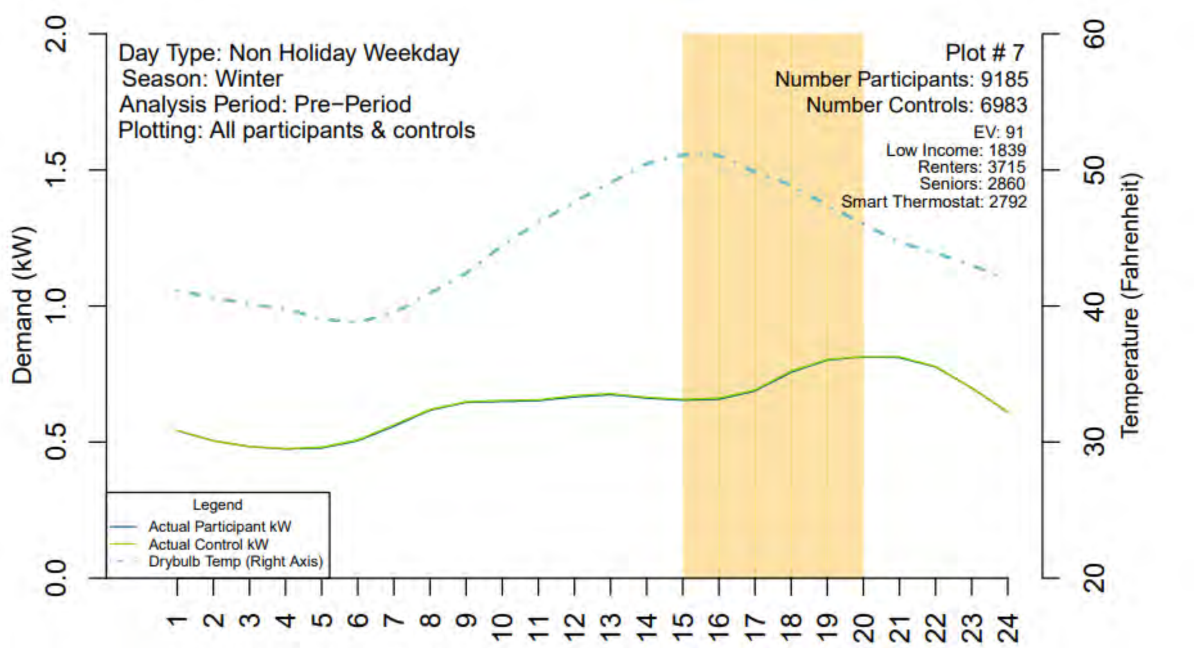
The full set of these load profile figures (including figures by segment, study area, weekend and weekday, season, pre-TOU period, and TOU pilot period) may be found in Appendix X2 under a separate cover. In Figure 2-1, pre-period load profiles are nearly identical and overlapping: the blue line (representing participant demand) is being covered by the very similar control group (green line) profile.

Figure 2-1. Pre-Period Load Profile Comparison - Summer



Source: Guidehouse analysis

Figure 2-2. Pre-Period Load Profile Comparison - Winter



Source: Guidehouse analysis

Figure 2-1 and Figure 2-2 show that participant and control customer average load profiles in the pre-period are nearly identical. While this result certainly increases the confidence in the random allocation of customers to the participant and control groups, it should be noted that an exact match is not essential to deliver a robust estimate of impacts because of the use of a lagged dependent variable (LDV) regression approach.

As described in Section 2.1.3, the use of the LDV approach (a special case of a difference-in-differences, or DID, estimator) means that robust estimates of program impacts can still be obtained even if pre-period load profiles do not align. It is the difference in changes that matters most. For example, if the average participant demand from 3 p.m.-8 p.m. is higher than average control group demand from 3 p.m.-8 p.m. in the pre-TOU period, but participant demand from 3 p.m.-8 p.m. becomes the same as control group demand from 3 p.m.-8 p.m. during the pilot period, this is evidence of a relative reduction in participant demand during the On-Peak period.

2.1.2 Data

The core datasets used in estimating the TOU pilot impacts are:

- **Customer Cross-Sectional Data:** Data defining which premises are participants and controls and identifying each premise's segment.
- **Customer LIHEAP Data:** Data defining all participant and control premises that have received LIHEAP assistance during the pre-pilot period or pilot period.
- **Customer AMI Data:** High frequency observations of customer energy consumption.

- **Customer Opt-Out and Move-Out Data:** Monthly reports identifying premises that have opted out of the pilot or premises where the customer has moved.
- **DSM Program Tracking Data:** Premise level DSM program tracking data.
- **Weather Data:** Hourly weather data.

The impact analysis also leveraged data from the customer experience research, as described in Section 2.2.

2.1.2.1 Customer Cross-Sectional Data

Customer cross-sectional data identifying participants and controls and segment information was originally developed by Guidehouse as part of the development of the experimental design and the allocation of customers to participant and control groups. This information is described in Appendix X1 of the interim report, a memorandum first submitted to Xcel Energy in July 2019 and attached to the interim evaluation report. Customer cross-sectional data identified 10,000 participants and 7,500 control customers.

2.1.2.2 Customer LIHEAP Data

Customer data identifying participant and control premises and their enrollment status in LIHEAP. LIHEAP data were provided twice – once before the interim report in January 2021, and once after the end of the pilot in October 2022. The data contained records for over 99% of customers included in the impact analysis, along with a variable indicating whether the customer received LIHEAP assistance. For premises with multiple LIHEAP recipient statuses, Guidehouse used the latest entry to reflect recipient status at the end of the pilot.

2.1.2.3 Customer AMI Data

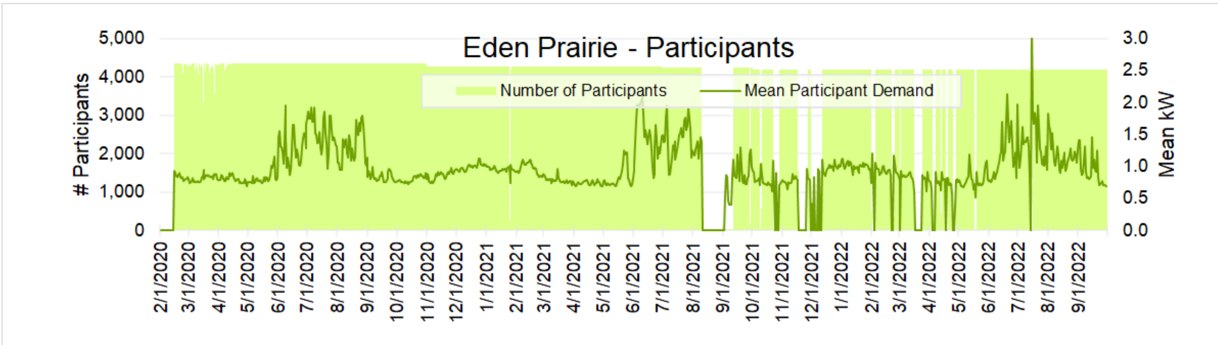
Customer AMI data were provided directly to Guidehouse via an automated daily process. AMI data are of 5-minute frequency and provided for 30,385 unique premises in calendar years 2020, 2021, and 2022. When the AMI data are combined with cross-sectional data and only participants and control customers with AMI data are retained, 9,250 participants and 7,023 control customers remain. After removing premises that are missing data for more than half of the pre-pilot period and premises without any observations during the period in which participants were subject to the TOU rate, the final sample that remains is 9,024 participants and 6,959 control customers.

Guidehouse aggregated the 5-minute frequency observations to an hourly frequency (average demand by hour and customer) to develop the load profiles and averaged these values by day and TOU period to obtain the data included in the regression analysis.

Intermittent data transfer interruptions, particularly in late summer and early fall of 2021, resulted in AMI data being incomplete or entirely missing for some periods. Between the interim report and final report some, but not all of these data gaps were filled. Impacts for year one of the pilot reflect results estimated using the most complete version of the data. As a result, impact estimates included in the interim report may differ slightly from the year one results reported in this final report.

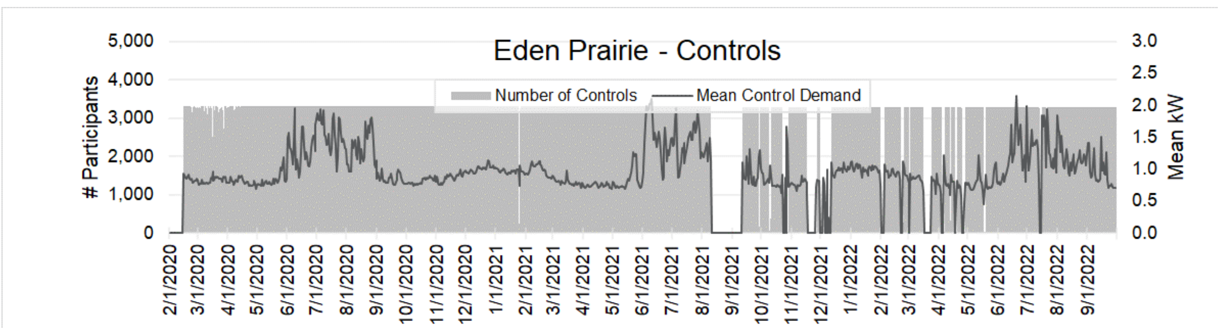
The completeness of the AMI data available for the analysis is summarized in the four figures below. Each figure shows the number of unique premises where data are available on each day of the analysis period and the pre-TOU period as a set of semitransparent green (participant) and grey (control customer) columns, read off the left axis. For additional context regarding the customers' demand, these figures also show average customer daily demand (kW) as a dark grey line, read off the right axis. A separate figure is provided for participants and control customers for each of the two study areas.

Figure 2-3. Data Completeness – Eden Prairie - Participants



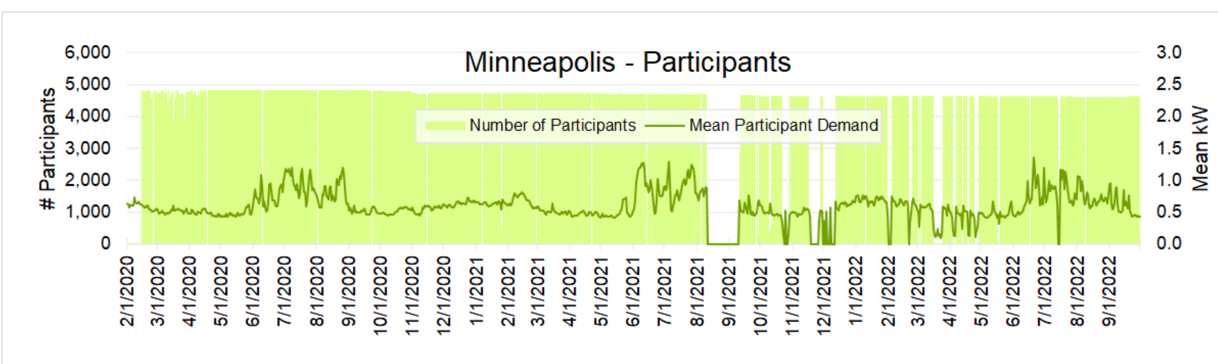
Source: Guidehouse analysis

Figure 2-4. Data Completeness – Eden Prairie - Controls



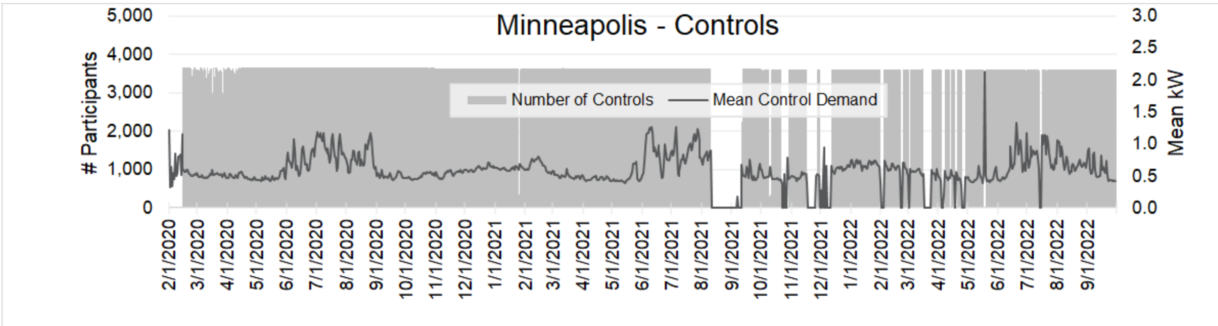
Source: Guidehouse analysis

Figure 2-5. Data Completeness – Minneapolis - Participants



Source: Guidehouse analysis

Figure 2-6. Data Completeness – Minneapolis - Controls



Source: Guidehouse analysis

The analysis of this pilot covers 23 months in which participants were exposed to the TOU rate. The two periods of analysis – November 1, 2020 through September 30, 2021, and October 1, 2021 through September 30, 2022 – are referred to as “year 1” and “year 2” throughout this report.

As illustrated in Figure 2-3 through Figure 2-6, data for the first year of the pilot was relatively complete, apart from in late summer. Little to no AMI data were available in the period from August 10, 2021, to September 10, 2021. In the second year of the pilot, several shorter periods were missing all (or almost all) AMI data. These periods include November 18, 2021 through November 25, 2021, and March 17, 2022 through March 24, 2022, among other others. A detailed summary of available AMI data throughout the pre-period and pilot period is included in Appendix X3. Data gaps symmetrically affected the participant and control groups, so the results reflect an unbiased estimate of impacts during the periods for which data were available. Guidehouse expects the data gaps to have little to no impact on the magnitude of the results presented in this report.

2.1.2.4 Customer Opt-Out and Move-Out Data

Customer move-out data were provided by Xcel Energy on a monthly basis. As discussed in section 1.5.1, premises with customer turnover during the pilot period are retained in the analysis.

Opt-out data were provided twice – once before the interim report in November 2021, and once after the end of the period of analysis in October 2022. Combined, this provides a comprehensive list of all opt-outs that occurred during the pilot. Customers who opt-out are included in the analysis up until their opt-out date.

2.1.2.5 DSM Program Tracking Data

DSM program tracking data were provided to Guidehouse by Xcel Energy. The data include premise number, DSM program name, and close date for the application. Application close dates ranged from March 28, 1996, through August 1, 2022.[33] Of the DSM tracking data from

[33] This date range excludes the final two months of the TOU pilot. However, because we analyze these data by comparing TOU participants and control customers, we do not anticipate any bias resulting from the truncated time period.

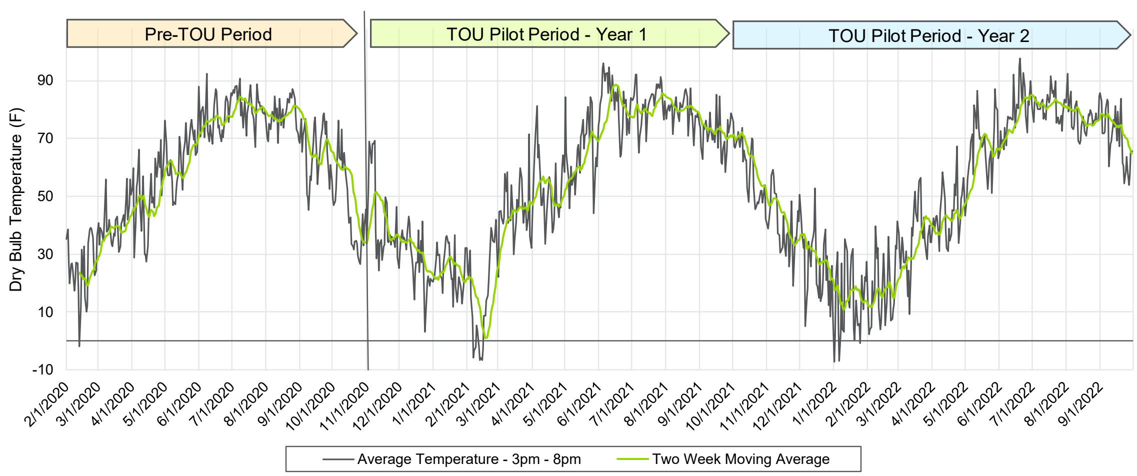
the period of interest (November 2019 through August 2022), 17 unique programs exist in the data, including both gas and electric programs.

2.1.2.6 Weather Data

Guidehouse obtains weather data directly from National Oceanic and Atmospheric Administration (NOAA). For this analysis, Guidehouse used weather data obtained from the Minneapolis-St. Paul International Airport weather station (WBAN: 14922, USAF code: 726580). Gaps in this weather data series were filled in using two nearby weather stations: Flying Cloud Airport (WBAN 94963, USAF code: 726579) and South St. Paul Municipal Airport – Richard E. Fleming Field (WBAN 04974, USAF code: 726603).

Figure 2-7 shows the average daily temperature during the 3 p.m.-8 p.m. period of each day from February 1, 2020, through September 30, 2022. Winter weather in the pilot period was similar across both years, with average temperatures during 2021 and 2022 of 36 degrees Fahrenheit and 35 degrees Fahrenheit, respectively. Summer temperatures were slightly warmer in the first year of the pilot, with an average temperature in 2021 of 74 degrees Fahrenheit compared to 72 degrees Fahrenheit in 2022. During the 2021 system peak hour the average temperature was 92 degrees Fahrenheit, compared to 99 degrees Fahrenheit during the system peak hour in 2022.

Figure 2-7. Average Weather, Pilot and Pre-Pilot Period



Source: Guidehouse analysis

2.1.3 Demand Impact Estimation Approach

This subsection provides a high-level overview of the approach used to estimate TOU period average demand impacts overall and by segment and the coincident peak demand impacts. Technical reviewers can find additional detail, including the algebraic regression model specifications, in Appendix A.

All demand impacts, including those for the new move-in and high-impact analyses, are estimated using an LDV regression analysis. An LDV approach is a special case of a DID estimator. Impacts are estimated by taking the difference between the average *change* in participant demand between the pre-period and the TOU period and the average *change* in control customer demand between the pre-period and the TOU period. This means that factors that affect usage of both participants and controls (e.g., weather, pandemic-related behavioral changes, etc.) are controlled for.

Since the pilot is designed as an RCT, the only systematic difference between the two groups—and the effect that is captured by the regression analysis in the parameters of interest—should be participation in the TOU pilot.

Given geographic (and demographic) distinctions between participants in these two groups, impacts were estimated separately for each study area to better identify the geographic idiosyncrasies of TOU response.

This subsection discusses the approach used to estimate the average demand impact by TOU period, season, study area, and segment and the approach used to estimate the average demand impact at the time of Xcel Energy's system peak demand—the coincident peak demand impact.

2.1.3.1 Average TOU Period Impacts

As indicated above, estimation of average TOU period impacts is implicitly done within a regression framework leveraging three slightly different model specifications and samples of data, discussed below.

- **Core:** The core model is estimated for each study area, season, and year of pilot for a total of eight regressions. The specification (i.e., the equation) is identical for all eight. The core model delivers average TOU period impacts and is used to estimate energy and bill impacts for all pilot participants. Additional detail can be found in Appendix A.1.

- **New Move-In:** The new move-in model is estimated for each study area and season, for a total of four regressions. Both years of the pilot are combined in the model.[34] Only premises occupied by customers who have moved into that premise since the pilot began are included in the estimation set. This model does not explicitly control for differences across segments but does include variables intended to identify whether new move-in TOU response changes over time (i.e., to identify if new move-in TOU response improves the longer a customer is exposed to the TOU rate). The full model specification is defined in Appendix A.3.

- **High-Impact:** The high-impact model is estimated for each study area and season but combines both years of the pilot (2021 and 2022). Only participants and controls that have responded to a survey are included in the estimation set. This model does not explicitly control for differences across segments but does differentiate between participants with survey-identified characteristics hypothesized by the evaluation team to contribute to higher price response, and participants without those survey-identified characteristics. This model delivers average TOU period impacts, as well as energy and bill impacts, of pilot participants identified as high-impact, as discussed in Section 2.1.4 and Appendix A.4.

The panel (or longitudinal) dataset applied to the regression used to estimate average TOU period impacts includes a separate observation of average demand (the dependent variable) for

[34] However, the data are skewed toward later in the pilot period since customers are only included after they moved in.

each unique combination of TOU period, customer, and day. These observations are drawn only from the TOU period (i.e., from November 1, 2020, through September 30, 2022). This dependent variable is regressed on a number of independent regression variables, described below.

- **Lagged Dependent Variable (LDV):** This refers to the customer's average demand from the same TOU period during the pre-pilot period (i.e., before November 1, 2020). The LDV helps control for heterogeneity in customer usage levels and any pre-existing differences between the pilot participants and control customers.
- **TOU Period Binaries:** A series of binary variables controlling for which TOU period the given observation falls in. These variables are interacted with every single other independent variable, which delivers a result that is analytically equivalent to estimating a separate regression for each TOU period.
- **Weather:** Four weather variables are included: cooling degree hours, heating degree hours, heat build-up, and cold build-up. The heat and cold build-up variables are exponentially decaying moving averages of a heat index (a function of temperature and humidity) and a cold index (a function of temperature and wind speed).
- **Segment Binaries** (core model only): A set of binary variables controlling for whether a customer is or is not in each of the five segments of interest. The parameters associated with these variables capture the incremental effects of segment association—each variable interacted with a segment binary is also included without the segment binary. The parameter associated with the variable that is not interacted with a segment binary provides the "base" effect—the effect relevant to the general population (those customers not included in any segment).
- **Treatment Binary:** This binary variable defines whether a customer is a pilot participant or not. The estimated parameters associated with the terms that include this variable provide the estimated impacts.
- **Tenure Term** (new move-in model only)**:** A linear trend that identifies the number of calendar months since the current occupant has moved into the premise. An interaction between the tenure trend and the treatment variable is included to capture the degree to which TOU response changes over time – i.e., to test the hypothesis that TOU response will increase the longer the customer has lived at their new premise.
- **High-Impact Binary** (high-impact model only)**:** This binary variable is equal to 1 if a customer is a high-impact participant and zero otherwise. High impact participants are identified using a two-stage process involving participant AMI and survey data, as described in Section 2.1.4. This term allows the model to identify both the average impact of TOU rates on survey respondents (which may differ from that of the participant sample as a whole) and the incremental effect of being identified as a high-impact participant.

Many of the variables described above are interacted with each other to control for or provide estimates of specific effects (e.g., the incremental effect of inclusion in one segment over another).

As noted above, the retention of premises in the analysis despite a change in occupancy is a relatively novel element of the estimation approach. To better understand the sensitivity of the analysis to this decision, Guidehouse also estimated the core model described above using a dataset that follows the more standard convention of excluding premises when occupancy changes. The results of these auxiliary regressions were presented along with the main regression results (that include all non-opted-out premises) for the overall average effect in the interim report.

For the final report, Guidehouse also conducted an entirely separate new move-in analysis to investigate the impact of TOU rates on customers that have recently moved in. The results of this analysis are summarized in this report, with details available in Appendix X1.

The regression specification (provided in Appendix A and briefly described above) was carefully selected to account for the fact that individual customers could belong to multiple segments at once. This also affects how segment-specific impacts are presented—when segment-specific impacts are presented, they are both presented as:

- **An incremental impact:** For example, a participant with a smart thermostat will on average reduce consumption by X more kW than one who does not have a smart thermostat.
- **A segment-specific total impact:** For example, a participant with a smart thermostat who is not part of any other segment will reduce consumption by Z kW on average. This is the sum of the incremental effect and the base effect.

The details of how to interpret the impacts presented are further discussed in Section 3.

2.1.3.2 Coincident Peak Demand Impacts

Coincident peak demand impacts are estimated using a simplified version of the core regression model to estimate TOU period impacts. In this case, the dataset includes only a single observation per year for each customer: that customer's average hourly demand during the hour of overall Xcel Energy peak demand in the summers of 2021 and 2022.

Peak demand in 2021 for Xcel Energy was observed in hour ending 17 (between 4 p.m. and 5 p.m. local prevailing time) on Wednesday, June 9.

Peak demand in 2022 for Xcel Energy was observed in hour ending 17 on Monday, June 20.

For the LDV value, the demand for each premise during the summer 2020 peak demand hour was used, which was observed in hour ending 17 on Wednesday, July 8 of that year.

The overall procedure for estimating peak demand impacts is very similar to that used for the average TOU period demands except that many fewer variables are required (e.g., no TOU period binary variables, no weather variables). A separate model was estimated for each year of the pilot (2021 and 2022) and study area (Eden Prairie and Minneapolis). The algebraic model specification may be found in Appendix A.

2.1.4 High-Impact Analysis

As part of the final analysis, the Guidehouse team conducted additional analysis to identify high-impact participants, leveraging both AMI data and survey responses. The purpose of this analysis was to identify the motivations and behaviors of high-impact participants to help Xcel Energy improve messaging and engagement strategies and achieve greater On-Peak and coincident peak demand reductions in future deployments of TOU.

This section describes the three steps used to identify likely high-impact participants using AMI and survey data, and how impacts were estimated for these participants. Additional details are provided in Appendix A.4.

- **Stage 1 participant identification.** Comparison of individual participant pre-pilot and pilot period summer demand data was used to identify those customers in which a substantial decrease in On-Peak period demand is observed. Only customers that have not moved since the pilot began are included.

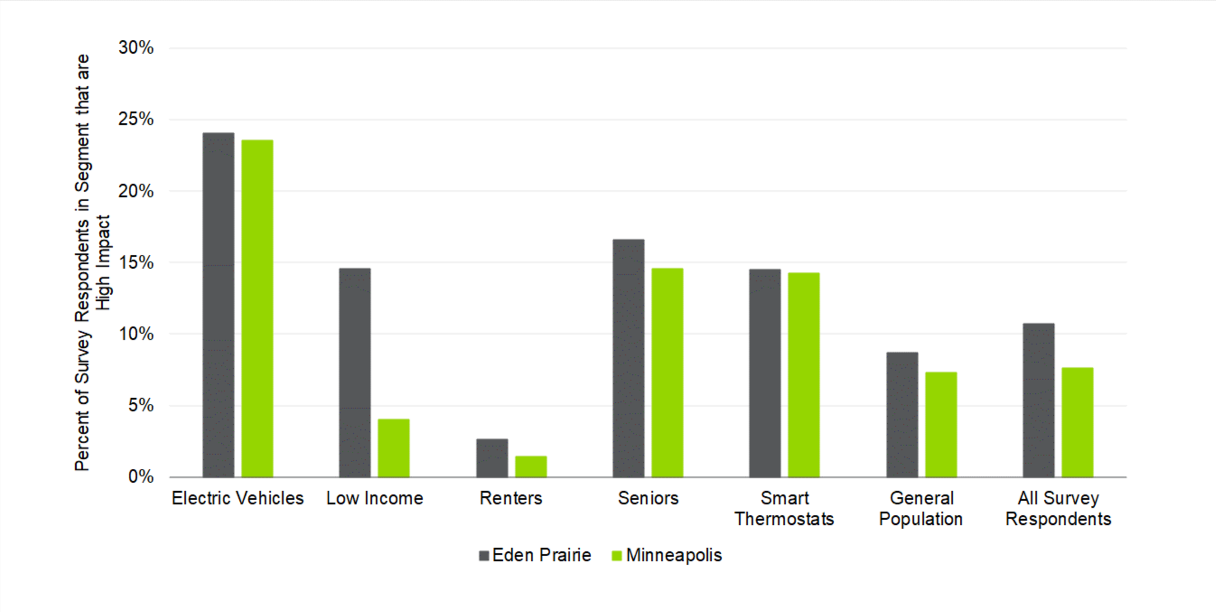
- **Stage 2 survey review & identification of defining characteristics.** Survey responses of likely high-impact participants identified in stage 1 were compared to those of standard participants to identify customer characteristics or behaviors that appear to be predictive of high impacts. All participants sharing these characteristics are identified as likely high-impact customers.

  Specifically, Guidehouse compiled survey responses from all five surveys. A series of t-tests were conducted to identify statistically significant differences between stage 1 high-impact participants and non-stage 1 high-impact participants. This analysis revealed that the most significant indicators of likely high-impact status were related to bill and pilot engagement. Guidehouse then developed several candidate indices to score survey respondents and help identify likely high-impact participants.

- **Estimate and test results for likely high-impact participants.** Using the AMI data for customers identified in stage 2 as likely high-impact participants, regression analysis is applied to estimate the impacts of these participants and to test that the selected characteristics are correlated with higher impacts. The impact evaluation team estimated the model described in section 2.1.3.1 four times for each set of flags, once for each unique combination of season and study area.

Figure 2-8 below shows the proportion of high-impact participants identified within each customer segment. EV owners, seniors, and smart thermostat owners have the highest proportions of high-impact participants at 24%, 16%, and 14%, respectively. Across all segments, 11% of Eden Prairie participant survey respondents and 8% of Minneapolis participant survey respondents were identified as high-impact.

Figure 2-8. High-Impact Participants as a Percent of Segment (Survey Respondents Only)



2.1.5 Bill Impact Calculations

Two types of average bill impacts are estimated for participants:

- Behavioral Bill Impacts
- Net Bill Impacts

Both are estimated using the TOU period average demand impacts from the core regression model described in Section 2.1.3.1. Bill impacts are also provided for the high-impact participants, with estimates derived from the high-impact regression model described in Appendix A.4.3. Effective January 1, 2022, an Interim Rate Surcharge of 8.92% want into effect for both the Standard and TOU pilot rates. Guidehouse did not incorporate the Interim Rate Surcharge when calculating customer bill impacts to allow for comparison across the two years of the pilot.

2.1.5.1 Behavioral Bill Impacts

The behavioral bill impact is the estimated average impact on the bill of a customer subject to TOU rates stemming from their response to that TOU rate. This bill impact reflects the difference between what the average participant would have paid under TOU rates had they made no changes to their behavior and what they actually paid. Behavioral bill impacts therefore compare two conditions:

- The average participant bill calculated with TOU rates applied to observed average hourly consumption under the TOU pilot, and
- The average participant bill calculated with TOU rates applied to estimated baseline hourly consumption during the same period.

Behavioral bill impacts were estimated by multiplying the estimated TOU period demand impacts, the TOU period rates, and the number of hours in the TOU period during which the corresponding price applies. This result was then summed across the periods and divided by the number of months in the period. TOU impacts are estimated separately for year 1 and year 2 of the pilot.

2.1.5.2 Net Bill Impacts

Net bill impacts are the estimated average bill impacts of switching from the residential Standard rate to the TOU rate, which implicitly include both the behavioral element (the average customer response to TOU) and a rate-structural element (the average effect on a customer's bill of moving from one rate structure to another).[35] Net bill impacts consider the base case as the average participant bill when participants are subject to the Standard residential rate and participants continue to consume electricity according to their pre-TOU patterns. The net bill impacts therefore compare two conditions:

- The average participant bill calculated with TOU rates applied to observed average hourly consumption under the TOU pilot, and
- The average participant bill calculated with the Standard residential rate applied to estimated baseline hourly consumption during the same period.

To estimate average monthly participant bills under the Standard rate, Guidehouse used regression model parameters to derive the predicted average baseline demand of a participant prior to TOU treatment for each segment. This overall average baseline was also estimated based on the observed distribution of segments in the sample. Segment-specific and overall average baseline demand were then applied to the Standard residential rate to derive the segment-specific and overall average monthly participant bill under the Standard rate.

To estimate average monthly participant bills under the TOU rate, the same regression coefficients were used to derive the predicted average monthly demand of a participant in the TOU pilot for each segment and year of the pilot, as well as on average across all segments. The segment-specific and overall average TOU pilot demand were then applied to the TOU rates to derive the segment-specific and overall average monthly participant bill under the TOU rate.

The reason for this approach (i.e., the use of model-predicted baseline demands instead of actual observed demands) is to obtain a set of "clean" segment-specific bill impacts to allow reviewers to better understand how the different segments are affected by the TOU rates. This approach allows Guidehouse to isolate the bill impacts by segment without any confounding effects from overlapping segment definitions.

The importance of this may be illustrated by considering Eden Prairie seniors. Seniors account for approximately 39% of Eden Prairie participants. Overall, approximately 20% of Eden Prairie participants are both seniors and smart thermostat participants (see Figure B-4 in Appendix A). The approach used by Guidehouse for presenting net bill impacts allows the reader to cleanly and clearly separate the bill impacts on seniors from those on smart. thermostat owners.

[35] In a world of perfect foresight, there would be no rate-structural element: TOU rates were set to be revenue-neutral on a weather-normal basis, assuming no change in behavior. Of course, the reality is that the load profile of the participants (due to weather, COVID-19, and other factors) is unlikely to exactly match the load profile used in the rate-setting process, making some rate-structural effects inevitable.

2.1.6 DSM Analysis

The purpose of this analysis is to estimate the incremental DSM participation by TOU pilot participants. The evaluation team used DSM program data to identify what proportion of participants and control customers participated in DSM programs both before and during the pilot period. Premises are counted as a DSM participant in the pre-period if they enrolled in any DSM program in the year before the pilot began (November 1, 2019, through September 30, 2021). Premises are counted as a DSM participant in the pilot period if they enrolled in any DSM program between the start of the pilot and August 1, 2022. DSM data were not available for the final two months of the evaluation period.

Guidehouse identified the proportion of customers that participated in DSM within four groups: control customers, participant customers, high-impact TOU participants, and control customers that had responded to at least one survey. Impacts on DSM participation levels are estimated by taking the difference between the average *change* in TOU participants' DSM participation levels between the pre-period and the TOU period and the average *change* in control customers' DSM participation levels between the pre-period and the TOU period. This means that factors that affect usage of both participants and controls (e.g., weather, pandemic-related behavioral changes, etc.) are controlled for. The difference-in-difference (DID) statistic is a measure of the incremental DSM participation by TOU pilot participants, over and above what would have happened absent the TOU pilot.

While not comprehensive[36], the use of confirmed and validated program tracking data allows for a comparison that is sufficiently robust to determine whether TOU participation has a meaningful impact on downstream DSM program uptake.

2.1.7 The Effects of COVID-19 on TOU Impacts

The COVID-19 pandemic is arguably the most significant demographic event in North America since the baby boom and has had a profound impact on society and consumer behavior. From a residential electricity demand perspective, although the precise nature of the effect on loads is unclear and continues to evolve, the substantial increase in people working from home and reducing their travel has doubtless had a material impact. Both the pre-pilot period (beginning in mid-February 2020) and the pilot period (beginning in November 2020) are affected.

The effects of COVID-19 on customer behavior are unlikely to have biased the estimated impacts. The RCT design of the pilot is such that the behavioral response of participants and control customers to the pandemic (e.g., working from home, reducing travel, etc.) should be effectively identical. These effects are captured and controlled for by the LDV (i.e., the implicit DID approach). COVID-19 and the public health measures enacted to mitigate its effects will not bias the impacts.

However, the existence of the COVID-19 pandemic may have affected how participants chose to respond to the TOU rate. The estimated impacts presented below are accurate but may well be different from what would have been estimated had there been no pandemic. This is a simple reality of empirical evaluation: the estimation of effects based on observed behavior will reflect observed behavior, and the observed behavior in this case will necessarily reflect the fact

[36] While Guidehouse could map downstream DSM participation to Eden Prairie and Minneapolis participants and controls, the same could not be accomplished for upstream and midstream DSM programs.

that the pilot took place during a massive global public health crisis of unprecedented proportions.

In summary, while the estimated impacts are doubtless affected by customer changes in behavior responding to the pandemic, they are unbiased (accurate) estimates of actual participant response.

2.2 Customer Experience Approach

This section presents the approach used to collect and analyze survey data in support of customer experience research. Guidehouse fielded five surveys between 2019 and 2022: a pre-launch survey, a pre-pilot survey, a post-heating season survey, a post-cooling season survey, and a final survey. The pre-launch, pre-pilot, and final surveys included both participants and control customers, while the two other post-season surveys focused on participants only. Table 2-1 summarizes the five surveys and the topics covered by each survey. Guidehouse used skip logic to ensure that customers who had responded to multiple surveys were not asked certain questions (e.g., demographics and home characteristics) repeatedly to keep surveys shorter and increase completion rates. Skip logic was not used for questions that may vary from year to year, such as income, number of people home during the day, and equipment present in the home. Given the use of this type of skip logic, comparisons across surveys should be made with the understanding that it is possible we are comparing two distinct populations. Respondents to the final survey, for example, may have some characteristics that differentiate them from earlier surveys, lower engagement being one possibility.

Table 2-1. Summary of Survey Efforts

Survey Features		Pre-Launch	Pre-Pilot	Post-Heating Season	Post-Cooling Season	Final
Mode	Web	✓	✓	✓	✓	✓
	Phone	✓				
Language	English	✓	✓	✓	✓	✓
	Spanish	✓				✓
	Somali	✓				
Population	Participants	✓	✓	✓	✓	✓
	Controls	✓	✓			✓
Survey Topics	Demographics	✓	✓	✓*	✓*	✓*
	Home characteristics	✓	✓			
	Equipment in home	✓	✓	✓*	✓	✓
	Energy conservation behaviors	✓				
	Energy-related attitudes	✓	✓	✓	✓	✓
	Typical equipment usage patterns		✓			
	Changes in heating or cooling behavior		✓	✓	✓	✓
	Changes in other equipment usage			✓	✓	✓
	Understanding of the pilot			✓	✓	✓
	Recall of educational materials			✓	✓	✓
	Satisfaction			✓	✓	✓

**Indicates that respondents were only asked questions on this topic if they didn't previously answer the same questions in a prior survey.*

Table 2-2 summarizes the timing, sample sizes, and response rates for each survey effort. The declining response rates over the course of the first four surveys may be due to survey fatigue (i.e., the same population receiving multiple surveys on similar topics from the same entity) and general fatigue because the post-heating and post-cooling season surveys were both fielded during the COVID-19 pandemic when many people were dealing with more responsibilities and stress than normal. Turnover in participating housing units may also account for some of the decline in response rates; customers who moved into their current homes after the pilot started may be less familiar with the pilot and therefore less inclined to respond to a survey about their pilot experiences.

Table 2-2. Survey Timelines and Dispositions

Survey	Dates Fielded	Valid Emails Sent	Number of Completed Surveys	Response Rate	Incentive[37]
Pre-Launch Survey	4/22/19 – 5/20/19	28,959	5,159	17.8%	Sweepstakes
Pre-Pilot Survey	9/26/19 – 10/11/19	11,260	1,775	15.8%	Sweepstakes
Post-Heating Season Survey	4/9/21 – 4/26/21	6,719	642	9.5%	Sweepstakes
Post-Cooling Season Survey	9/29/21 – 10/27/21	5,701	420	7.3%	Sweepstakes
Final Survey	9/21/22 – 10/25/22	8,400	1,262	15.0%	$15 participants (full), $10 participants (mini) & controls

Source: Guidehouse analysis

Guidehouse conducted statistical analysis of each survey dataset individually and collectively using statistical software programs (SPSS and R) to generate frequencies, cross-tabs, and t-tests, with a focus on comparing responses by study area and key segments of interest (i.e., seniors, renters, low income, smart thermostats, and EV owners).

[37] Sweepstakes details: Sweepstakes prizes include a total of 11 Amazon gift cards. The gift cards include 1 - $250 gift card, 5 - $100 gift cards, and 5 - $50 gift cards.

3. Impact Findings

This section presents the estimated demand impacts by TOU period and at the time of Xcel Energy's system peak (coincident peak demand impacts). This section also presents the set of average estimated participant bill impacts reflective of the estimated TOU period demand impacts. Impacts are presented on average across all participants in each study area as well as by segment.

The pilot has demonstrated that a default (opt-out) TOU rate can deliver modest but statistically significant demand savings of up to 1.6% during On-Peak periods and up to 2% impacts during the system coincident peak. However, estimated impacts vary substantially across study areas, seasons, and pilot years.

The average annual impact on customer bills across all participants over the entire pilot period was less than $1.50 per month and appears to be driven by the more cost-reflective design of the TOU rate (i.e., higher rates when summer air conditioning loads are driving many customer bills). Although average participant bill impacts are small (as a percentage of an average monthly bill), it is clear from the high-impact analysis (see Section 3.3) that some TOU participants made significant changes to their household electricity behavior, realizing monthly bill savings approaching $4.00.

Key findings related to demand and bill impacts include the following:

- **Demand Impacts**
  - **TOU pilot participants reduced their summer On-Peak demand by up to 1.6%, but impacts varied by study area and pilot year.**

    In Eden Prairie, on average participants reduced their summer On-Peak demand by approximately 1.3% of baseline demand in both years of the pilot. In Minneapolis, participants reduced their summer On-Peak demand by approximately 1.6% of baseline demand in the first summer, but on average did not reduce On-Peak demand during the second summer of the pilot. During both summers and in both study areas participant demand during the Off-Peak period increased by 1-4%.
  - **TOU pilot participants reduced their coincident peak demand up to 2.6%, but impacts varied by study area and pilot year.**

    TOU pilot participants in Eden Prairie reduced their coincident peak demand by approximately 2.6% (0.074 kW) on average in the second year of the pilot, but participants in Minneapolis did not reduce demand during the same hour. In the first year of the pilot, on average participants in both study areas reduced coincident peak demand by approximately 2.1% of baseline demand.
- **Drivers of Demand Impacts**
  - **A small, highly engaged subset of participants account for a disproportionate share of the estimated On-Peak reductions.** Specifically, survey respondents who indicated high awareness of rates, engagement with their energy bill, knowledge of Xcel Energy resources (pilot materials, My Account), and self-reported effort to reduce peak load were identified as high-impact participants. These high-impact participants accounted for 11% of Eden Prairie survey respondents and 8% of Minneapolis survey respondents. On average, high-impact participants in both study areas delivered summer On-Peak demand reductions greater than 10% of their

baseline consumption. Summer On-Peak impacts are more than 5 times the magnitude of those estimated for the full sample of participants, as a percentage of baseline consumption, and approximately 10 times the absolute magnitude of reductions estimated for the full sample of participants. During summer Off-Peak periods, high-impact participants increased load by up to 9.5% of baseline consumption, in response to the low electricity price during this period. High impact participants also contribute greater demand reductions than the full sample of participants during winter, with On-Peak period demand reductions of 7.5% of baseline demand in Eden Prairie and 5.6% of baseline demand in Minneapolis, on average.

- **Segment-level demand impacts have low statistical precision, but usage analysis suggests that smart thermostat owners drive the Minneapolis area On-Peak reductions. In Eden Prairie, there is no single segment that is clearly driving On-Peak demand reductions, but seniors and renters are both major contributors during summer.** The standard errors of estimated segment-level impacts are relatively high, meaning that these estimates are less precise than those for the sample of participants as a whole.
- **Premises with changes in occupancy do not contribute to On-Peak reductions.** On average, new premise occupants do not contribute to On-Peak demand reductions in either season or study area. While it is possible that new occupants would eventually respond to TOU prices over time, this effect is not apparent over the evaluation period.

- **Energy Impacts**
  - **Average net energy impacts are small, as might be expected given the revenue-neutral rate design.** On average, annual energy consumption increased by 0% to 0.5%, with some minor variation across study areas and pilot years. This corresponds to an annual increase in energy consumption of 30 kWh or less, on average.
- **Bill Impacts**
  - **Average bill impacts resulting from participant behavior changes are quite modest and reflect TOU period demand impacts.**

    Compared to what their bills would have been had they not changed their behavior (but still been enrolled in the TOU rate), Eden Prairie participants achieved an average savings of approximately $0.23 per month across the entire pilot period. Off-Peak demand increases in Minneapolis motivated by the very low price in that time period resulted in an average behavioral bill increase of $0.02 per month across the entire pilot period. Behavioral bill impacts vary by season and study area, but do not exceed $0.50 per month, on average.
  - **Average net bill impacts are quite small, as would be expected given the revenue-neutral rate-setting approach.**

    On average, the transition from Standard to TOU rates is estimated to have reduced the average participant monthly bill in the winter months and increased the average participant monthly bill in summer months. This small increase in summer bills is driven by the higher proportion of summer energy consumed during the On-Peak period. The average bill impact for Minneapolis participants is a reduction of approximately $1.10 (2.2%) per month during the pilot period. The average bill impact for Eden Prairie participants is an increase of approximately $0.40 (0.5%) per month during the pilot period.

The remainder of this section is divided into seven sections:

1. **TOU Period Demand Impacts:** This section provides the average estimated impact of the pilot for each TOU period and season for both years of the pilot.
2. **TOU Period Demand Impacts – New Move-Ins:** This section provides the average estimated impact of the pilot for each TOU period for participants who moved into their premise after the pilot began. TOU period impacts are estimated over the full pilot period.
3. **TOU Period Demand Impacts – High-Impact Participants:** This section provides the average estimated impact of the pilot for each TOU period for participants identified as high-impact. TOU period impacts are estimated for both years of the pilot.
4. **Coincident Peak Demand Impacts:** This section provides the average estimated impact of the pilot at the time of Xcel Energy's 2021 and 2022 system peaks.
5. **Energy Impacts:** This section provides the average estimated impacts on energy consumption in response to the TOU rate.
6. **Customer Bill Impacts:** This section provides the average estimated behavioral (i.e., compared to TOU bills with no behavior change) and net (i.e., compared to Standard rate bills with no behavior change) average bill impacts.
7. **DSM Analysis**: This section provides a summary of participant and control DSM participation before and during the pilot.

3.1 TOU Period Demand Impacts

This section provides the average estimated impact of the pilot for each TOU period and season for both years of the pilot.

TOU period impacts (the average impact in the On-Peak, Mid-Peak, and Off-Peak periods) are the core metric of any TOU rate impact evaluation because they are the most direct reflection of participant behavior in response to the incentives provided by the rate. The TOU rate is designed to incentivize participants to reduce their demand during the On-Peak periods and to allow it to increase during the Off-Peak and Mid-Peak periods, and the estimated average participant response reflects this.

Participants in both Eden Prairie and Minneapolis have contributed modest average per-participant On-Peak demand reductions in the summer months when the TOU price is highest, but impacts varied by study area and pilot year. Participants in both study areas have also, on average, increased their demand in the Off-Peak periods in the summer months when the TOU price is lowest. Although segment-specific impacts are highly uncertain (and should be interpreted with caution), it appears as though **the principal drivers of On-Peak reductions in Minneapolis are smart thermostat owners, and in Eden Prairie are seniors**.

This section is divided into two sections:

- **Average TOU Period Demand Impacts:** This section presents the average TOU period impacts across all customers, split by study area, for both years of the pilot.
- **Segment-Specific TOU Period Impacts:** This section presents the average TOU period impacts in the On-Peak period for the specific participant segments, split by study area, for the second year of the pilot.

3.1.1 Average TOU Period Demand Impacts

In the first year of the pilot, summer On-Peak impacts were relatively consistent as a percentage of baseline consumption across the two study areas, though on an absolute (kW) basis Eden Prairie participants delivered 1.5 times the impact provided by Minneapolis participants.

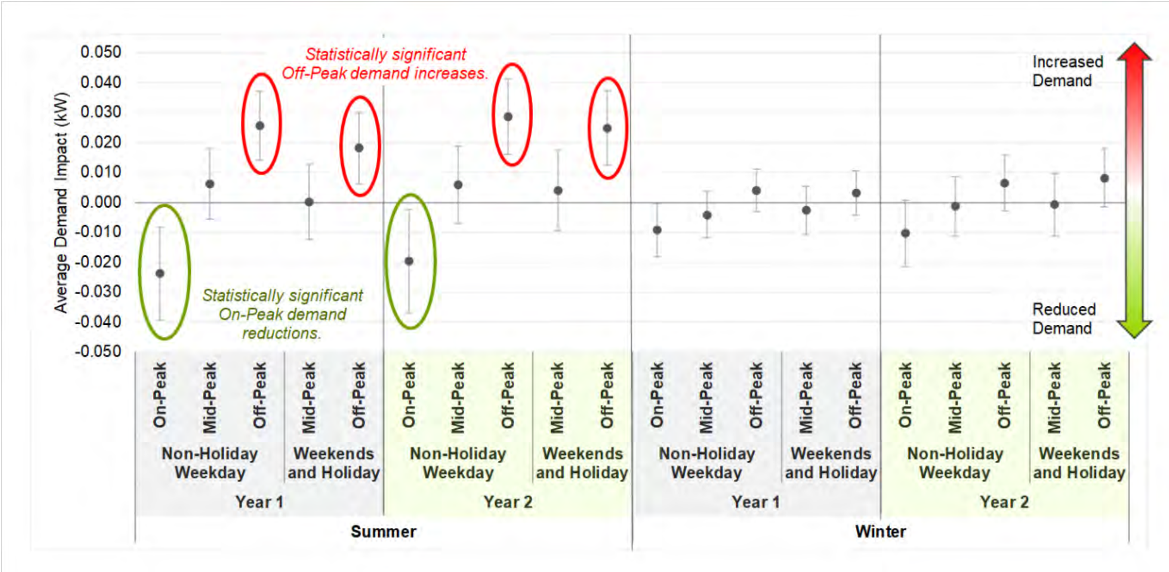
In the second year of the pilot, the difference between study areas grew, with Eden Prairie participants still contributing a demand reduction during On-Peak periods of over 1% on average, but Minneapolis participant demand reductions fell to zero during the same period. Minneapolis participant average demand reductions in winter increased from zero in the first winter to approximately 1% in the second winter of the pilot, in line with the percentage impact achieved by Eden Prairie participants for the winter On-Peak period. Decreased summer impacts for Minneapolis participants in year 2 of the pilot may be driven by renters, which represented nearly two-thirds of participating premises. This hypothesis is explored more in Section 3.1.2.

This section is divided into two sections. The first presents the average TOU period impacts for Eden Prairie, and the second presents the average TOU period impacts for Minneapolis.

3.1.1.1 Eden Prairie Average TOU Period Demand Impacts

Figure 3-1 below shows the average estimated demand impact—represented by the dots—by TOU period, season, day-type, and year of the pilot for Eden Prairie. Estimated demand reductions are represented as negative values and increases in demand as positive values. The 90% confidence interval (derived from cluster-robust standard errors) is represented as the set of whiskers bracketing each estimate. Where the whiskers cross the zero line (e.g., summer weekday Mid-Peak), the estimated impacts are not statistically significant at the 90% level. The statistically significant TOU period impacts are highlighted with green and red circles, corresponding to the direction of the impact.

Figure 3-1. Estimated Demand Impacts by TOU Period – Eden Prairie



Source: Guidehouse analysis

Table 3-1 below presents the same information in tabular form. The “Mean kW Impact” columns present the average demand impacts. The “% Impact” columns show the estimated average demand impacts as a percentage of the estimated baseline (or counterfactual) demand. The “Relative Precision (+/-) at 90% Confidence” columns provide the relative precision of the estimated impacts. Rows highlighted in red indicate estimated impacts that are not statistically significant at the 90% confidence level, negative values indicate demand reductions, and positive values indicate increases in demand.

Table 3-1. Estimated Demand Impacts by TOU Period – Eden Prairie

Season	Day-Type	TOU Period	Year 1			Year 2		
			Mean kW Impact	% Impact	Relative Precision (+/-) at 90% Confidence	Mean kW Impact	% Impact	Relative Precision (+/-) at 90% Confidence
Summer	Non-Holiday Weekday	On-Peak	-0.024	-1.3%	66%	-0.020	-1.2%	88%
		Mid-Peak	0.006	0.5%	193%	0.006	0.5%	217%
		Off-Peak	0.026	2.9%	45%	0.029	3.7%	44%
	Weekends and Holiday	Mid-Peak	0.000	0.0%	8670%	0.004	0.3%	328%
		Off-Peak	0.018	2.1%	65%	0.025	3.3%	50%
Winter	Non-Holiday Weekday	On-Peak	-0.009	-0.9%	96%	-0.010	-1.0%	108%
		Mid-Peak	-0.004	-0.5%	188%	-0.001	-0.1%	767%
		Off-Peak	0.004	0.6%	182%	0.007	1.0%	142%
	Weekends and Holiday	Mid-Peak	-0.003	-0.3%	296%	-0.001	-0.1%	1459%
		Off-Peak	0.003	0.5%	228%	0.008	1.2%	119%

Note: Rows highlighted in red indicate estimated impacts that are not statistically significant at the 90% confidence level.

Source: Guidehouse analysis

In an empirical impact evaluation, a statistically non-significant result is typically interpreted in one of two ways:

- **No Impact**: The failure to reject the hypothesis that the estimate is not statistically significantly different from zero indicates that there was no effect. Where the uncertainty is very high, the sample size is large, and there is no additional evidence of a material effect, this is often the preferred interpretation.
- **Highly Uncertain Impact**: Though non-significant, the estimated parameters of a well-specified model remain the best available estimate of the impact. In some cases (e.g., a small sample, highly variable underlying data, evidence that a set of impacts is jointly statistically significant), particularly if mitigating evidence exists, this may be the preferred interpretation.

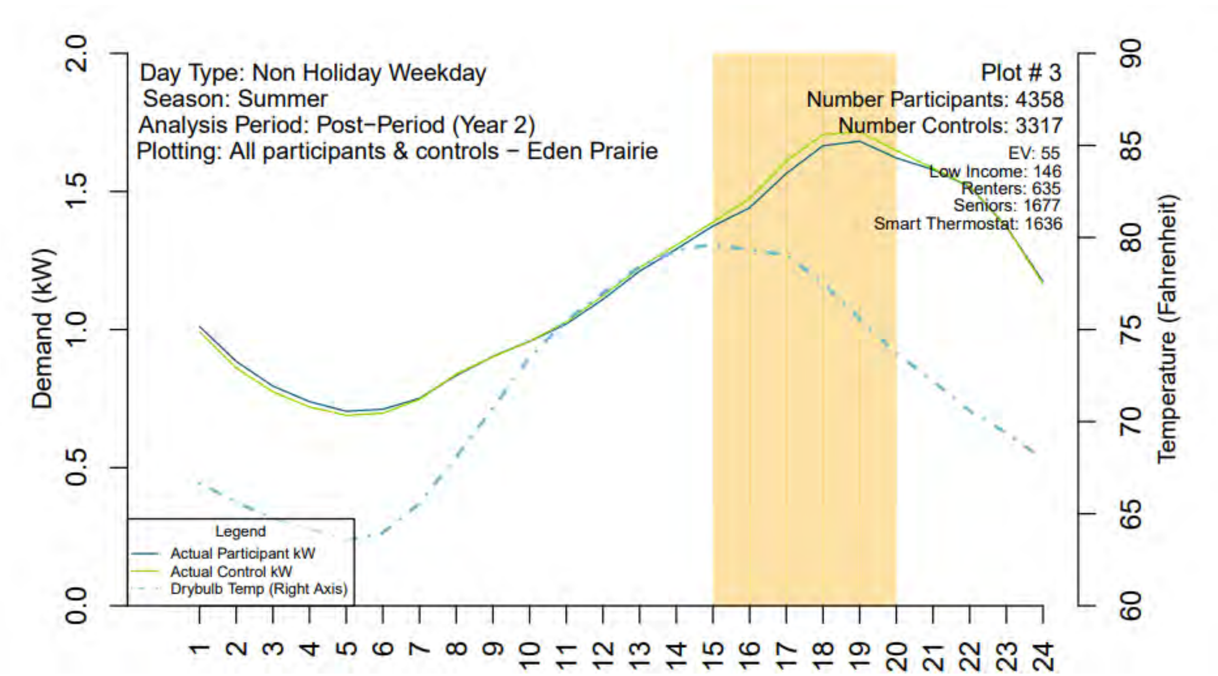
In general, given the reasonably large sample sizes available for this evaluation, the Guidehouse evaluation team takes the first interpretation of statistically non-significant results, though several exceptions exist (as may be seen below), particularly when considering the segment-specific results.

As indicated in the table above, Eden Prairie pilot participants reduced their On-Peak demand in summer and winter, with the summer impact approximately double that estimated for the winter. In addition, the On-Peak demand reduction in summer was coupled with an increase of similar magnitude in Off-Peak demand. There is no evidence that participants increased demand in the winter Off-Peak period.

The difference between summer and winter response is likely tied to the curtailment of AC loads, which has been found by other studies to be a primary driver of residential consumer behavioral price response.[38] This hypothesis is further supported by the fact that the coincident peak demand impacts (see Section 3.4) are materially higher than the average On-Peak demand impacts across the entire summer. The observed temperature on the system peak day was much higher than the average summer temperature at the same time. This is particularly evident when comparing coincident peak demand impacts across years of the pilot – estimated demand impacts were highest on the 2022 system peak day when the temperature was 99 degrees Fahrenheit, and coincident peak demand impacts were slightly lower on the 2021 system peak day when the temperature was 92 degrees Fahrenheit. This hypothesis is also supported by customer survey responses (see Figure 4-19) indicating participant TOU response behaviors included making changes in thermostat setpoints.

The On-Peak demand impact is visible in the figure of participant versus control customer demand on non-holiday summer weekdays in the second year of the TOU pilot (see Figure 3-2). Observe the visible gap between the green load profile (control group demand) and the blue load profile (participant group demand) during the On-Peak period (shaded orange).

Figure 3-2. Eden Prairie Average Summer Load Profile – Year 2



Source: Guidehouse analysis

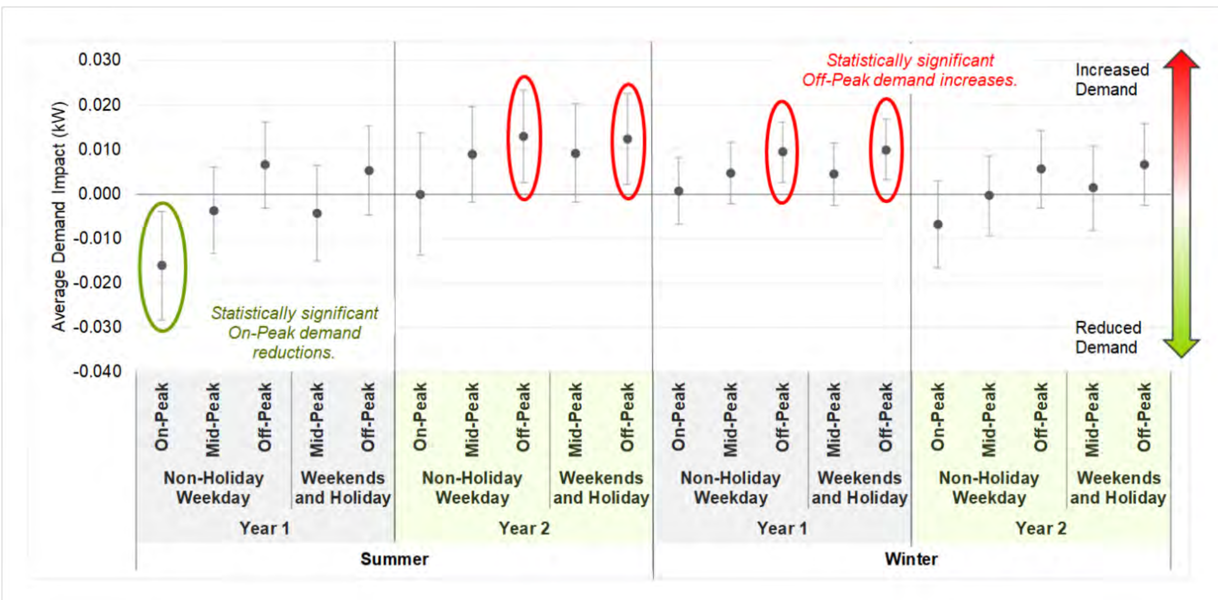
Comparisons of additional load profiles are provided in Appendix X2, a PDF appendix of load profiles provided under a separate cover.

[38] See, for example,
Guidehouse (operating as Navigant) prepared for London Hydro, *Regulated Price Plan Roadmap Pilot Program Final Impact Evaluation*, April 2020,
https://www.oeb.ca/sites/default/files/LondonHydro-RPP-Pilot-Final-Evaluation-Report-20200421.pdf.

3.1.1.2 Minneapolis Average TOU Period Impacts

Figure 3-3 below shows the average estimated demand impact—represented by the dots—by TOU period, season, day-type, and year of the pilot for Minneapolis. Estimated demand reductions are represented as negative values and increases in demand as positive values. The 90% confidence interval (derived from cluster-robust standard errors) is represented as the set of whiskers bracketing each estimate. Where the whiskers cross the zero line (e.g., summer weekday Mid-Peak), the estimated impacts are not statistically significant at the 90% level. The statistically significant TOU period impacts are highlighted with green and red circles, corresponding to the direction of the impact.

Figure 3-3. Estimated Demand Impacts by TOU Period – Minneapolis



Source: Guidehouse analysis

Table 3-2 below presents the same information in tabular form. All column definitions are the same as those for the tables described in the section above. Rows highlighted in red indicate estimated impacts that are not statistically significant at the 90% confidence level, negative values indicate demand reductions, and positive values indicate increases in demand.

Table 3-2. Estimated Demand Impacts by TOU Period – Minneapolis

Season	Day-Type	TOU Period	Year 1			Year 2		
			Mean kW Impact	% Impact	Relative Precision (+/-) at 90% Confidence	Mean kW Impact	% Impact	Relative Precision (+/-) at 90% Confidence
Summer	Non-Holiday Weekday	On-Peak	-0.016	-1.6%	76%	0.000	0.0%	123167%
		Mid-Peak	-0.004	-0.5%	262%	0.009	1.2%	120%
		Off-Peak	0.007	1.0%	147%	0.013	2.2%	80%
	Weekends and Holiday	Mid-Peak	-0.004	-0.5%	247%	0.009	1.3%	120%
		Off-Peak	0.005	0.8%	187%	0.012	2.2%	82%
Winter	Non-Holiday Weekday	On-Peak	0.001	0.1%	1027%	-0.007	-1.1%	144%
		Mid-Peak	0.005	0.8%	146%	0.000	-0.1%	2450%
		Off-Peak	0.009	2.1%	72%	0.006	1.2%	157%
	Weekends and Holiday	Mid-Peak	0.004	0.7%	157%	0.001	0.2%	688%
		Off-Peak	0.010	2.2%	69%	0.007	1.4%	139%

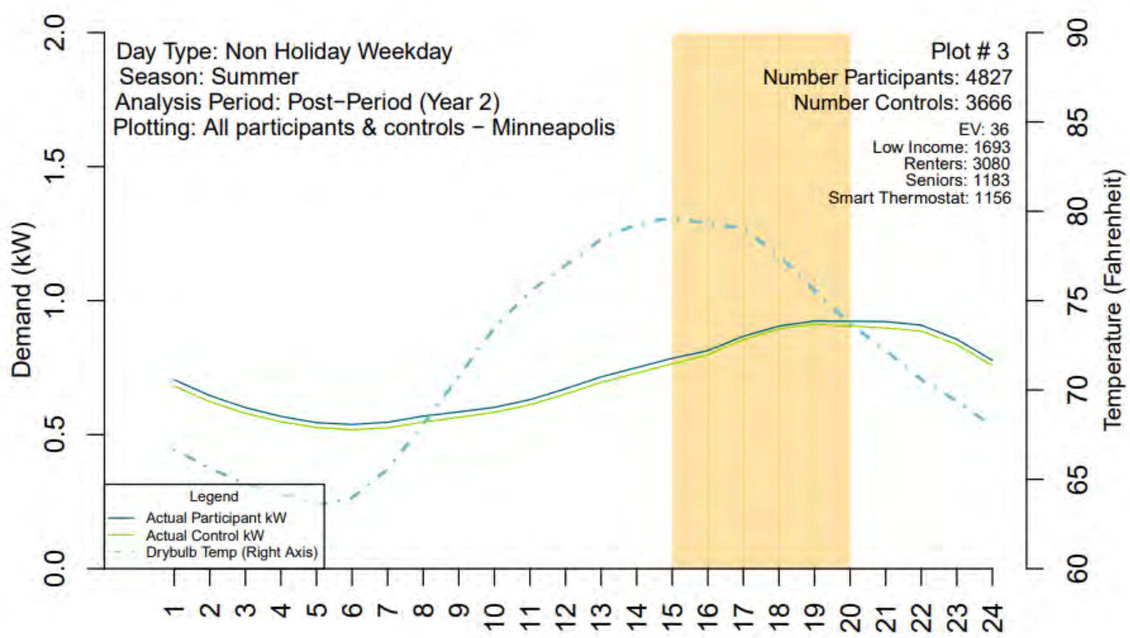
Note: Rows highlighted in red indicate estimated impacts that are not statistically significant at the 90% confidence level.

Source: Guidehouse analysis

In Minneapolis, participants are estimated to have reduced demand during the summer On-Peak period and to have slightly increased winter Off-Peak demand during the first year of the pilot. Guidehouse believes this winter Off-Peak impact could be related to the increased use of auxiliary (plug-in) space heaters, which are more common in Minneapolis (31% of survey respondents) than in Eden Prairie (22% of survey respondents). In the second summer of the pilot, the estimated On-Peak demand impact was near zero, with statistically significant increases in Off-Peak demand. In the second winter of the pilot, there is no evidence of customer response to the TOU rate. Decreased summer impacts for Minneapolis participants in year 2 of the pilot may be driven by renters, which represented nearly two-thirds of participating premises. This hypothesis is explored more in Section 3.1.2.

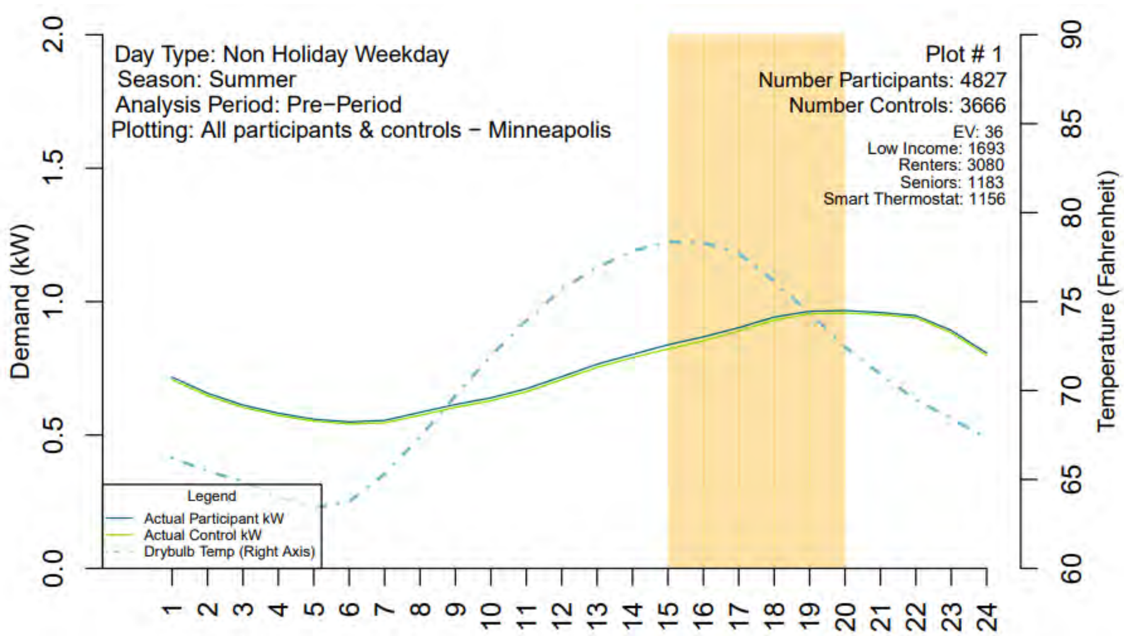
The On-Peak demand impact is not visible in the figure of participant versus control customer demand on non-holiday summer weekdays in the second year of the TOU pilot (see Figure 3-4). The lack of impact is clearer when comparing this figure to the corresponding figure from the pre-pilot period, shown in Figure 3-5, where pre-pilot period On-Peak demand was also slightly higher than control group demand.

Figure 3-4. Minneapolis Average Summer Load Profile – Year 2



Source: Guidehouse analysis

Figure 3-5. Minneapolis Average Summer Load Profile – Pre-Pilot Period



Source: Guidehouse analysis

3.1.2 Segment-Specific TOU Period Impacts

This section provides the segment-specific estimated impacts for the On-Peak TOU period during the second year of the pilot. Segment-specific impacts in other periods, and for the first year of the pilot, are included in Appendix X3, the Microsoft Excel spreadsheet appendix that accompanies this report, but have not been included in this report for conciseness.

A review of the segment-specific estimated impacts, particularly when considering the overall average impacts presented above, reveals some potential patterns in segment-specific response, though specific impacts are often highly uncertain with relatively high estimated standard errors.

The high standard errors associated with segment-specific impacts make them less certain than the overall average impacts presented in Section 3.1.1. This is a natural result of several factors. These factors include the segments each having fewer data points than the sample as a whole; many samples overlapping, which may result in some multicollinearity (increasing uncertainty); and the fact that many segment assignments are estimates rather than known with certainty. Care should be taken when interpreting segment-specific estimated impacts.

The fact that segments may overlap (e.g., a given participant may be a senior, a renter, and low income) presents a challenge for the display of segment-specific impacts in a way that avoids confounding the effects of one segment with another. For example, simply presenting the average impact of all seniors is problematic because so many seniors in Eden Prairie are also equipped with smart thermostats; such a display might make it unclear which of these two characteristics was contributing most of the impact.

Segment impacts are therefore presented in the sections below in two ways: as incremental impacts (“Mean Incremental kW Impact”) and as segment-specific total impacts (“Mean Total kW Impact”).

Segment-specific total impacts are equivalent to the sum of the base impact (estimated for all participants regardless of segment) and the incremental segment effect. For example, a participant in only the senior segment would have an average On-Peak impact equal to the sum of the base impact and the seniors-specific incremental impact. For participants in multiple segments, their average On-Peak impact is equivalent the base impact plus the segment-specific incremental impacts of each segment they are included in. A participant in the general population (i.e., not included in any overlapping segment) has an average On-Peak impact of the base impact only.

This section is divided into two sections. The first presents the average TOU period impacts for Eden Prairie, and the second presents the average TOU period impacts for Minneapolis.

3.1.2.1 Eden Prairie Segment-Specific TOU Period Impacts

Table 3-3 provides the estimated On-Peak impacts by segment in Eden Prairie in the second year of the pilot.

Table 3-3. Estimated On-Peak Demand Impacts by Segment – Eden Prairie, Year 2

Season	Segment	Mean Incremental kW Impact	Relative Precision (+/-) at 90% Confidence (Incremental Impact)	Mean Total kW Impact	Relative Precision (+/-) at 90% Confidence (Total Impact)	% of Sample Assigned to Segment
Summer	**Base Impact**	**-0.001**	**3887%**	**-0.001**	**3887%**	**100%**
	Electric Vehicles	-0.120	153%	-0.121	152%	1%
	Low Income	0.000	106104%	-0.001	16339%	3%
	Renters	-0.022	245%	-0.022	224%	14%
	Seniors	-0.023	160%	-0.024	142%	39%
	Smart Thermostats	-0.014	273%	-0.015	262%	38%
	Overall Average Impact	**-**	**-**	**-0.020**	**88%**	**100%**
Winter	**Base Impact**	**-0.013**	**139%**	**-0.013**	**139%**	**100%**
	Electric Vehicles	-0.064	217%	-0.076	181%	1%
	Low Income	-0.065	112%	-0.077	95%	3%
	Renters	0.002	1737%	-0.011	301%	14%
	Seniors	-0.001	2591%	-0.013	164%	39%
	Smart Thermostats	0.014	180%	0.001	2020%	38%
	Overall Average Impact	**-**	**-**	**-0.010**	**108%**	**100%**

Note: Rows highlighted in red indicate estimated impacts that are not statistically significant at the 90% confidence level. “Incremental kW impact” reflects the change in estimated demand impact from a customer being part of a particular segment; it is additive to the “Base Impact” and to the incremental impact of other segments to which the customer belongs. “Total kW Impact” reflects the estimated demand impact for a customer of a given segment, but only if that customer belongs to that segment and no others.

Source: Guidehouse analysis

In Eden Prairie, there is no single segment that is clearly driving the overall estimated On-Peak impact in the second year of the pilot. In the summer, renters and seniors deliver the greatest contributions to On-Peak period demand reductions and jointly represent approximately 50% of Eden Prairie participants. During winter, low income customers and electric vehicle owners contribute the largest magnitude reductions to On-Peak demand. However, given the very small sample size of these two groups, caution should be used in interpreting these results.

In the first year of the pilot, seniors contributed to On-Peak demand reductions in both seasons for Eden Prairie,[39] but this effect appears to have diminished in the second winter of the pilot. In contrast, renters did not contribute incremental On-Peak demand reductions in the first summer of the pilot but delivered considerable demand reductions during the same period in the second summer of the pilot.

As may be seen in Table 3-3, the incremental effects of segment assignment are statistically insignificant for all but one segment (low income segment, winter impact). In some cases (e.g., low income segment, summer impact), this likely means that assignment to the given segment does not affect participants’ TOU response on average. In other cases (e.g., electric vehicles, seniors), this is likely due to statistical “noise” in the data and impacts are real, though highly imprecise.

For example, consider the On-Peak summer impact of the electric vehicles segment. In absolute terms, this is the largest impact estimated of any segment. This impact is consistent with the expectation that EV loads are highly transferable and typically very responsive to TOU

[39] Refer to Appendix X3 attached to this report, which contains updated values for year 1 impacts based on more complete data. See Section 2.1.2.3 for more information.

pricing and with the findings of EV-targeted TOU pilots in other study areas.[40] However, it is not statistically significant. The evaluation team's interpretation of this result is that the highly variable participant loads and the relatively small sample size of the segment are driving this result rather than simple random variation in the data, and that electric vehicles segment participants are contributing substantial (but highly uncertain) demand reductions during the On-Peak period.

3.1.2.2 Minneapolis Segment-Specific TOU Period Impacts

Table 3-4 provides the estimated On-Peak impacts by segment in Minneapolis in the second year of the pilot.

Table 3-4. Estimated On-Peak Demand Impacts by Segment – Minneapolis, Year 2

Season	Segment	Mean Incremental kW Impact	Relative Precision (+/-) at 90% Confidence (Incremental Impact)	Mean Total kW Impact	Relative Precision (+/-) at 90% Confidence (Total Impact)	% of Sample Assigned to Segment
Summer	**Base Impact**	**0.011**	**265%**	**0.011**	**265%**	**100%**
	Electric Vehicles	-0.081	171%	-0.070	196%	1%
	Low Income	-0.009	315%	0.002	1339%	35%
	Renters	-0.001	3557%	0.010	231%	63%
	Seniors	-0.002	1419%	0.009	383%	25%
	Smart Thermostats	-0.026	126%	-0.015	253%	24%
	Overall Average Impact	**-**	**-**	**0.000**	**123167%**[41]	**100%**
Winter	**Base Impact**	**-0.011**	**186%**	**-0.011**	**186%**	**100%**
	Electric Vehicles	-0.003	5168%	-0.014	959%	1%
	Low Income	-0.004	498%	-0.015	149%	35%
	Renters	0.021	97%	0.010	164%	63%
	Seniors	-0.006	370%	-0.017	141%	25%
	Smart Thermostats	-0.027	88%	-0.038	70%	24%
	Overall Average Impact	**-**	**-**	**-0.007**	**144%**	**100%**

Note: Rows highlighted in red indicate estimated impacts that are not statistically significant at the 90% confidence level. "Incremental kW impact" reflects the change in estimated demand impact from a customer being part of a particular segment; it is additive to the "Base Impact" and to the incremental impact of other segments to which the customer belongs. "Total kW Impact" reflects the estimated demand impact for a customer of a given segment, but only if that customer belongs to that segment and no others.

Source: Guidehouse analysis

All else equal, smart thermostat participants on average reduce their On-Peak winter demand by a statistically significant 0.027 kW more than participants without smart thermostats and are the principal drivers of winter On-Peak reductions in Minneapolis. Additionally, consistent with the estimated impacts for Eden Prairie, electric vehicle owners have the largest On-Peak

[40] For example, consider the estimated On-Peak impacts of the Alectra Utilities Overnight Regulated Price Plan TOU pilot, which estimated a 0.1 kW demand reduction for a group of participants of whom slightly less than half were confirmed to own or lease EVs:

See Table 58 of

Alectra Utilities with its partner BEWorks, *Regulated Price Plan Pilot – Final Report*, August 2020, **https://www.oeb.ca/sites/default/files/Alectra-RPP-roadmap-12-Month-Report-20200831.pdf.**

[41] The high relative precision value is a result of the estimated impact being nearly indistinguishable from zero (0.000011 kW).

reductions in summer, although this estimate is statistically insignificant. Given the very small sample size of electric vehicle owners, caution should be used in interpreting these results.

Despite estimated reductions in demand across these two segments, renters are the largest segment in Minneapolis (nearly two-thirds of premises) and their lack of impacts are driving down the overall average estimated impacts. Although the precise cause for the lack of summer impacts in year 2 for Minneapolis renters is unknown, one hypothesis is that Minneapolis renters tended to make behavioral changes (rather than structural changes) and gave up on these efforts in year 2 of the pilot when bill impacts did not materialize. For example, roughly three-quarters of renters in Minneapolis have room air conditioners, while just over half of owners in Minneapolis have central air conditioning, as shown in Table 3-5. Customers with room air conditioners must rely on manual (behavioral) changes to their HVAC usage and are unable to make structural changes to their HVAC consumption via use of thermostat set points. Additionally, there is substantial overlap between renters and the new mover group, which were found to have little or no response to the TOU rate (discussed in the next section). Guidehouse recommends additional qualitative research on this group to understand their motivations and barriers to action, as this is an important subset to engage if the TOU rate is rolled-out to all residential customers.

Table 3-5. Distribution of AC Ownership by Study Area and Segment

Study Area	Segment	Proportion with Room AC	Proportion with Central AC
Eden Prairie	Renters	33%	63%
	Owners	2%	98%
Minneapolis	Renters	76%	12%
	Owners	49%	53%

Note: Percentages may not sum to 100 as respondents were able to select all that apply, and some participants did not report having any home cooling equipment at all.
Source: Guidehouse final survey (n=739).

Segment-specific impacts in the first year of the pilot were similar to those estimated in the second year, though the incremental impact from most segments decreased in year 2.

3.2 TOU Period Demand Impacts – New Move-Ins

This section provides the average estimated impact of the pilot for new occupants - participants who moved into the premise since the pilot began. As with the core model, this was estimated four times, once for each unique combination of season and study area. However, data for the entire pilot period was included in the estimation set, meaning that output estimated impacts are the average across the entire pilot period.[42]

On average, new premise occupants do not contribute to On-Peak demand reductions in either season or study area. Despite receiving the same information as legacy participants, new occupants have little or no response to the TOU rate. In Eden Prairie, results suggest that new occupants slightly increased their usage in all TOU periods, while new occupants in Minneapolis have no change in usage due to the TOU rate. New occupants had moved into a new home during a pandemic, so energy bills may have been a lower priority than other items related to moving. The precise cause for the lack of impacts for new occupants is unknown.

[42] However, the data are skewed toward later in the pilot period since premises are only included after the first change in occupancy during the pilot period.

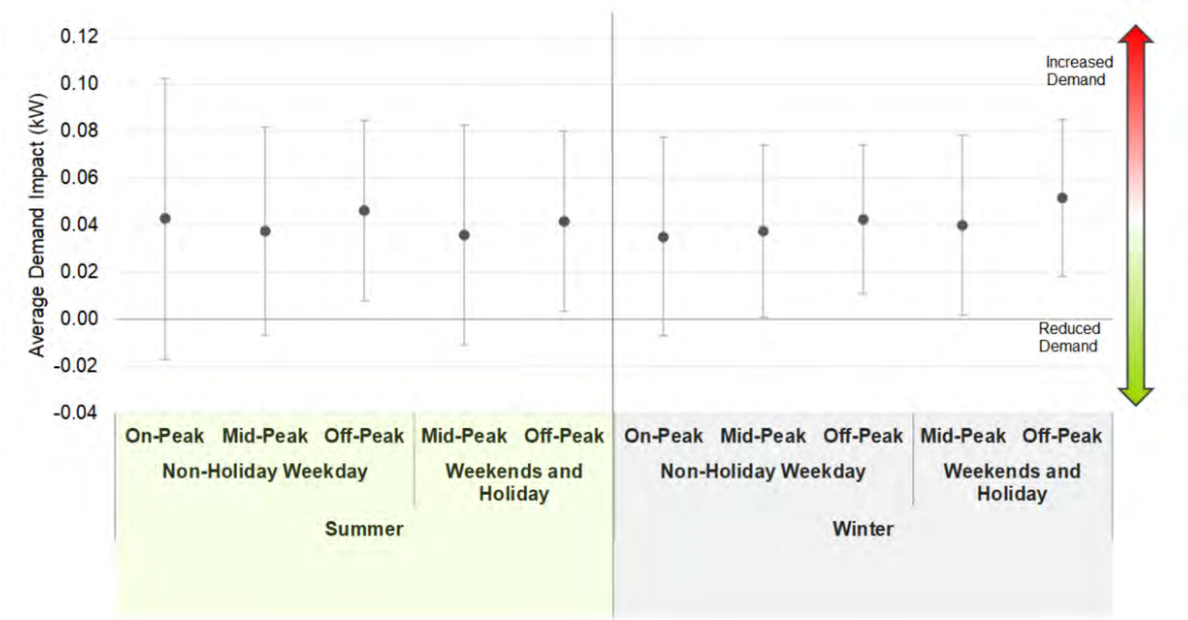
Guidehouse recommends additional qualitative research on this group to understand their motivations and barriers to action, as this is an important subset to engage if the TOU rate is rolled-out to all residential customers.

This section is divided into two sections. The first presents and discusses the average TOU period impacts for new occupants in Eden Prairie, and the second for new occupants in Minneapolis.

3.2.1 Eden Prairie Average TOU Period Demand Impacts

Figure 3-6 shows the average estimated demand impact—represented by the dots—by TOU period, season, and day-type for new move-in participants in Eden Prairie. Estimated demand reductions are represented as negative values and increases in demand as positive values. The 90% confidence interval (derived from cluster-robust standard errors) is represented as the set of whiskers bracketing each estimate. Where the whiskers cross the zero line (e.g., weekday On-Peak), the estimated impacts are not statistically significant at the 90% level.

Figure 3-6. Estimated Demand Impacts for New Move Ins by TOU Period – Eden Prairie



Source: Guidehouse analysis

Table 3-6 presents the same information in tabular form. Rows highlighted in red indicate estimated impacts that are not statistically significant at the 90% confidence level, negative values indicate demand reductions, and positive values indicate increases in demand. All column definitions are the same as those for the tables described in the section above.

Table 3-6. Estimated New Move-In Participant Demand Impacts by TOU Period – Eden Prairie

Season	Day-Type	TOU Period	Mean kW Impact	% Impact	Relative Precision (+/-) at 90% Confidence
Summer	Non-Holiday Weekday	On-Peak	0.043	3.4%	140%
		Mid-Peak	0.038	4.0%	118%
		Off-Peak	0.046	7.3%	83%
	Weekends and Holiday	Mid-Peak	0.036	3.6%	131%
		Off-Peak	0.041	6.7%	92%
Winter	Non-Holiday Weekday	On-Peak	0.035	4.9%	121%
		Mid-Peak	0.037	6.0%	98%
		Off-Peak	0.042	9.4%	75%
	Weekends and Holiday	Mid-Peak	0.040	6.0%	96%
		Off-Peak	0.052	11.1%	65%

Note: Rows highlighted in red indicate estimated impacts that are not statistically significant at the 90% confidence level.

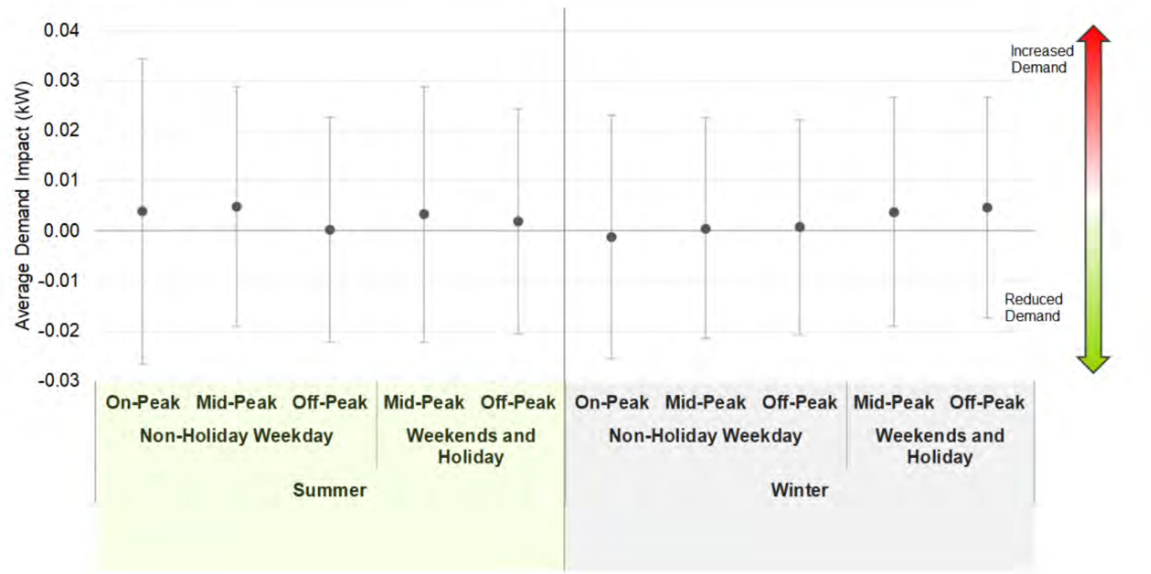
Source: Guidehouse analysis

In Eden Prairie, no statistically significant demand reductions are estimated. Instead, the results suggest that new move-in participants increased their usage in all TOU periods. Based on these estimates and additional analysis detailed in Appendix A.3, there is no evidence that new move-in occupants are responding to the TOU rate in the intended manner, by reducing demand during the On-Peak period.

3.2.2 Minneapolis Average TOU Period Demand Impacts

Figure 3-7 shows the average estimated demand impact—represented by the dots—by TOU period, season, and day-type for new move-in participants in Minneapolis. Estimated demand reductions are represented as negative values and increases in demand as positive values. The 90% confidence interval (derived from cluster-robust standard errors) is represented as the set of whiskers bracketing each estimate. None of the estimated impacts are statistically significant at the 90% level.

Figure 3-7. Estimated Demand Impacts for New Move Ins by TOU Period – Minneapolis



Source: Guidehouse analysis

Table 3-7 presents the same information in tabular form. Rows highlighted in red indicate estimated impacts that are not statistically significant at the 90% confidence level, negative values indicate demand reductions, and positive values indicate increases in demand. All column definitions are the same as those for the tables described in the section above.

Table 3-7. Estimated New Move-In Participant Demand Impacts by TOU Period – Minneapolis

Season	Day-Type	TOU Period	Mean kW Impact	% Impact	Relative Precision (+/-) at 90% Confidence
Summer	Non-Holiday Weekday	On-Peak	0.004	0.6%	784%
		Mid-Peak	0.005	0.9%	484%
		Off-Peak	0.000	0.1%	8746%
	Weekends and Holiday	Mid-Peak	0.003	0.6%	763%
		Off-Peak	0.002	0.4%	1151%
Winter	Non-Holiday Weekday	On-Peak	-0.001	-0.3%	1948%
		Mid-Peak	0.001	0.1%	4130%
		Off-Peak	0.001	0.2%	2974%
	Weekends and Holiday	Mid-Peak	0.004	0.8%	600%
		Off-Peak	0.005	1.3%	475%

Note: Rows highlighted in red indicate estimated impacts that are not statistically significant at the 90% confidence level.

Source: Guidehouse analysis

In Minneapolis none of the estimated changes in demand are statistically significant. Based on these estimates and additional analysis detailed in section Appendix A.3, there is no evidence that new occupants respond to the TOU rate.

3.3 TOU Period Demand Impacts – High-Impact Participants

There is a growing body of evidence that suggests that a disproportionate amount of price response in electricity customers comes from a relatively small group of the most enthusiastic participants. This is the implicit conclusion of the DOE meta-analysis' finding that when TOU is deployed with opt-out enrollment, the average per-participant impact falls considerably.[43] In short, opt-out enrollment reduces the proportion of very enthusiastic participants in the sample.

This section provides the average TOU period impacts for high-impact participants in Eden Prairie and Minneapolis in both years of the pilot (combined). High impact participants were identified using a two-stage analysis, which involved the use of both survey and AMI data. The characteristics used to define high-impact participants are discussed in greater detail in Section 2.1.4 and include high awareness of rates, energy bill engagement, knowledge of Xcel Energy resources (pilot materials, My Account), and self-reported efforts to reduce peak load. **Guidehouse identified that approximately 11% of Eden Prairie survey respondents and 8% of Minneapolis survey respondents exhibit larger shifts in their behavior in response to the TOU prices, with average On-Peak savings of over 10%.** This subset of participants also exhibited an increase in demand during Off-Peak periods, providing further evidence of a response to TOU rates.

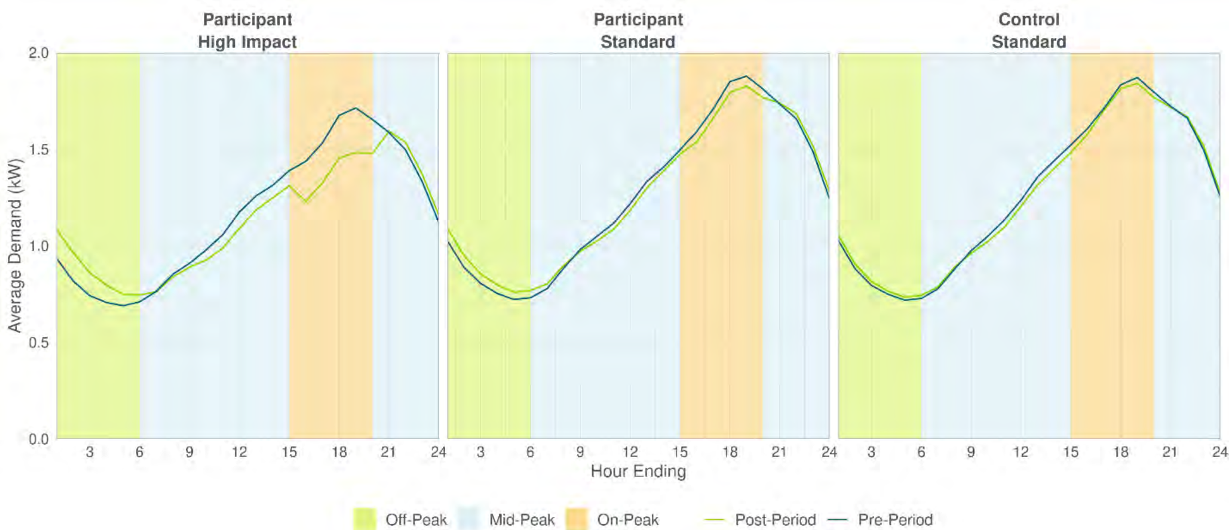
High impact participants were identified from the set of survey respondents, a group that is likely to be more engaged than the general population of participants simply because they took the effort to respond to the survey. Guidehouse compared the impact estimate for the full population of participants to the impact estimate from the set of participants who responded to the surveys and found that although some point estimates differed in magnitude, the differences were not statistically significant. Caution should be used when extrapolating results for the high impact survey respondents to the whole population.

Nevertheless, the impact estimates for the high impact group are quite large. If we assume that survey respondents are approximately representative of the full population, results imply that **high impact customers account for a disproportionate share of the estimated On-Peak reductions, despite representing approximately 10% of participants.** Guidehouse recommends additional qualitative research on this group to understand their motivations and actions taken to achieve meaningful impacts, with a goal of identifying opportunities to convert standard participants to high impact participants via increased engagement.

Figure 3-8 and Figure 3-9 compare the average summer load shapes during non-holiday weekdays for high-impact participants, standard participants, and controls, in Eden Prairie and Minneapolis across both summers of the pilot. Consistent with the high-impact analysis, only survey respondents are included in this comparison. On-Peak hours are highlighted in orange and Off-Peak periods are highlighted in green.

[43] U.S. Department of Energy, Electricity Delivery & Energy Reliability, *American Recovery and Reinvestment Act of 2009: Customer Acceptance, Retention, and Response to Time-Based Rates from the Consumer Behavior Studies*, Smart Grid Investment Program, November 2016
https://www.energy.gov/sites/prod/files/2016/12/f34/CBS_Final_Program_Impact_Report_Draft_20161101_0.pdf

Figure 3-8. Average Summer Load Profiles – Eden Prairie



Source: Guidehouse analysis

Figure 3-9. Average Summer Load Profiles - Minneapolis

Source: Guidehouse analysis

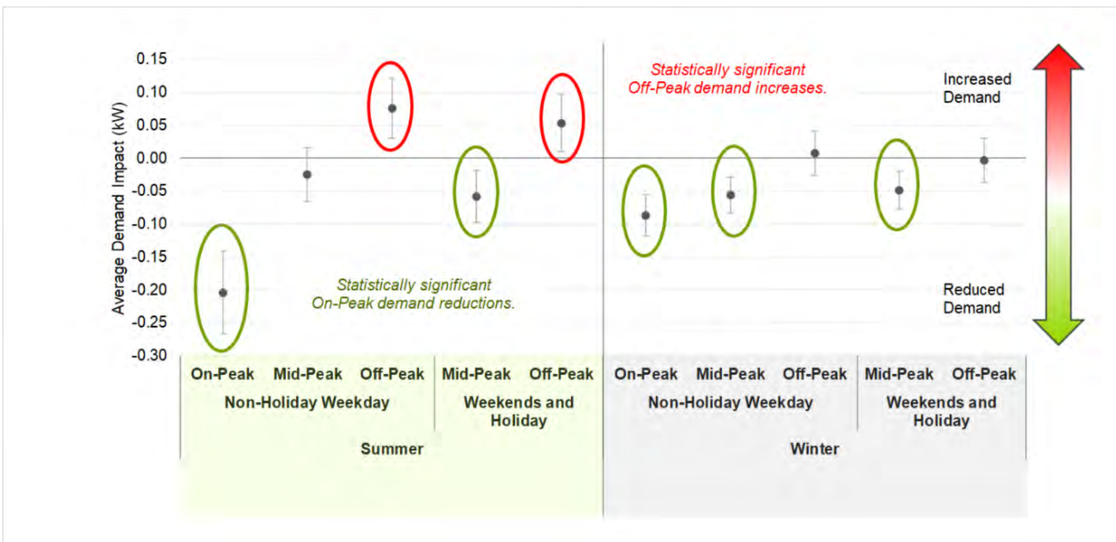
These figures illustrate a clear departure from earlier demand patterns in the TOU period: a relatively deep trough in load that extends across the On-Peak period and an increase in load during the Off-Peak period is observed for high-impact participants. This pattern is strongly suggestive of participants undertaking meaningful efforts to reduce their On-Peak loads.

Identifying the most enthusiastic TOU participants can provide a number of benefits to the utility. Surveys targeting such customers may yield useful intelligence for improving overall program response if a wider program rollout is being considered. As such, if Xcel Energy continues to offer some of its customers a default (opt-out) TOU rate, the company may wish to consider a strategy for identifying and targeting its most enthusiastic participants for additional information-gathering.

3.3.1 Eden Prairie Average TOU Period Demand Impacts

Figure 3-10 shows the average estimated demand impact—represented by the dots—by TOU period, season, and day-type for high-impact participants in Eden Prairie, approximately 11% of survey respondent participants. Estimated demand reductions are represented as negative values and increases in demand as positive values. The 90% confidence interval (derived from cluster-robust standard errors) is represented as the set of whiskers bracketing each estimate. Where the whiskers cross the zero line (e.g., weekday Mid-Peak), the estimated impacts are not statistically significant at the 90% level. The statistically significant TOU period impacts are highlighted with green and red circles, corresponding to the direction of the impact.

Figure 3-10. Estimated Demand Impacts for High-Impact Participants by TOU Period – Eden Prairie



Note: Estimated demand impacts are provided are from data spanning both years of the pilot.

Source: Guidehouse analysis

Table 3-8 presents the same information in tabular form. Rows highlighted in red indicate estimated impacts that are not statistically significant at the 90% confidence level, negative values indicate demand reductions, and positive values indicate increases in demand. All column definitions are the same as those for the tables described in the section above.

Table 3-8. Estimated High-Impact Participant Demand Impacts by TOU Period – Eden Prairie

Season	Day-Type	TOU Period	Mean kW Impact	% Impact	Relative Precision (+/-) at 90% Confidence
Summer	Non-Holiday Weekday	On-Peak	-0.204	-10.8%	31%
		Mid-Peak	-0.025	-1.9%	164%
		Off-Peak	0.076	9.5%	60%
	Weekends and Holiday	Mid-Peak	-0.059	-4.2%	68%
		Off-Peak	0.054	6.8%	82%
Winter	Non-Holiday Weekday	On-Peak	-0.087	-7.5%	36%
		Mid-Peak	-0.055	-5.7%	50%
		Off-Peak	0.007	1.0%	471%
	Weekends and Holiday	Mid-Peak	-0.049	-4.7%	59%
		Off-Peak	-0.003	-0.4%	1186%

Note: Rows highlighted in red indicate estimated impacts that are not statistically significant at the 90% confidence level. Estimated demand impacts are provided are from data spanning both years of the pilot.

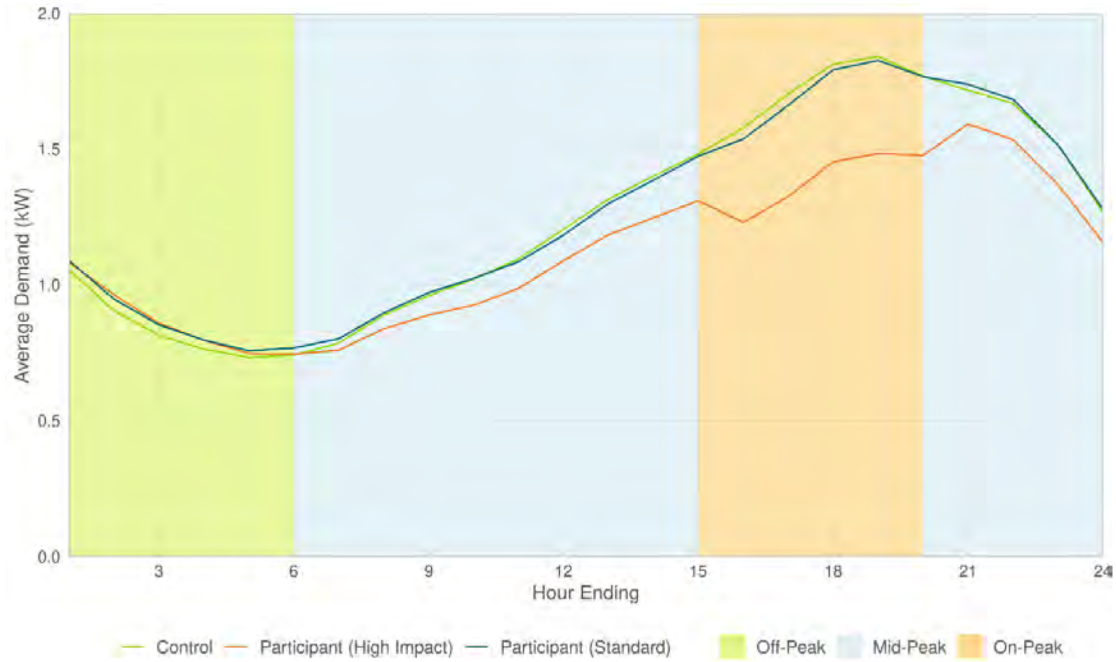
Source: Guidehouse analysis

In Eden Prairie, high-impact participants appear to have responded principally by reducing demand during the summer On-Peak and Mid-Peak periods. Average On-Peak demand reductions are 0.204 kW, 10.8% of baseline demand in the same period. During the Off-Peak periods when the price of electricity is lowest, high-impact participants respond by increasing demand by approximately 9.5% on weekdays and 6.8% on weekends or holidays.

In winter, Eden Prairie high-impact participants reduced demand during the On-Peak and weekday Mid-Peak periods by 7.5% and 5.7% of baseline demand, respectively. In contrast to the response estimated in summer, high-impact participants did not increase demand during Off-Peak periods.

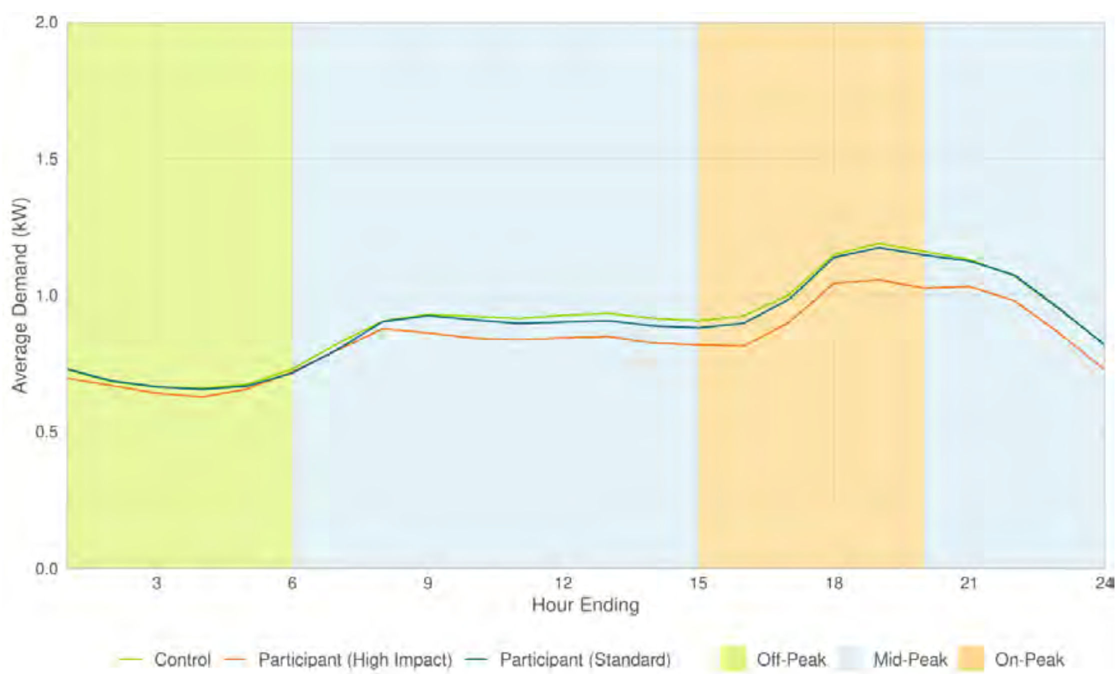
The On-Peak and Off-Peak impacts during summer are visible in the figure of control, standard participant, and high-impact participant customer loads on non-holiday days in the pre- and post-TOU periods (see Figure 3-11). On-Peak and Off-Peak impacts are less visible during the winter season in Figure 3-12, where demand for high-impact participants is lower than both survey respondent controls and participants during all periods of the day, on average. Consistent with the approach used for estimating TOU period impacts for high-impact participants, Figure 3-11 and Figure 3-12 include only participants and controls who responded to at least one survey.

Figure 3-11. Average Summer Post-Period Load Profiles by Customer Type – Eden Prairie



Note: Load profiles provided are from data spanning both summers of the pilot.
Source: Guidehouse analysis

Figure 3-12. Average Winter Post-Period Load Profiles by Customer Type – Eden Prairie

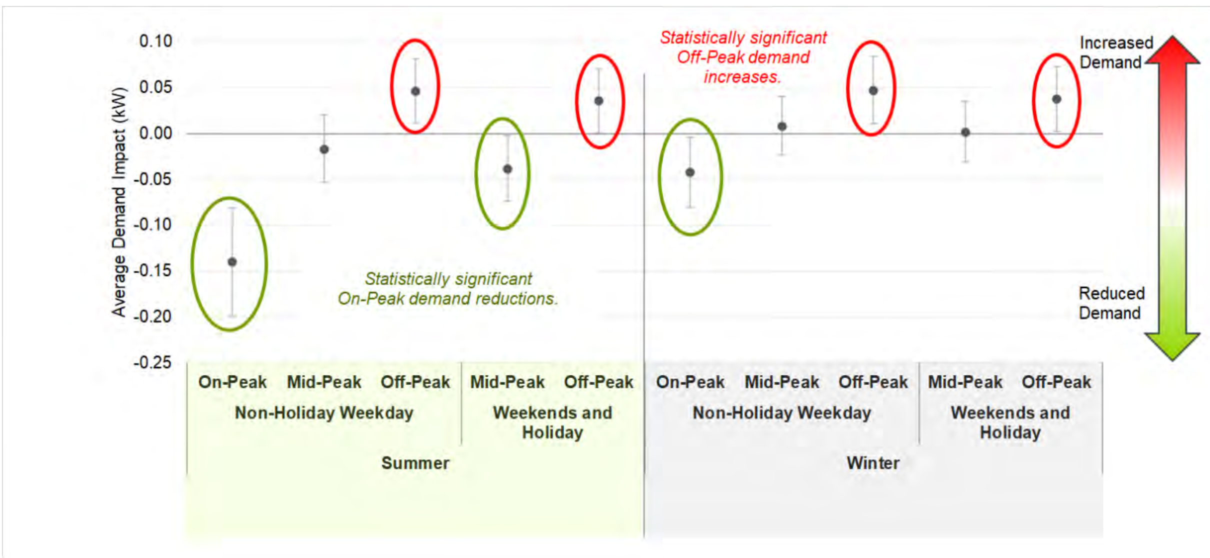


Note: Load profiles provided are from data spanning both winters of the pilot.
Source: Guidehouse analysis

3.3.2 Minneapolis Average TOU Period Demand Impacts

Figure 3-13 shows the average estimated demand impact—represented by the dots—by TOU period, season, and day-type for high-impact participants in Minneapolis, approximately 8% of survey respondent participants. Estimated demand reductions are represented as negative values and increases in demand as positive values. The 90% confidence interval (derived from cluster-robust standard errors) is represented as the set of whiskers bracketing each estimate. Where the whiskers cross the zero line (e.g., weekday Mid-Peak), the estimated impacts are not statistically significant at the 90% level. The statistically significant TOU period impacts are highlighted with green and red circles, corresponding to the direction of the impact.

Figure 3-13. Estimated Demand Impacts for High-Impact Participants by TOU Period – Minneapolis



Note: Estimated demand impacts are provided are from data spanning both years of the pilot.

Source: Guidehouse analysis

Table 3-9 presents the same information in tabular form. Rows highlighted in red indicate estimated impacts that are not statistically significant at the 90% confidence level, negative values indicate demand reductions, and positive values indicate increases in demand. All column definitions are the same as those for the tables described in the section above.

Table 3-9. Estimated High-Impact Participant Demand Impacts by TOU Period – Minneapolis

Season	Day-Type	TOU Period	Mean kW Impact	% Impact	Relative Precision (+/-) at 90% Confidence
Summer	Non-Holiday Weekday	On-Peak	-0.140	-11.8%	42%
		Mid-Peak	-0.017	-1.9%	219%
		Off-Peak	0.046	6.9%	75%
	Weekends and Holiday	Mid-Peak	-0.038	-4.1%	94%
		Off-Peak	0.036	5.3%	98%
Winter	Non-Holiday Weekday	On-Peak	-0.042	-5.6%	91%
		Mid-Peak	0.008	1.3%	388%
		Off-Peak	0.047	10.3%	78%
	Weekends and Holiday	Mid-Peak	0.002	0.3%	1723%
		Off-Peak	0.038	7.9%	93%

Note: Rows highlighted in red indicate estimated impacts that are not statistically significant at the 90% confidence level. Estimated demand impacts are provided are from data spanning both years of the pilot.

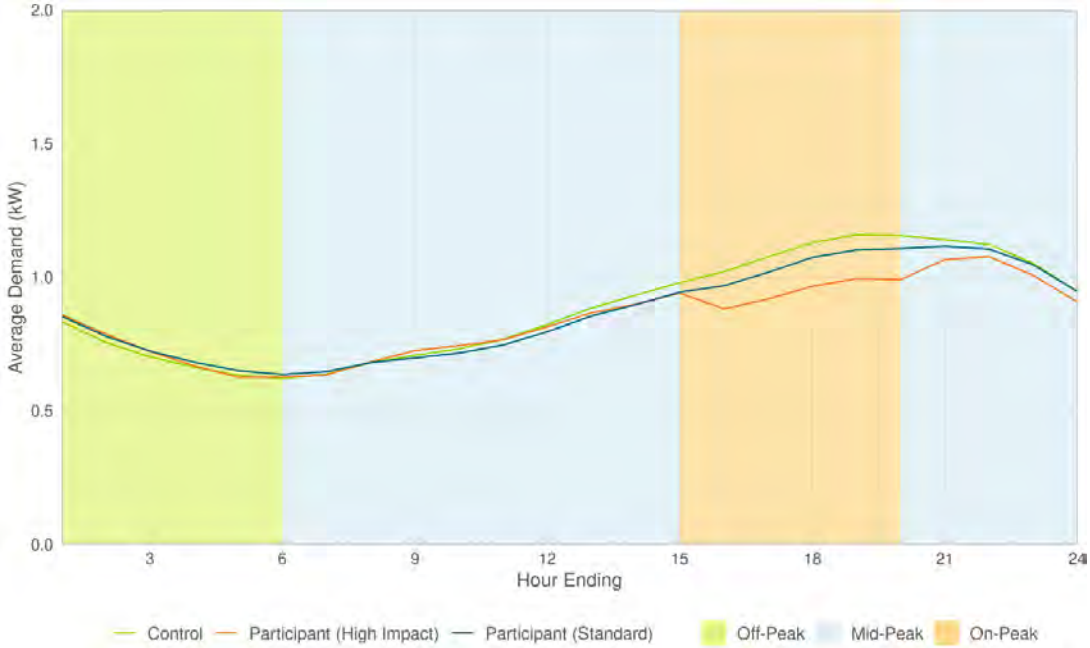
Source: Guidehouse analysis

In Minneapolis, high-impact participants appear to have responded principally by reducing demand during the summer On-Peak and Mid-Peak periods. Average On-Peak demand reductions are 0.140 kW, 11.8% of baseline demand in the same period. During the Off-Peak periods when the price of electricity is lowest, high-impact participants responded by increasing demand by approximately 6.9% on weekdays and 5.3% on weekends or holidays.

In winter, Minneapolis high-impact participants reduced demand during the On-Peak period by an average of 5.6% of baseline demand. During Off-Peak periods, high-impact participants increased demand.

The On-Peak and Off-Peak summer impacts are visible in the figure of control, standard participant, and high-impact participant customer loads on non-holiday days in the pre- and post-TOU periods (see Figure 3-14). On-Peak impacts are less visible during the winter season in Figure 3-15. Demand for high-impact participants is on average, greater than both survey respondent controls and participants for most periods of the day. The gap between high-impact participants and controls narrows during the On-Peak period, indicating a reduction in demand from high-impact participants during this period. In alignment with the approach for estimating TOU period impacts for high-impact participants, Figure 3-14 and Figure 3-15 include only participants and controls who responded to at least one survey.

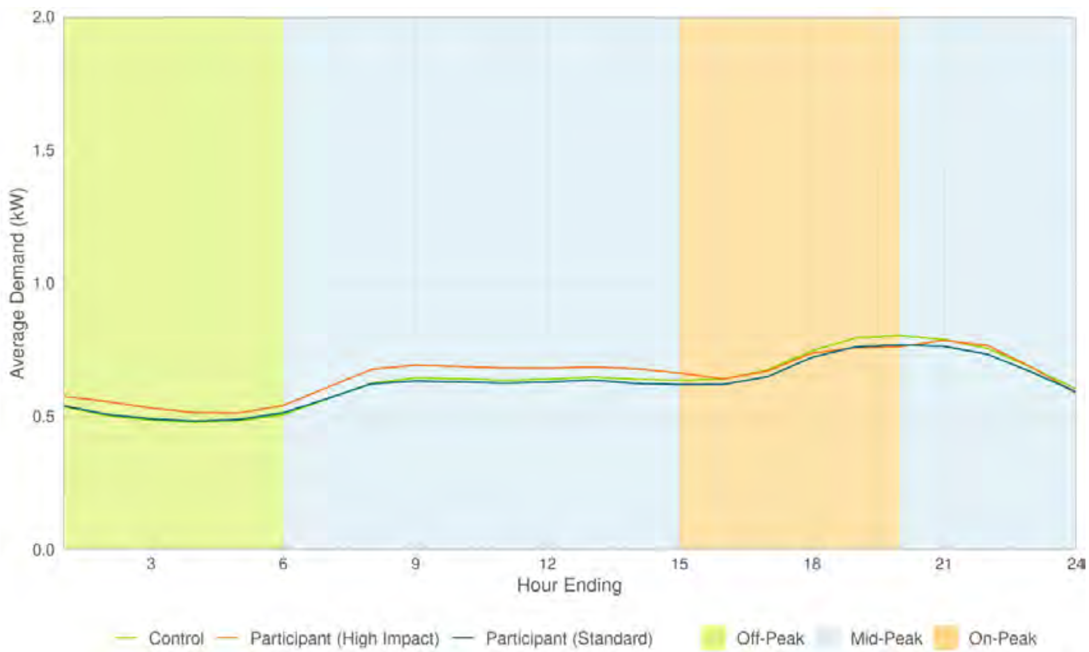
Figure 3-14. Average Summer Post-Period Load Profiles by Customer Type – Minneapolis



Note: Load profiles provided are from data spanning both summers of the pilot.

Source: Guidehouse analysis

Figure 3-15. Average Winter Post-Period Load Profiles by Customer Type – Minneapolis



Note: Load profiles provided are from data spanning both winters of the pilot.

Source: Guidehouse analysis

3.4 Coincident Peak Demand Impacts

This section provides the impact of the TOU rate on coincident peak demand, which reflects the impacts during the time in which Xcel Energy experienced its highest load in each year of the pilot. The system coincident peak is determined after the summer concludes. Given the nature of system coincident peaks, participants were not notified in advance about the timing of the system peaks. System peak periods are identified in Table 3-10. Notably, the 2022 system peak occurred during a federal holiday (Juneteenth, observed).

Table 3-10. Coincident Peak Demand Periods

Coincident Peak Demand Timing	Date	Hour Ending
Pilot Period Year 2	2022-06-20	17
Pilot Period Year 1	2021-06-09	17
Pre-Pilot Period	2020-07-08	17

Source: Guidehouse analysis

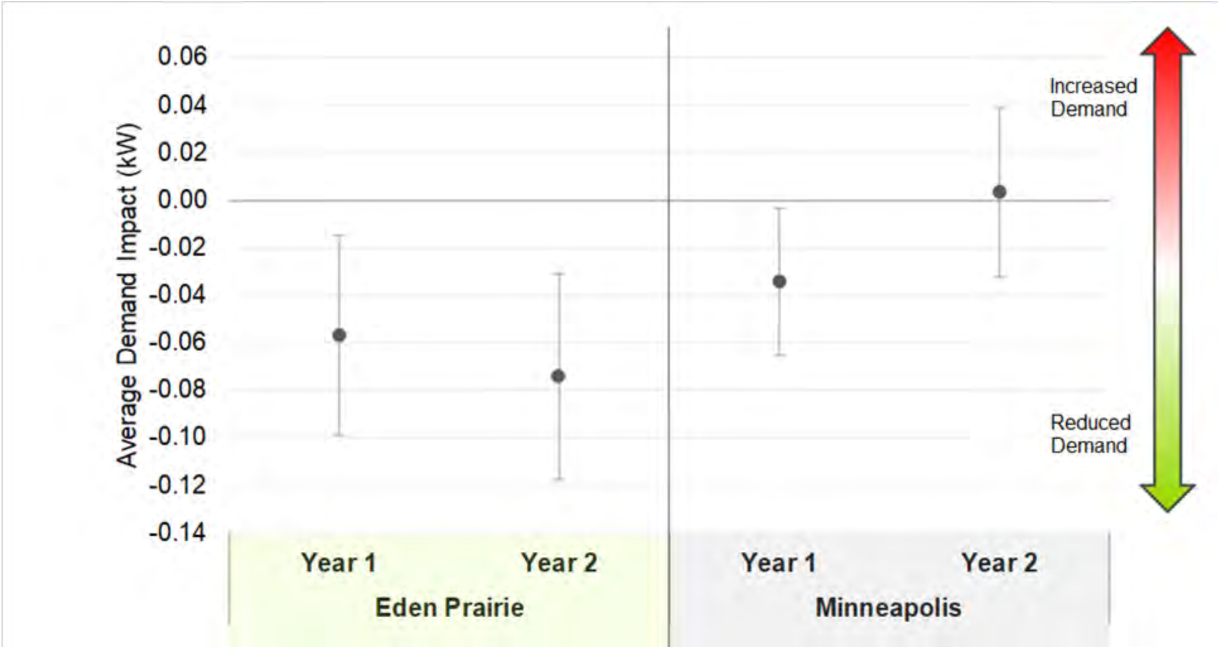
TOU pilot participants in Eden Prairie reduced their coincident peak demand by approximately 2.6% (0.074 kW) on average in the second year of the pilot, but participants in Minneapolis did not reduce demand during the same hour. In the first year of the pilot, on average participants in both study areas reduced coincident peak demand by approximately 2.1% of baseline demand. The lack of impacts during the 2022 system peak hour for Minneapolis participants is consistent with the erosion of impacts seen throughout the summer during the On-Peak period, as discussed in Section 3.1.

This section is divided into two subsections. The first presents the average estimated impact of the TOU pilot at the time of system peak across all participants (by study area), whereas the second subsection presents the segment-specific coincident peak demand impacts.

3.4.1 Average Coincident Peak Demand Impacts

Figure 3-16 provides the estimated average participant impact of the TOU pilot during the hour of Xcel Energy's 2021 and 2022 system coincident peaks.

Figure 3-16. Coincident Peak Demand Impacts



Source: Guidehouse analysis

The 2021 system peak occurred on a June weekday during the hour from 4-5pm with a temperature of 92 degrees Fahrenheit. The estimated coincident peak demand impacts in summer 2021 are statistically significant for both study areas. As with the TOU period impacts, though the Eden Prairie impacts are greater in absolute value than the Minneapolis impacts, they are very similar in proportion to the estimated participant baseline demand (both slightly higher than 2%), due to baseline demand being lower in Minneapolis. The increase in demand impacts during coincident peak hours compared to all On-Peak hours, and system peak demand being strongly correlated with extreme summer temperatures, suggests that a significant proportion of participant response is being driven by changes in AC use.

The 2022 system peak occurred on a June weekday during the hour from 4-5pm with a temperature of 99 degrees Fahrenheit. The estimated coincident peak demand impacts delivered by Eden Prairie are statistically significant, while the Minneapolis impacts are near zero. The lack of impacts during the system peak hour for Minneapolis participants is consistent with the erosion of impacts seen throughout the summer during the On-Peak period, as discussed in Section 3.1.

Eden Prairie impacts are slightly greater than those estimated in the first year of the pilot and represent a reduction of 2.6% compared to baseline demand. Given the higher temperature during the 2022 system peak (compared to 92 degrees Fahrenheit in 2021), the increase in estimated demand impact is consistent with the hypothesis that curtailment of AC loads is primary driver of the behavioral price response observed in Eden Prairie. Nearly all participants in Eden Prairie report having central air conditioning (96%), compared to 47% of Minneapolis participants. Customers with central air conditioning are able to make structural changes to their HVAC consumption by programming efficient thermostat setpoint schedules, while those with room air conditioners must rely on behavioral (manual) changes. As hypothesized in Section

3.1.2, Minneapolis customers with room air conditioners may have given up their behavioral changes in year 2 of the pilot when bill impacts did not materialize.

Table 3-11 below presents the same information in tabular form. The "Mean kW Impact" column presents the average demand impacts. The "% Impact" column shows the estimated average demand impacts as a percentage of the estimated baseline (or counterfactual) demand. The "Relative Precision (+/-) at 90% Confidence" column provides the relative precision of the estimated impacts. Rows highlighted in red indicate estimated impacts that are not statistically significant at the 90% confidence level, negative values indicate demand reductions, and positive values indicate increases in demand.

Table 3-11. Coincident Peak Demand Impacts

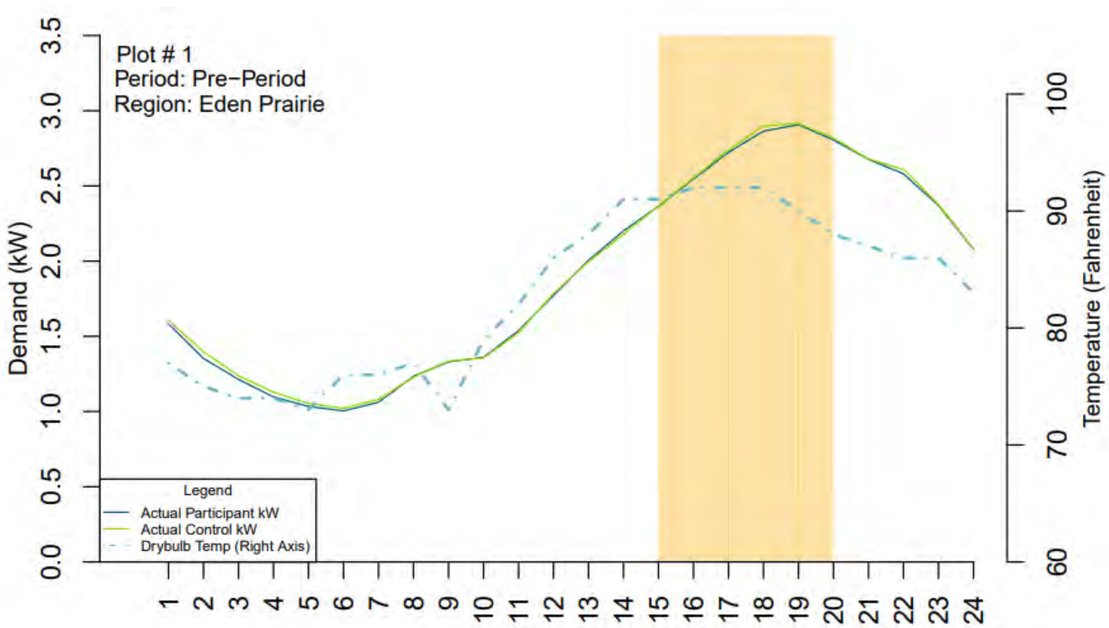
Study Area	Year of Pilot	Mean kW Impact	% Impact	Relative Precision (+/-) at 90% Confidence
Eden Prairie	Year 1	-0.06	-2.0%	74%
	Year 2	-0.07	-2.6%	58%
Minneapolis	Year 1	-0.03	-2.2%	90%
	Year 2	0.00	0.2%	1182%

Note: Rows highlighted in red indicate estimated impacts that are not statistically significant at the 90% confidence level.

Source: Guidehouse analysis

As with the On-Peak impacts discussed in Section 3.1, the impacts may be seen through a careful comparison of the load profiles on the peak demand days. Figure 3-17 shows the average participant and control customer demands in Eden Prairie on the system peak demand day in the pre-period (June 9, 2020).

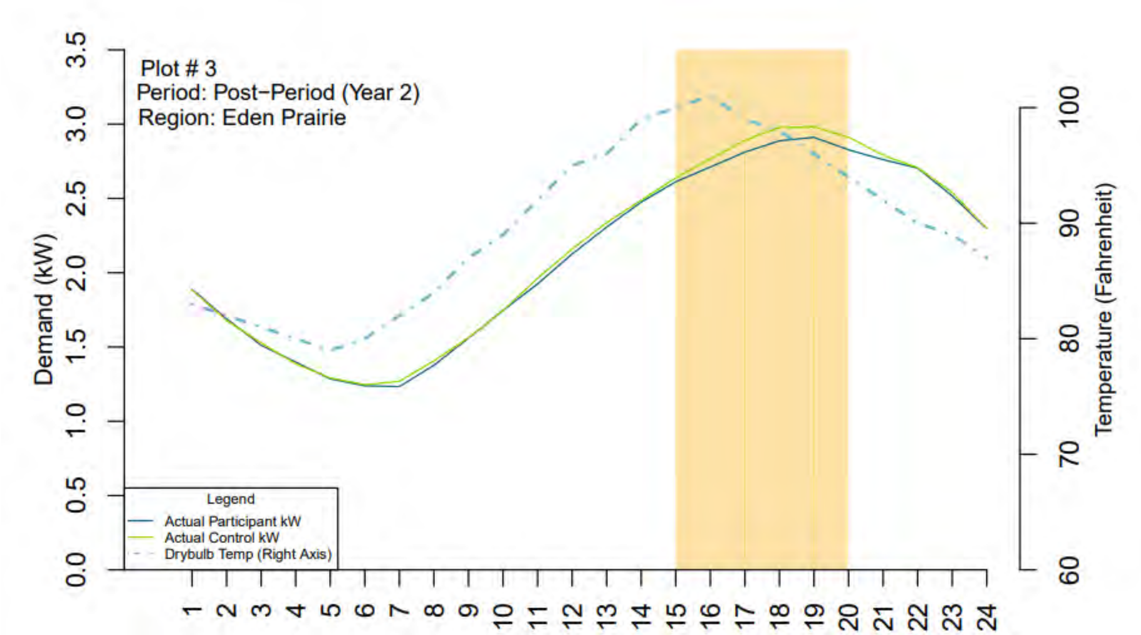
Figure 3-17. Peak Demand Day – Pre-Period – Eden Prairie



Source: Guidehouse analysis

Figure 3-18 shows the average demand of the same customers but on the system peak demand day in 2022 (June 20, 2022). Note the clear drop in demand of participants relative to controls during the On-Peak period.

Figure 3-18. Peak Demand Day – TOU Year 2 – Eden Prairie



Source: Guidehouse analysis

Similar figures corresponding to Minneapolis customers are available in Appendix X2, attached to this report.

3.4.2 Segment-Specific Coincident Peak Demand Impacts

Table 3-12 provides the estimated coincident impacts by segment for the system peak occurring in summer 2022. Coincident impacts by segment for the system peak in the first year of the pilot (summer 2021) can be found in Appendix X3. This table follows the same conventions as Table 3-3 and Table 3-4 by showing both incremental and total average per-customer impacts. Impacts for both study areas are shown in the same table.

As with the many of the On-Peak segment-specific impacts, despite the overall average impact being jointly statistically significant, most segment-specific estimates are not individually statistically significant, though a few estimates (e.g., the base impact or general population for Eden Prairie) are close to statistical significance, with a relative precision somewhat higher than 100%. Caution should be used when interpreting results, given the share of participants in the segment and the magnitude of the incremental segment-specific effect. In Eden Prairie, seniors appear to be a appear to be a key driver of coincident peak demand reductions and in Minneapolis, renters and seniors contribute to coincident peak demand increases.

Table 3-12. Coincident Peak Demand Impacts by Segment –Year 2

Study Area	Segment	Mean Incremental kW Impact	Relative Precision (+/-) at 90% Confidence (Incremental Impact)	Mean Total kW Impact	Relative Precision (+/-) at 90% Confidence (Total Impact)	% of Sample Assigned to Segment
Eden Prairie	**Base Impact**	**-0.057**	**115%**	**-0.057**	**115%**	**100%**
	Electric Vehicles	-0.476	111%	-0.533	99%	1%
	Low Income	0.010	2606%	-0.048	535%	3%
	Renters	0.018	689%	-0.040	291%	15%
	Seniors	-0.050	192%	-0.107	82%	39%
	Smart Thermostats	0.015	642%	-0.042	230%	38%
	Overall Average	**-**	**-**	**-0.074**	**58%**	**100%**
Minneapolis	**Base Impact**	**0.013**	**570%**	**0.013**	**570%**	**100%**
	Electric Vehicles	-0.035	1330%	-0.022	2092%	1%
	Low Income	-0.072	100%	-0.059	139%	35%
	Renters	0.000	33251%	0.013	465%	63%
	Seniors	0.053	155%	0.066	137%	25%
	Smart Thermostats	0.010	856%	0.023	429%	24%
	Overall Average	**-**	**-**	**0.003**	**1182%**	**100%**

Note: Rows highlighted in red indicate estimated impacts that are not statistically significant at the 90% confidence level. "Incremental kW impact" reflects the change in estimated demand impact from a customer being part of a particular segment; it is additive to the "Base Impact" and to the incremental impact of other segments to which the customer belongs. "Total kW Impact" reflects the estimated demand impact for a customer of a given segment, but only if that customer belongs to that segment and no others.

Source: Guidehouse analysis

In contrast with the first year of the pilot, renters, seniors, and smart thermostat owners in Minneapolis do not contribute incremental demand savings during the coincident peak in year 2. Similarly, in Eden Prairie, segment-specific incremental demand reductions from smart thermostat owners and renters fell in the second year of the pilot.

3.5 Energy Impacts

In Section 3.1, Guidehouse reported on the average demand (kW) impact per TOU period. The energy impacts provided in this section are calculated directly from the same estimated regression parameters as those in Section 3.1 and provide a robust estimate of the impact of the pilot on participant demand during the second year. In TOU impact evaluations, TOU period demand impacts are frequently the core output because they effectively normalize for the differing lengths of TOU periods and make it easier to compare response across periods on an "apples-to-apples" basis. Overall energy impacts, however, are important as well, particularly when aggregated across TOU periods to identify to what degree overall response may be the result of either shifting[44] or conservation.

Average net energy impacts are small, as might be expected given the revenue-neutral rate design. On average, annual energy consumption increased by 0% to 0.5%, with some minor variation across study areas and pilot years. This corresponds to an annual increase in

[44] In the TOU evaluation literature the migration of energy consumption from higher-price to lower-priced periods is typically referred to as "shifting." It should be noted, however, that while the evaluation can estimate an increase in one period and a decrease in another, this may be a result of true shifting (e.g., running a dishwasher later in the day) or simply the result of the different combinations of reductions and increases combined together (e.g., reducing A/C use during the On-Peak period, but increasing lighting use during Off-Peak periods).

energy consumption of 30 kWh or less, on average. The magnitude of these impacts is trivial and not practically significant.

This section reports on:

- **Average Energy Impacts.** The estimated average annual energy impacts of the TOU pilot per participant in Eden Prairie and Minneapolis by TOU period, by season, and in total for the second year of the pilot

- **Average Energy Impacts by Segment.** The estimated average annual energy impacts of the TOU pilot per participant who is uniquely a member of each segment, by season, and in total for the second year of the pilot

- **Average Energy Impacts – High-Impact Participants.** The estimated average annual energy impacts of the TOU pilot per high-impact participant in Eden Prairie and Minneapolis by TOU period, by season, and in total. The energy impacts in this section are an average across both years of the pilot.

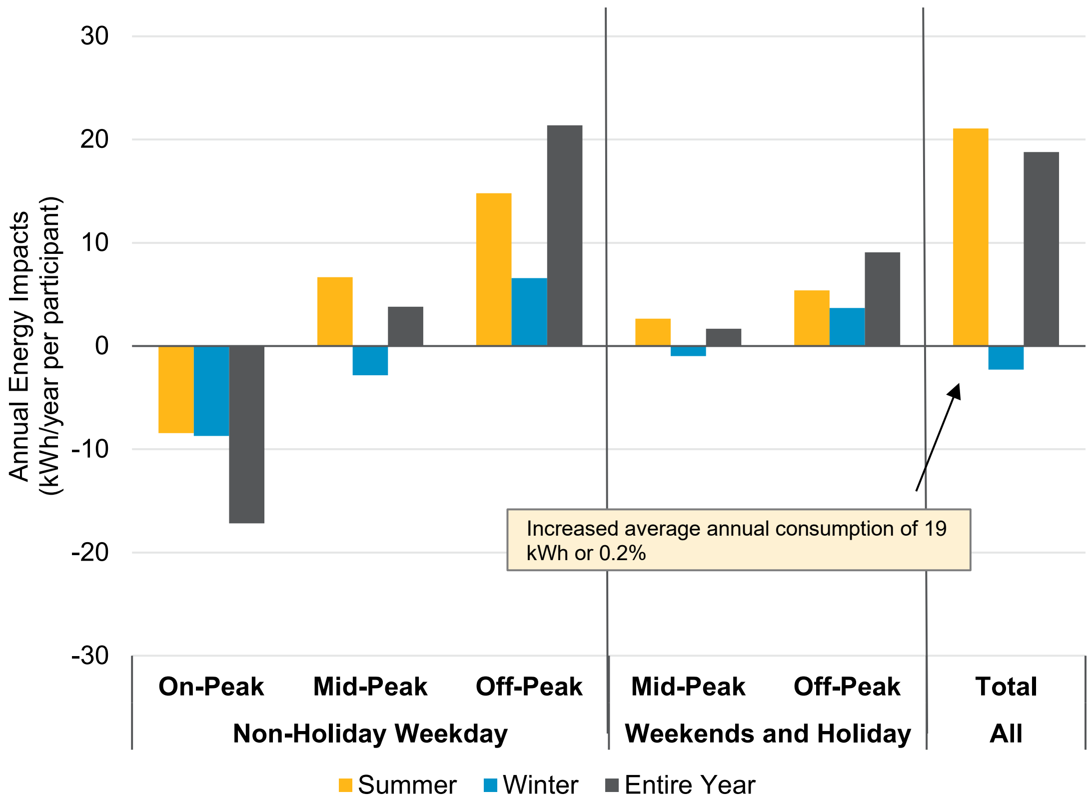
Energy impacts for year 1 of the pilot can be found in Appendix X3 and are included in the interim report.

3.5.1 Average Energy Impacts

Estimated average (per participant) annual energy impacts are calculated by taking the product of the estimated demand impact in each of the periods (e.g., summer On-Peak, summer Mid-Peak weekends, summer Mid-Peak weekdays, etc.) and the number of hours in the year during which those periods apply. The average annual energy impact for participants in Eden Prairie can be seen in Figure 3-19. As in previous diagrams and tables, a negative value indicates a consumption reduction.

Eden Prairie participants increased their energy consumption in the summer by 21 kWh on average. Reduced energy consumption in the winter did not fully offset the summer increase, resulting in an annual increase of 19 kWh (0.2%) on average. The magnitude of these impacts is trivial and not practically significant, and it is attributable to random noise in the data.

Figure 3-19: Average Annual Energy Impacts – Eden Prairie, Year 2



Source: Guidehouse analysis

Table 3-13 below presents the same information in tabular form. Rows highlighted in red indicate estimated impacts that are not statistically significant at the 90% confidence level

Table 3-13. Average Annual Demand and Energy Impacts – Eden Prairie, Year 2

Season	Day-Type	TOU Period	Mean kW Impact	Hours in Period	Mean kWh Impact
Summer	Non-Holiday Weekday	On-Peak	-0.020	430	-8.4
		Mid-Peak	0.006	1118	6.7
		Off-Peak	0.029	516	14.8
	Weekends and Holiday	Mid-Peak	0.004	648	2.7
		Off-Peak	0.025	216	5.4
	Total		**0.007**	**2928**	**21.1**
Winter	Non-Holiday Weekday	On-Peak	-0.010	840	-8.7
		Mid-Peak	-0.001	2184	-2.8
		Off-Peak	0.007	1008	6.6
	Weekends and Holiday	Mid-Peak	-0.001	1350	-1.0
		Off-Peak	0.008	450	3.7
	Total		**0.000**	**5832**	**-2.3**
Entire Year	**Total**		**0.002**	**8760**	**18.8**

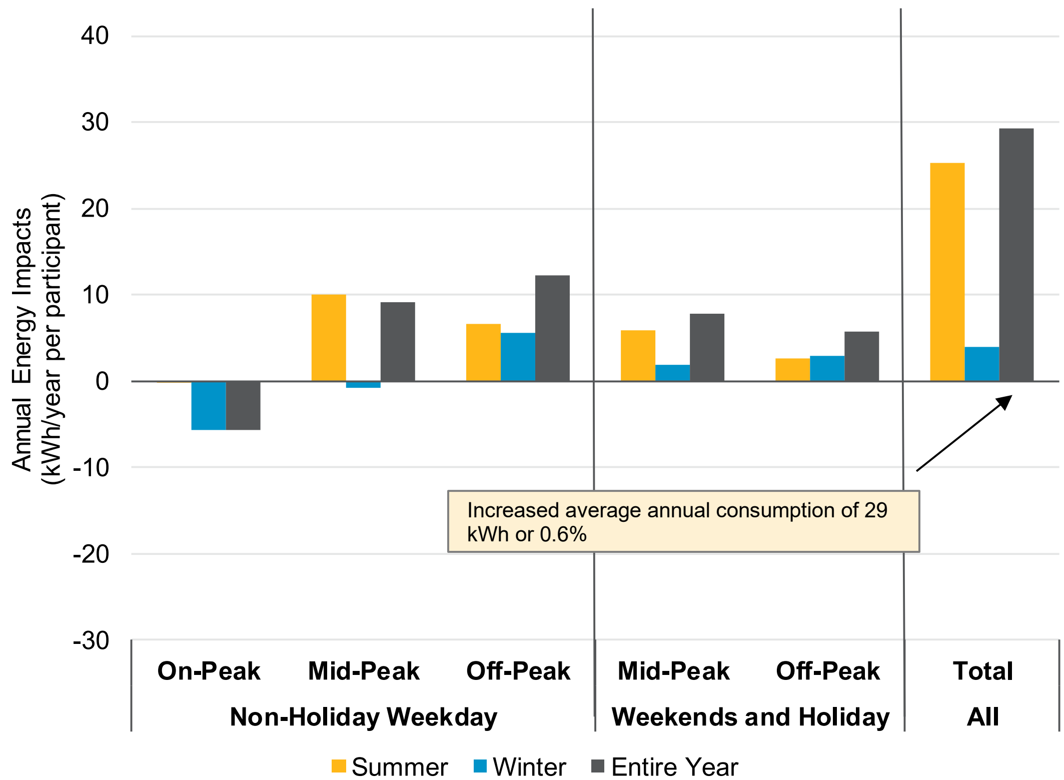
Note: Rows highlighted in red indicate estimated impacts that are not statistically significant at the 90% confidence level.

Source: Guidehouse analysis

Figure 3-20 and Table 3-14 show the average annual energy impacts for a participant in Minneapolis exposed to TOU for an entire year.

Minneapolis participants increased their energy consumption in both the summer and winter seasons, resulting in an annual increase of 29 kWh on average (0.6%). The magnitude of these impacts is trivial and not practically significant, and it is attributable to random noise in the data.

Figure 3-20: Average Annual Energy Impacts – Minneapolis, Year 2



Source: Guidehouse analysis

Table 3-14 below presents the same information in tabular form. Rows highlighted in red indicate estimated impacts that are not statistically significant at the 90% confidence level

Table 3-14. Average Annual Demand and Energy Impacts – Minneapolis, Year 2

Season	Day-Type	TOU Period	Mean kW Impact	Hours in Period	Mean kWh Impact
Summer	Non-Holiday Weekday	On-Peak	0.000	430	0.0
		Mid-Peak	0.009	1118	10.0
		Off-Peak	0.013	516	6.7
	Weekends and Holiday	Mid-Peak	0.009	648	5.9
		Off-Peak	0.012	216	2.7
	Total		**0.009**	**2928**	**25.3**
Winter	Non-Holiday Weekday	On-Peak	-0.007	840	-5.7
		Mid-Peak	0.000	2184	-0.8
		Off-Peak	0.006	1008	5.6
	Weekends and Holiday	Mid-Peak	0.001	1350	1.9
		Off-Peak	0.007	450	3.0
	Total		**0.001**	**5832**	**4.0**
Entire Year	**Total**		**0.003**	**8760**	**29.3**

Note: Rows highlighted in red indicate estimated impacts that are not statistically significant at the 90% confidence level.

Source: Guidehouse analysis

3.5.2 Average Energy Impacts by Segment

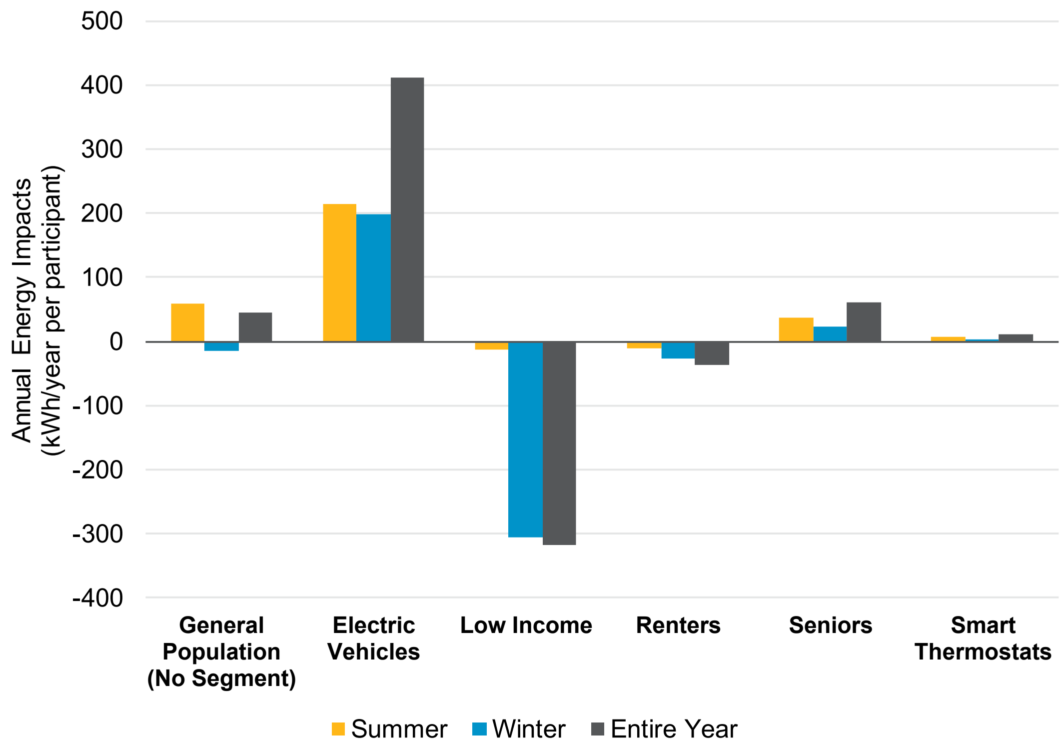
In this section, the average seasonal energy impacts are summarized by segment. There are two critical pieces of contextual information required in reviewing the results presented below:

1. **Estimates represent the average impact for a participant who is included only in the segment identified.** Because segmentation is not mutually exclusive (see Figure B-4), presenting the average impact for all customers in a segment may confound conclusions regarding which segment is driving which effect. For example, in Eden Prairie, most seniors are also smart thermostat participants. A simple average of impacts for the senior segment would be a blend of senior and smart thermostat effects. The evaluation team has applied controls in its modeling to allow for the presentation of the average impact for a customer who is a senior but not in any other segment. This is an abstraction intended to assist the interpretation of the results by removing the confounding effects of the reality that more than 60% of participants belong to more than one segment.

2. **Estimates of segment-specific impacts are highly uncertain.** As noted in Section 3.1.2, segment-specific impacts tend to have very low relative precision and, in most cases, segment-specific impacts are not statistically significant. The fact that segment-level impacts are less certain than overall impacts is a result of each segment's sample being much smaller than the overall sample, and that segment allocations are themselves estimated and thus uncertain (see Section 1.4.2).

Figure 3-21 shows the average energy impacts of a participant in Eden Prairie who is exclusively a member of a given segment. Energy impacts by TOU period may be found in Appendix X3, the spreadsheet that accompanies this report. Approximately 75% of the participants in Eden Prairie belong to the general population, seniors, or smart thermostat segments. Electric vehicle owners and low income participants account for approximately 1.3% and 3% of the participant sample in Eden Prairie, respectively.

Figure 3-21: Average Annual Energy Impacts by Segment – Eden Prairie, Year 2

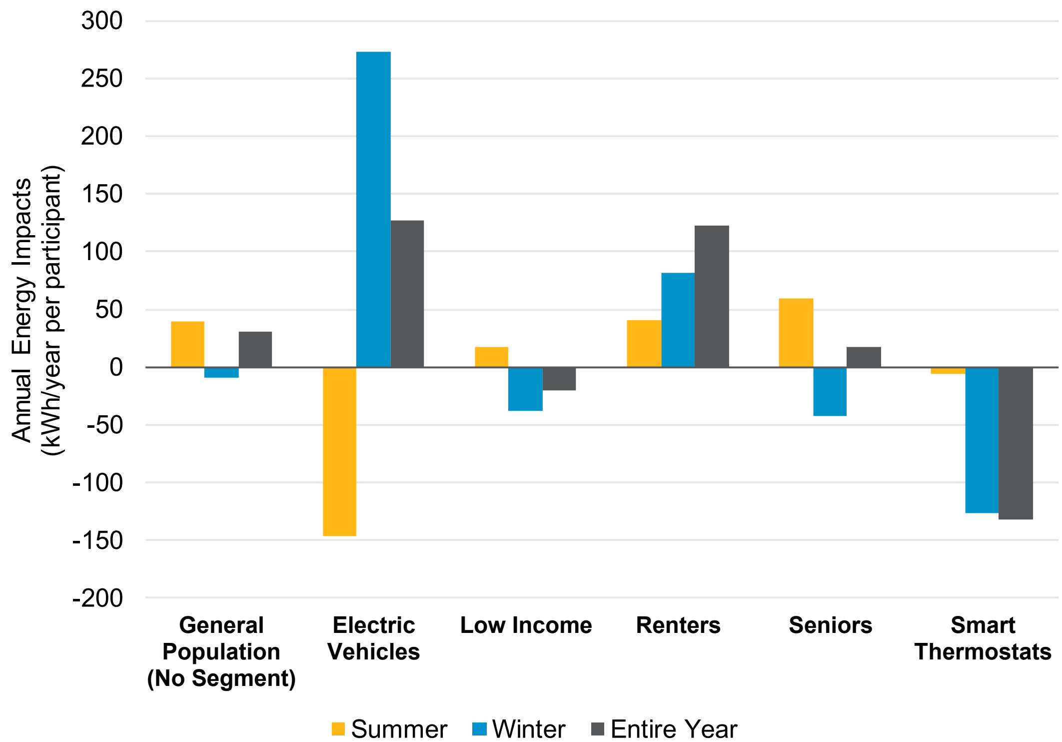


Note: Estimated energy impacts presented here are the estimated energy impacts for a participant that is in only the segment identified.

Source: Guidehouse analysis

Figure 3-22 shows the average energy impacts of a participant in Minneapolis who is exclusively a member of the given segment displayed. Energy impacts by TOU period may be found in Appendix X3, the spreadsheet that accompanies this report. Only 15% of Minneapolis participants are in the general population segment (i.e., do not belong to any other segments). Approximately two-thirds of the Minneapolis participants are either renters or smart thermostat owners, and three-quarters of low income participants are also either renters or smart thermostat owners.

Figure 3-22: Average Annual Energy Impacts by Segment – Minneapolis, Year 2



Note: Estimated energy impacts presented here are the estimated energy impacts for a participant that is in **only** the segment identified.
Source: Guidehouse analysis

One of the most striking features of the charts above is the very large increase in electric vehicle owners' consumption during the winter months. Care must be taken in interpreting these results because the number of electric vehicle owners is quite small, accounting for approximately 1.3% of Eden Prairie participants and 0.7% of Minneapolis participants.[45] That said, a recent evaluation of the Overnight TOU[46] rate designed for EV drivers (43% of the participants) in Ontario found that EV drivers increased their overnight summer consumption by 115% but reduced their On-Peak consumption by 10%, resulting in a net increase in consumption of 23%. Results were even more dramatic in the winter months, when EV drivers more than tripled their

[45] A further complication is the timing of EV purchases in relation to the pilot. Customers who purchased an EV after the pilot launched will have an overall increase in electricity use. To the extent EV purchases are happening at similar rates for the pilot participants and controls, the increased usage will net out. The survey responses indicate that control customers with EVs may have purchased their EVs later in the pilot period than pilot participants, although the sample size for this group is extremely small.

[46] See Section 3.3 of

Guidehouse, prepared for Ontario Energy Board, *Additional Investigation of the Benefits of an Overnight Pricing Plan*, March 2022
https://www.oeb.ca/sites/default/files/Supplemental-Report-Benefits-of-an-Overnight-Pricing-Plan-20220331.pdf.

overnight consumption. Likewise, a recent evaluation of an opt-in TOU pilot in Missouri[47] estimated summer reductions of between 405 and 63 kWh and winter increases of between 420 and 899 kWh for EV participants.

In both cases, the factors for these impacts are unknown, though two possibilities have been considered to explain the increase in net consumption. One is that EV-owning participants may be shifting charging from public charging locations (e.g., a workplace) to the home to take advantage of the lower overnight rates. Another possibility considered is that in multi-car households where one vehicle is an EV and the other is an internal combustion engine (ICE) vehicle, participation in the pilot may lead to customers favoring the use of the EV over the ICE vehicle, leading to the estimated increase in consumption and some (unobserved) decrease in gasoline use.

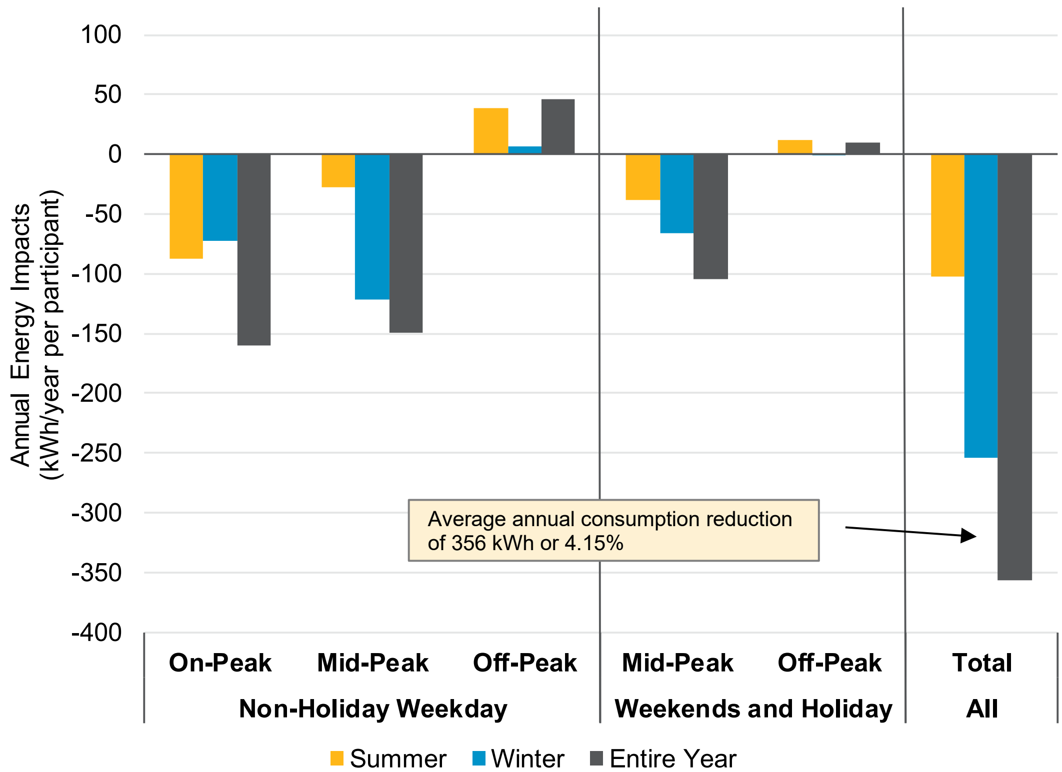
3.5.3 Average Energy Impacts – High-Impact Participants

This section summarizes the average seasonal energy impacts for high-impact participants. Estimated average (per participant) annual energy impacts are calculated by as described above. The average annual energy impact for participants in Eden Prairie can be seen in Figure 3-23. As in previous diagrams and tables, a negative value indicates a consumption reduction.

Eden Prairie high-impact participants reduced their energy consumption in the summer by 103 kWh on average. Reduced energy consumption was even greater in the winter, resulting in annual reductions of 357 kWh (4.15%) on average. Across seasons, average demand reductions were similar, with an average demand reduction per participant of 0.035 kW in summer and 0.044 kW in winter. These energy impacts suggest Eden Prairie high-impact participants are reducing, more than shifting, load in response to the TOU rate.

[47] See Figure A-7 of Appendix A of
Guidehouse, prepared for Evergy, *Evergy Missouri Residential Time-of-Use Rate Evaluation*, December 2021 **https://www.efis.psc.mo.gov/mpsc/commoncomponents/view_itemno_details.asp?caseno=ER-2018-0146&attach_id=2022010845.**

Figure 3-23. Average Annual Energy Impacts – Eden Prairie, High-Impact Participants



Source: Guidehouse analysis

Table 3-15 below presents the same information in tabular form. Rows highlighted in red indicate estimated impacts that are not statistically significant at the 90% confidence level.

Table 3-15. Average Annual Demand and Energy Impacts – Eden Prairie, High-Impact Participants

Season	Day-Type	TOU Period	Mean kW Impact	Hours in Period	Mean kWh Impact
Summer	Non-Holiday Weekday	On-Peak	-0.204	430	-87.7
		Mid-Peak	-0.025	1118	-27.8
		Off-Peak	0.076	516	39.1
	Weekends and Holiday	Mid-Peak	-0.059	648	-38.0
		Off-Peak	0.054	216	11.6
	Total		**-0.035**	**2928**	**-102.8**
Winter	Non-Holiday Weekday	On-Peak	-0.087	840	-72.8
		Mid-Peak	-0.055	2184	-121.1
		Off-Peak	0.007	1008	7.2
	Weekends and Holiday	Mid-Peak	-0.049	1350	-66.0
		Off-Peak	-0.003	450	-1.3
	Total		**-0.044**	**5832**	**-254.0**
Entire Year	**Total**		**-0.041**	**8760**	**-356.7**

Note: Rows highlighted in red indicate estimated impacts that are not statistically significant at the 90% confidence level.
Source: Guidehouse analysis

Figure 3-24 and Table 3-16 show the average annual energy impacts for a participant in Minneapolis exposed to TOU for an entire year.

Minneapolis participants reduced their energy consumption in the summer by an average of 72 kWh but increased their energy consumption in winter, resulting in an annual reduction of 22 kWh on average (0.4%). The magnitude of these impacts is trivial and not practically significant, given the seasonal impacts largely offset each other.

Figure 3-24: Average Annual Energy Impacts – Minneapolis, High-Impact Participants

Source: Guidehouse analysis

Table 3-16 below presents the same information in tabular form. Rows highlighted in red indicate estimated impacts that are not statistically significant at the 90% confidence level.

Table 3-16. Average Annual Demand and Energy Impacts – Minneapolis, Year 2

Season	Day-Type	TOU Period	Mean kW Impact	Hours in Period	Mean kWh Impact
Summer	Non-Holiday Weekday	On-Peak	-0.140	430	-60.3
		Mid-Peak	-0.017	1118	-18.8
		Off-Peak	0.046	516	24.0
	Weekends and Holiday	Mid-Peak	-0.038	648	-24.8
		Off-Peak	0.036	216	7.7
	Total		**-0.025**	**2928**	**-72.1**
Winter	Non-Holiday Weekday	On-Peak	-0.042	840	-35.2
		Mid-Peak	0.008	2184	18.1
		Off-Peak	0.047	1008	47.6
	Weekends and Holiday	Mid-Peak	0.002	1350	2.6
		Off-Peak	0.038	450	17.0
	Total		**0.009**	**5832**	**50.0**
Entire Year	**Total**		**-0.003**	**8760**	**-22.2**

Note: Rows highlighted in red indicate estimated impacts that are not statistically significant at the 90% confidence level.
Source: Guidehouse analysis

3.6 Customer Bill Impacts

This section provides estimated average customer bill impacts, which are calculated from the difference between the TOU and Standard rates and the energy impacts provided in Section 3.5.

Average bill impacts are quite small, as would be expected given the revenue-neutral rate-setting approach. The average net impact on customer bills across all participants was less than $1.50 per month. On average, the transition from Standard to TOU rates is estimated to have reduced the average participant monthly bill in the winter months and increased the average participant monthly bill in summer months.

Two types of bill impacts are presented in this section. Each is discussed separately in its own subsection:

- **Behavioral Bill Impacts:** These are the average bill impacts calculated by comparing what average participant monthly energy charges would have been under TOU rates had there been no behavioral response (i.e., the estimated baseline) with average monthly energy charges resulting from observed average demand.
- **Net Bill Impacts:** These are the average bill impacts calculated by comparing what average participant monthly energy charges would have been under Standard rates (and without any behavioral changes associated with TOU response) with average monthly energy charges based on TOU rates and the estimated TOU behavior response.

3.6.1 Behavioral Bill Impacts

The behavioral bill impact is the estimated average impact on the bill of a customer subject to TOU rates stemming from their response to that TOU rate. This bill impact reflects the difference between what the average participant would have paid under TOU rates had they made no changes to their behavior and what they actually paid. Behavioral bill impacts therefore compare two conditions:

- The average participant bill calculated with TOU rates applied to observed average hourly consumption under the TOU pilot; and
- The average participant bill calculated with TOU rates applied to estimated baseline hourly consumption. All estimated TOU period impacts (including those not statistically significant at the 90% confidence level) were used to derive these bill impacts.

Table 3-17 presents these average monthly TOU impacts by study area, TOU period, day-type, and season. Bill reductions are represented as negative values, and increases are represented as positive values. Participants in Eden Prairie achieved average bill savings of approximately $0.13 per month in the summer months, driven by their On-Peak savings. Participants in Minneapolis saw an increase in bills of approximately $0.42 per month in the summer months. This was due to no measurable change in consumption during On-Peak hours and an increase in consumption during periods outside of the On-Peak period. In the winter months, participants in Eden Prairie achieved average bill savings of approximately $0.21 per month, while those in Minneapolis achieved savings of $0.10 per month.

Table 3-17. Average Behavioral Bill Impacts, Year 2

Season	Day-Type	TOU Period	Average Monthly Behavioral Bill Impact ($/Month)	
			Eden Prairie	Minneapolis
Summer	Non-Holiday Weekday	On-Peak	-$0.48	$0.00
		Mid-Peak	$0.15	$0.23
		Off-Peak	$0.10	$0.05
	Weekends and Holiday	Mid-Peak	$0.06	$0.13
		Off-Peak	$0.04	$0.02
	All	**Total**	**-$0.13**	**$0.42**
Winter	Non-Holiday Weekday	On-Peak	-$0.21	-$0.14
		Mid-Peak	-$0.03	-$0.01
		Off-Peak	$0.02	$0.02
	Weekends and Holiday	Mid-Peak	-$0.01	$0.02
		Off-Peak	$0.01	$0.01
	All	**Total**	**-$0.21**	**-$0.10**

Source: Guidehouse analysis

Table 3-18 presents the average monthly TOU impacts by study area, TOU period, day-type, and season for high-impact participants across both years of the pilot. Bill reductions are represented as negative values, and increases are represented as positive values. High impact participants in Eden Prairie achieved average behavioral bill savings of approximately $6.08 per month in the summer months, driven by their On-Peak savings. High impact participants in Minneapolis also saw a reduction in bills of approximately $4.16 per month in the summer months. In the winter months, high-impact participants in Eden Prairie achieved average bill savings of approximately $3.49 per month, while those in Minneapolis achieved savings of $0.43 per month.

Table 3-18. Average Behavioral Bill Impacts, High-Impact Participants

Season	Day-Type	TOU Period	Average Monthly Behavioral Bill Impact ($/Month)	
			Eden Prairie	Minneapolis
Summer	Non-Holiday Weekday	On-Peak	-$4.95	-$3.40
		Mid-Peak	-$0.63	-$0.42
		Off-Peak	$0.27	$0.17
	Weekends and Holiday	Mid-Peak	-$0.86	-$0.56
		Off-Peak	$0.08	$0.05
	All	**Total**	**-$6.08**	**-$4.16**
Winter	Non-Holiday Weekday	On-Peak	-$1.75	-$0.85
		Mid-Peak	-$1.14	$0.17
		Off-Peak	$0.02	$0.17
	Weekends and Holiday	Mid-Peak	-$0.62	$0.02
		Off-Peak	$0.00	$0.06
	All	**Total**	**-$3.49**	**-$0.43**

Source: Guidehouse analysis

Even in Eden Prairie, where material average demand reductions were achieved in the On-Peak periods, **the average bill impact of this price response is small or imperceptible for many customers** – a 13 cent per month benefit may not be noticed. **A lack of payoff may discourage future price response**, particularly if participants are adopting cumbersome or inconvenient forms of price response (e.g., shifting laundry or dishwasher runs). For example, a customer who reduces their On-Peak consumption by 25% and makes no changes to consumption in other periods—a drastic response to the TOU rate—will save approximately $6 per month or 9% of their total bill.

Customer feedback gathered through surveys supports this finding, with 37% of participants reporting that they did not know how the TOU rate impacted their bill and 29% of participants reporting feeling neutral toward the pilot (see Section 4.3). In open-ended responses, multiple survey respondents shared sentiments around confusion on how the TOU pricing and accompanying usage during different periods would affect their monthly bill, and if efforts to reduce On-Peak usage would actually translate to substantial savings. For example, one customer stated "In the beginning it was very confusing, and I don't believe that I have actually saved money. My family has done a lot to conserve energy, but I am not seeing any savings."

A meta-analysis of Ontario TOU pilots noted the challenges for utilities of such frustration: *"…the focus group analysis* [identified that] *… participants felt let down by a perceived differential between their level of effort and their achieved savings. Some participants in these focus group sessions indicated that they were dissatisfied with their bill credit, and further indicated that the effort expended did not seem* 'worthwhile as compared to the savings'". [48]

3.6.2 Net Bill Impacts

Net bill impacts are the estimated average bill impacts of switching from the residential Standard rate to the TOU rate. Net bill impacts consider the base case as the average participant bill

[48] See Section 2.2.2 of:
Guidehouse, prepared for the Ontario Energy Board, *Regulated Price Plan Pilot Meta-Analysis – Final Report*, December 2020,
https://www.oeb.ca/sites/default/files/report-RPP-Pilot-Meta-Analysis-20211110.pdf.

when participants are subject to the Standard residential rate and participants continue to consume electricity according to their pre-TOU patterns. The net bill impacts therefore compare two conditions:

- The average participant bill calculated with TOU rates applied to observed average hourly consumption under the TOU pilot, and
- The average participant bill calculated with the Standard residential rate applied to estimated baseline hourly consumption during the same period.

As such, the net bill impacts capture both the behavioral bill impacts from changes in consumption patterns and the structural bill impacts, which reflect deviations between the assumptions used to set the revenue-neutral TOU rate (e.g., weather and load profile forecasts) and the observed weather and actual pilot behavior.

The most obvious deviation between revenue-setting assumptions and observed behavior is that rates were set using a system-average load profile, rather than a set of geography-specific load profiles. As such, given the differences between the Eden Prairie (peakier) and Minneapolis (flatter) load profiles as compared to a system-average load profile, participants in each of these study areas will, on average, experience some bill impacts driven by changes to the rate structure.

Table 3-19 shows the average monthly net bill impacts by TOU period and season as well as the overall monthly average impact across the second year for Eden Prairie participants. The net bill impacts are relatively minor. On average, for Eden Prairie participants, there is a net increase in average summer bills due to the high price for On-Peak consumption, a net decrease in average winter bills due to the Mid- and Off-Peak period discounts, and an average annual increase in energy charges of approximately $0.37 per month.

Table 3-19. Average Monthly Net Bill Impacts – Eden Prairie, Year 2

Season	Day-Type	TOU Period	Average Monthly Energy Charges ($/Month)		Estimated Impact ($/Month)
			Status Quo	Under TOU	
Summer	Non-Holiday Weekday	On-Peak	$18.08	$39.14	$21.07
		Mid-Peak	$33.99	$29.89	-$4.10
		Off-Peak	$10.41	$2.92	-$7.49
	Weekends and Holiday	Mid-Peak	$20.41	$17.92	-$2.49
		Off-Peak	$4.22	$1.18	-$3.04
	All	**Total**	**$87.11**	**$91.05**	**$3.94**
Winter	Non-Holiday Weekday	On-Peak	$9.45	$20.47	$11.02
		Mid-Peak	$21.14	$18.02	-$3.12
		Off-Peak	$7.30	$2.33	-$4.97
	Weekends and Holiday	Mid-Peak	$14.11	$12.04	-$2.07
		Off-Peak	$3.35	$1.07	-$2.28
	All	**Total**	**$55.36**	**$53.94**	**-$1.42**
Overall Annual Average					**$0.37**

Note: "Status Quo" references a case where the average participant bill is calculated using the Standard residential rate applied to estimated baseline hourly consumption, and "Under TOU" references a case where the average participant bill is calculated with the TOU rates applied to hourly consumption under the TOU pilot.

Source: Guidehouse analysis

Table 3-20 shows the average monthly net bill impacts by TOU period and season as well as the overall monthly average impact over the year for Minneapolis participants. On average, for

Minneapolis participants, the benefits of the non-On-Peak discounts in winter outweigh the additional costs of the On-Peak period consumption, leading to an average net bill reduction of nearly $1.08 per month.

Table 3-20. Average Monthly Net Bill Impacts – Minneapolis, Year 2

Season	Day-Type	TOU Period	Average Monthly Energy Charges ($/Month)		Estimated Impact ($/Month)
			Status Quo	Under TOU	
Summer	Non-Holiday Weekday	On-Peak	$9.85	$21.60	$11.74
		Mid-Peak	$20.77	$18.40	-$2.37
		Off-Peak	$7.82	$2.16	-$5.66
	Weekends and Holiday	Mid-Peak	$12.03	$10.66	-$1.37
		Off-Peak	$3.16	$0.87	-$2.29
	All	**Total**	**$53.64**	**$53.69**	**$0.05**
Winter	Non-Holiday Weekday	On-Peak	$5.87	$12.71	$6.84
		Mid-Peak	$13.83	$11.80	-$2.03
		Off-Peak	$5.20	$1.67	-$3.54
	Weekends and Holiday	Mid-Peak	$8.97	$7.67	-$1.29
		Off-Peak	$2.39	$0.77	-$1.62
	All	**Total**	**$36.26**	**$34.62**	**-$1.65**
Overall Annual Average					**-$1.08**

Note: Status Quo references a case where the average participant bill is calculated using the Standard residential rate applied to estimated baseline hourly consumption, and Under TOU references a case where the average participant bill is calculated with the TOU rates applied to hourly consumption under the TOU pilot.

Source: Guidehouse analysis

Figure 3-25 displays the overall average monthly bill impact values by season and study area (from Table 3-19 and Table 3-20). This figure also includes the percentage increase (positive numbers) or savings (negative numbers) as a label at the end of each bar. Note that the denominator for the percentage bill impacts includes the average monthly customer charge.[49]

On-Peak consumption is a key driver of the differences between study areas: on average, participants in Eden Prairie use approximately 1.8 times as much energy during the summer On-Peak period as participants in Minneapolis. This may reflect the fact that central air conditioning is more common in Eden Prairie than in Minneapolis: the final survey found that while 96% of Eden Prairie participants have central air conditioning, only 47% of Minneapolis participants do.

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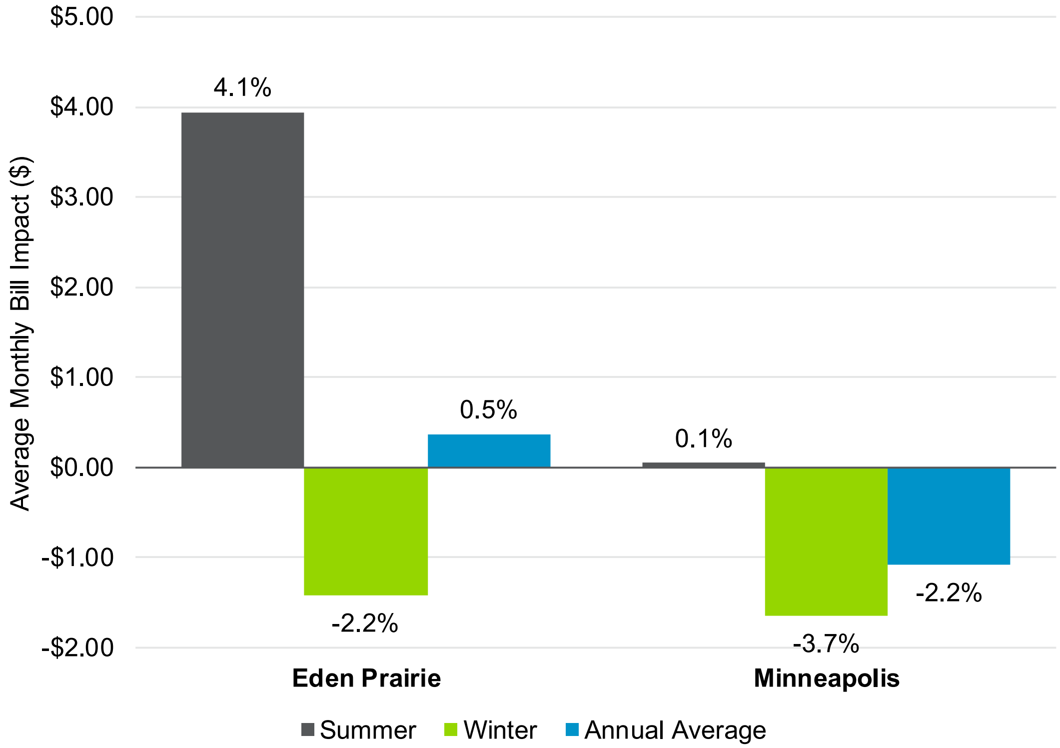
[49] As the participants are a mix of A01 (overhead) and A03 (underground) customers, the average monthly customer charge applied is an average of A01 and A02 customer charges, weighted by the number of participants in each category.

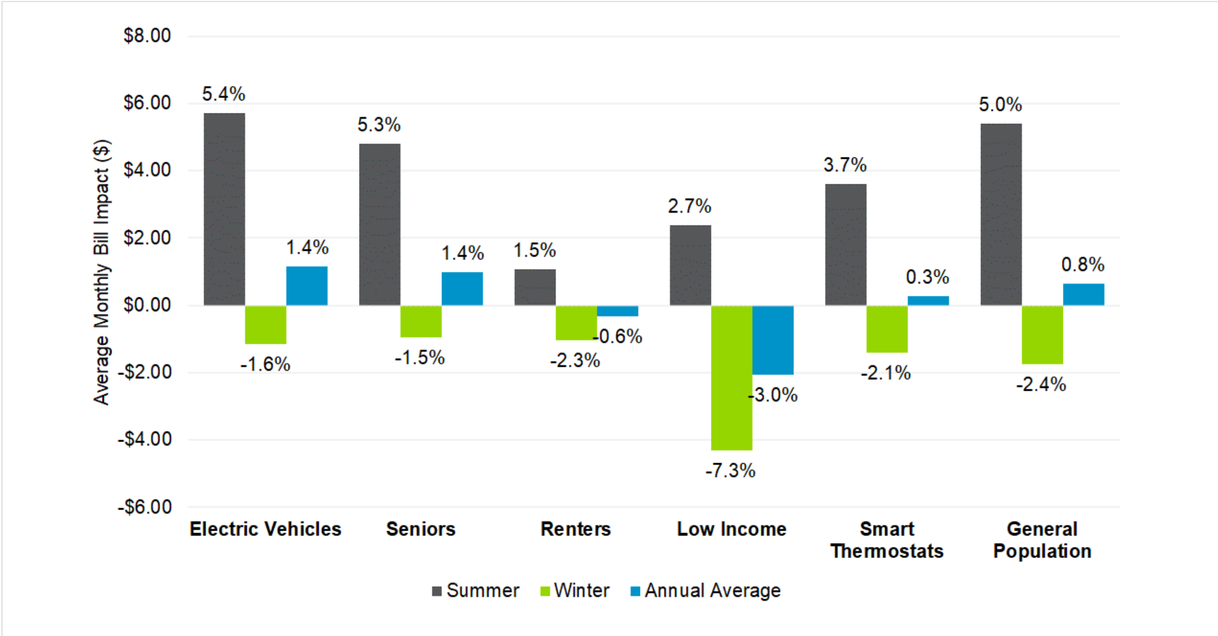
Figure 3-25. Average Monthly Net Bill Impacts by Season and Study Area, Year 2



Note: The summer period consists of 4 months, and the winter period 8 months. The annual impact (shown in blue) is a weighted average of the seasonal impacts (in grey and green).
Source: Guidehouse analysis

Figure 3-26 presents the average monthly net bill impact for each segment in summer, winter, and overall across the year in Eden Prairie. The average net bill impacts presented here are for a participant who belongs only to the segment in question. These values are based on segment-specific predicted baseline demand and model-predicted TOU period demand (as opposed to actual observed participant demand). The reason for the use of in-sample predictions (as opposed to actual averages) is to provide a clear split in the segments and avoid any potential confusion that could arise in interpretation where a high degree of overlap occurs across some segments.

Figure 3-26. Segment-Specific Net Bill Impacts - Eden Prairie, Year 2



Note: Estimated bill impacts presented here are the estimated bill impacts for a participant who is only in the segment identified. The summer period consists of 4 months, and the winter period 8 months. The annual impact (shown in blue) is a weighted average of the seasonal impacts (in grey and green).

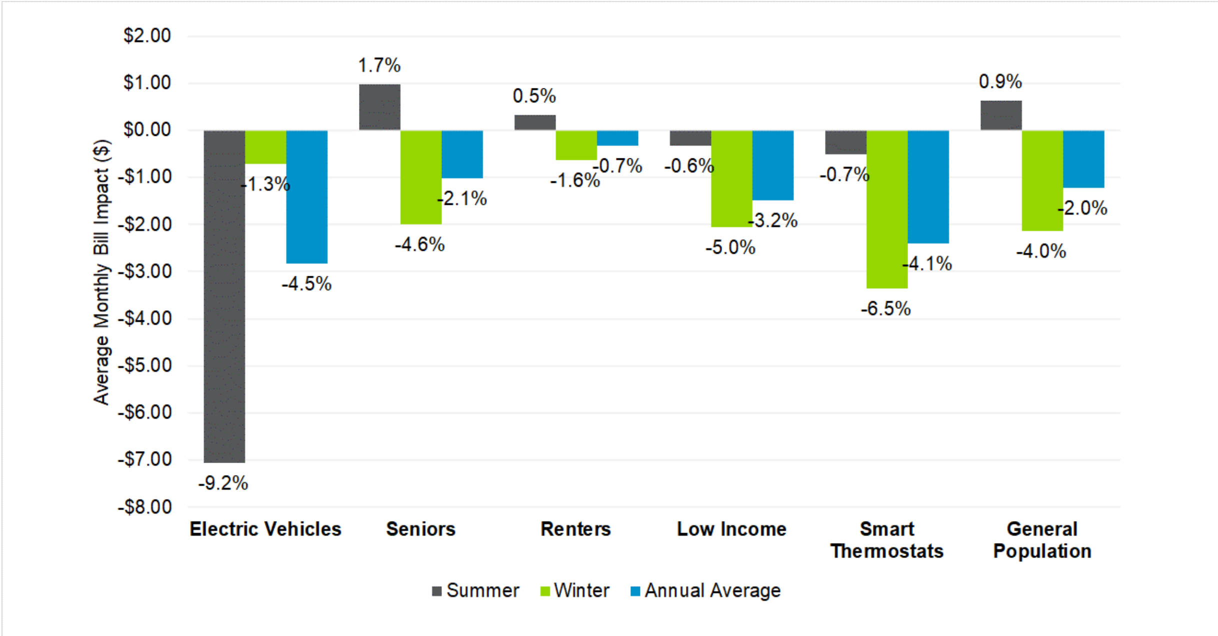
Source: Guidehouse analysis

The general pattern for Eden Prairie (highlighted in Figure 3-25) is relatively consistent across nearly all segments presented above, with higher summer On-Peak costs outweighing Mid- and Off-Peak discounts in the summer. This led to summer average monthly bill increases of as much as 5.4% in some groups. On average bill reductions in winter largely offset these increases when the year is considered as a whole.

Figure 3-27 presents the average monthly net bill impact for each segment in summer, winter, and overall across the year in Minneapolis. The pattern of seasonal impacts is generally consistent across segments, with bills falling or nearly static in the summer for the most populous segments and bills falling somewhat for all segments in the winter. Looking at the year as a whole, monthly bills decreased by 1-3% for the most populous segments.

Notably, customers in the low income segment saw annual bill reductions of approximately 3% on average, and the reduction is relatively consistent across study areas and pilot years.

Figure 3-27. Segment-Specific Net Bill Impacts – Minneapolis, Year 2



Note: Estimated bill impacts presented here are the estimated bill impacts for a participant who is only in the segment identified. The summer period consists of 4 months, and the winter period 8 months. The annual impact (shown in blue) is a weighted average of the seasonal impacts (in grey and green).

Source: Guidehouse analysis

Table 3-21 shows the average monthly net bill impacts by TOU period and season as well as the overall monthly average impact across both years for Eden Prairie high-impact participants. On average, the benefits of the Mid- and Off-Peak discounts in winter and summer outweigh the additional costs of the On-Peak period consumption, leading to an average net bill reduction of $3.89 per month.

Table 3-21. Average Monthly Net Bill Impacts – Eden Prairie, High-Impact Participants

	Day-Type	TOU Period	Average Monthly Energy Charges ($/Month)		Estimated Impact ($/Month)
			Status Quo	Under TOU	
Summer	Non-Holiday Weekday	On-Peak	$17.78	$34.02	$16.24
		Mid-Peak	$33.97	$29.10	-$4.87
		Off-Peak	$10.56	$3.13	-$7.43
	Weekends and Holiday	Mid-Peak	$21.26	$17.74	-$3.51
		Off-Peak	$4.34	$1.25	-$3.09
	All	**Total**	**$87.91**	**$85.25**	**-$2.67**
Winter	Non-Holiday Weekday	On-Peak	$9.79	$19.67	$9.88
		Mid-Peak	$22.04	$17.67	-$4.36
		Off-Peak	$7.35	$2.35	-$5.00
	Weekends and Holiday	Mid-Peak	$14.51	$11.77	-$2.74
		Off-Peak	$3.34	$1.05	-$2.29
	All	**Total**	**$57.03**	**$52.52**	**-$4.51**
Overall Annual Average					**-$3.89**

Note: "Status Quo" references a case where the average participant bill is calculated using the Standard residential rate applied to estimated baseline hourly consumption, and "Under TOU" references a case where the average participant bill is calculated with the TOU rates applied to hourly consumption under the TOU pilot.

Source: Guidehouse analysis

Table 3-22 shows the average monthly net bill impacts by TOU period and season as well as the overall monthly average impact over both years for Minneapolis high-impact participants. On average, the benefits of the Mid- and Off-Peak discounts in winter and summer outweigh the additional costs of the On-Peak period consumption, leading to an average net bill reduction of $2.33 per month.

Table 3-22. Average Monthly Net Bill Impacts – Minneapolis, High-Impact Participants

	Day-Type	TOU Period	Average Monthly Energy Charges ($/Month)		Estimated Impact ($/Month)
			Status Quo	Under TOU	
Summer	Non-Holiday Weekday	On-Peak	$12.12	$23.15	$11.03
		Mid-Peak	$25.25	$21.67	-$3.58
		Off-Peak	$8.90	$2.57	-$6.33
	Weekends and Holiday	Mid-Peak	$15.29	$12.82	-$2.47
		Off-Peak	$3.73	$1.06	-$2.67
	All	**Total**	**$65.29**	**$61.28**	**-$4.01**
Winter	Non-Holiday Weekday	On-Peak	$7.00	$14.47	$7.47
		Mid-Peak	$16.37	$14.14	-$2.22
		Off-Peak	$5.48	$1.90	-$3.58
	Weekends and Holiday	Mid-Peak	$10.49	$8.98	-$1.51
		Off-Peak	$2.48	$0.84	-$1.64
	All	**Total**	**$41.82**	**$40.34**	**-$1.48**
Overall Annual Average					**-$2.33**

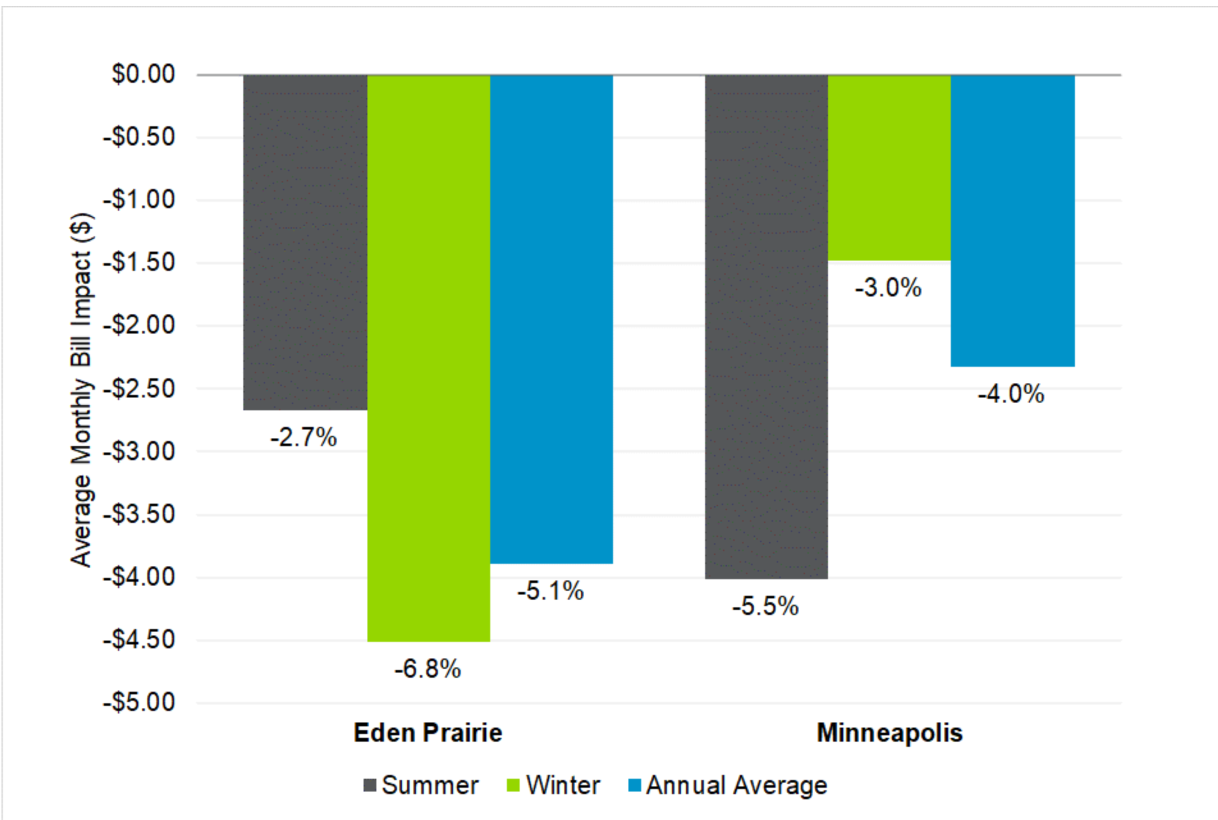
Note: Status Quo references a case where the average participant bill is calculated using the Standard residential rate applied to estimated baseline hourly consumption, and Under TOU references a case where the average participant bill is calculated with the TOU rates applied to hourly consumption under the TOU pilot.

Source: Guidehouse analysis

Figure 3-28 displays the overall average monthly bill impact values by season and study area (from Table 3-21 and Table 3-22) for high-impact participants. This figure also includes the percentage increase (positive numbers) or savings (negative numbers) as a label at the end of each bar. Note that the denominator for the percentage bill impacts includes the average monthly customer charge.[50]

Even amongst the most engaged participants, bill reductions are modest, amounting to less than a cup of coffee, at $4 or less per month. For customers to maintain this level of engagement in return for a modest reduction in their electricity bills, the inconvenience of their actions needs to be minimal. Structural changes to energy usage patterns (e.g., programming thermostat schedules with efficient set points, use of appliances that enable automated response) are more likely to be maintained by customers over time than behavioral or manual actions (e.g., shifting laundry schedules).

Figure 3-28. Average Monthly Net Bill Impacts by Season and Study Area, High-Impact Participants



Note: The summer period consists of 4 months, and the winter period 8 months. The annual impact (shown in blue) is a weighted average of the seasonal impacts (in grey and green).
Source: Guidehouse analysis

[50] As the participants are a mix of A01 (overhead) and A03 (underground) customers, the average monthly customer charge applied is an average of A01 and A02 customer charges, weighted by the number of participants in each category.

3.7 DSM Analysis

For this analysis, the evaluation team used DSM program data to identify what proportion of participants and control customers participated in downstream DSM programs both before and during the pilot period. The difference-in-difference (DID) statistic is a measure of the incremental DSM participation by TOU pilot participants, over and above what would have happened absent the TOU pilot.

3.7.1 Eden Prairie DSM Participation

DSM program participation for Eden Prairie controls and participants by segment and pilot period is included in Table 3-23 as a percent of total premises in the group. Overall, participants and control customers in Eden Prairie had similar levels of downstream DSM participation both prior to and during the TOU pilot. The DID statistic suggests no incremental DSM participation by pilot participants, with the exception of low income participants (a small segment) and high impact participants.

Compared to control customers who responded to the survey, high-impact TOU pilot participants had higher DSM participation levels both prior to and during the TOU pilot. The proportional difference increased from 4 percentage points in the pre-period to 10 percentage points in the post-period, resulting in a DID statistic of 6%. This suggests that high-impact participants increased their DSM participation levels by 6% in response to the TOU pilot. These results should be interpreted with caution given the small sample size (fewer than 30 premises participating in DSM). In addition, there is no parallel high-impact control group; instead, the comparison group is all control customers who responded to the surveys. [51]

Table 3-23. DSM Participation by Segment and Pilot Period - Eden Prairie

Segment	Participants			Controls			Difference in Differences
	Pre-Pilot	Pilot	Difference	Pre-Pilot	Pilot	Difference	
EV	14%	21%	7%	11%	19%	7%	**0%**
Low Income	9%	14%	5%	10%	10%	0%	**5%**
Renters	4%	4%	0%	4%	3%	0%	**1%**
Seniors	11%	13%	2%	10%	13%	2%	**0%**
Smart Thermostat	11%	14%	3%	10%	13%	3%	**0%**
High Impact	13%	23%	10%	9%	13%	4%	**6%**
All	**10%**	**12%**	**2%**	**10%**	**12%**	**2%**	**0%**

Note: DID references the difference-in-differences, which is equal to the difference between the change in DSM participation within one group and the change in DSM participation within another group. For example, for two groups that changed their DSM program participation by the same amount between the pre-period and post-period, the DID is zero. The control group for high impact participants is survey respondent controls.

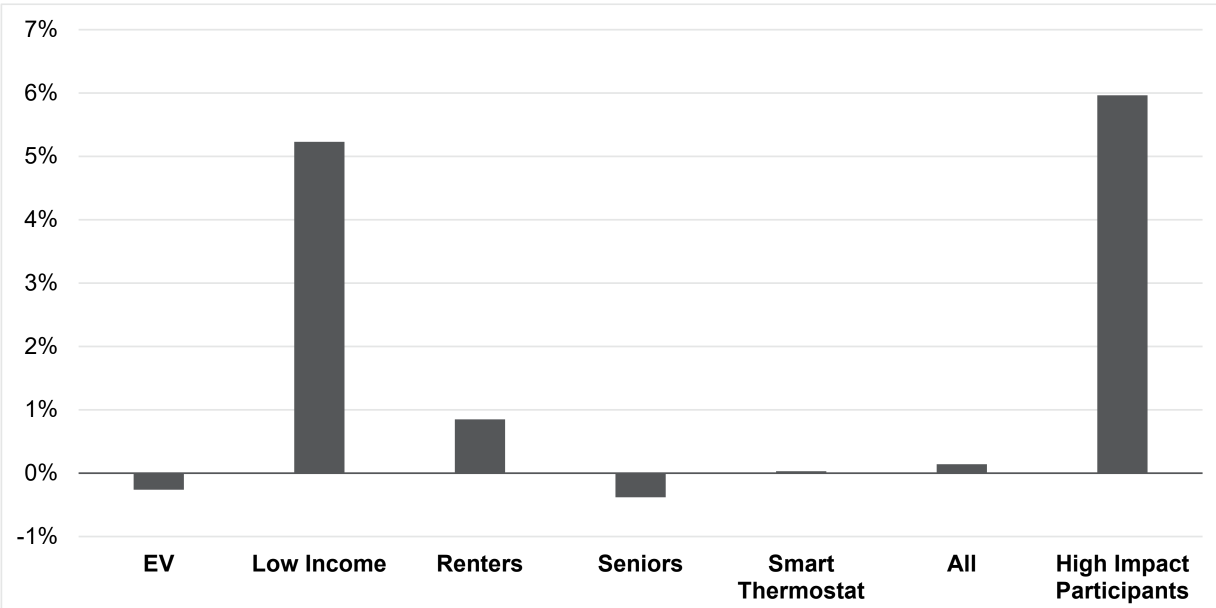
Source: Guidehouse analysis

Figure 3-29 illustrates the DID statistic, with positive value indicating increased levels of DSM participation for TOU participants, and negative values indicating decreased levels of DSM participation. For most segments, the DID statistic is close to zero. One exception is the low

[51] High impact participants have characteristics that may, in addition to increasing their On-Peak impacts, influence their likelihood of participating in DSM programs. Without a comparable control group, Guidehouse cannot confidently conclude that increases in DSM participation were attributed to the pilot versus the other factors.

income segment, with participants experiencing a 5% increase in DSM participation during the pilot period, compared to their control counterparts. This difference is likely related to the small sample size of the group. In Eden Prairie, 3.3% of participants are low income and fewer than 50 participated in DSM prior to or during the TOU pilot. Another exception is the high impact segment, where customers show an estimated 6% increase in DSM participation during the pilot period. The high-impact segment and set of DSM participants have substantial overlap due to smart thermostat purchases.

Figure 3-29. DSM Difference-in-Differences - Eden Prairie



Source: Guidehouse analysis

3.7.2 Minneapolis DSM Participation

Table 3-24 presents DSM program participation for Minneapolis controls and participants by segment and pilot period as a percent of total premises in each group. Overall, participants and control customers in Minneapolis had similar levels of downstream DSM participation both prior to and during the TOU pilot. The DID statistic suggests no incremental DSM participation by pilot participants, with the exception of high impact participants.

Compared to control customers who responded to the survey, high-impact TOU pilot participants had higher DSM participation levels both prior to and during the TOU pilot. The DID statistic suggests that high-impact participants increased their DSM participation levels by 4% in response to the TOU pilot. However, these results should be interpreted with caution given the small sample size (fewer than 30 premises participating in DSM). In addition, there is no parallel high-impact control group; instead, the comparison group is all control customers who responded to the surveys. [52]

[52] High impact participants have characteristics that may, in addition to increasing their On-Peak impacts, influence their likelihood of participating in DSM programs. Without a comparable control group, Guidehouse cannot confidently conclude that increases in DSM participation were attributed to the pilot versus the other factors.

Table 3-24. DSM Participation by Segment and Pilot Period - Minneapolis

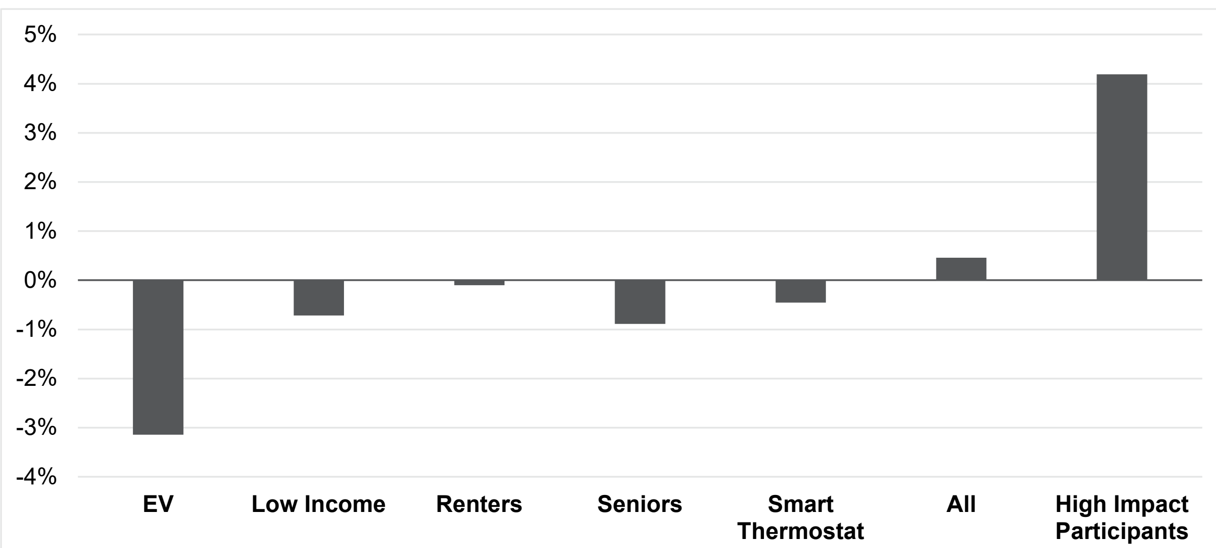
Segment	Participants			Controls			Difference in Differences
	Pre-Pilot	Pilot	Difference	Pre-Pilot	Pilot	Difference	
EV	3%	8%	6%	0%	9%	9%	**-3%**
Low Income	3%	5%	2%	3%	5%	2%	**-1%**
Renters	3%	5%	2%	3%	5%	2%	**0%**
Seniors	4%	6%	2%	3%	6%	3%	**-1%**
Smart Thermostat	5%	10%	5%	3%	8%	5%	**0%**
High Impact	11%	19%	7%	6%	9%	3%	**4%**
All	**4%**	**7%**	**3%**	**4%**	**6%**	**3%**	**0%**

Note: DID references the difference-in-differences, which is equal to the difference between the change in DSM participation within one group and the change in DSM participation within another group. For example, for two groups that changed their DSM program participation by the same amount between the pre-period and post-period, the DID is zero. The control group for high impact participants is survey respondent controls.

Source: Guidehouse analysis

Figure 3-30 illustrates the DID statistic, with positive value indicating increased levels of DSM participation for TOU participants, and negative values indicating decreased levels of DSM participation. For most segments, the DID statistic is close to zero. The 4% decrease in DSM participation for EV owners should be interpreted with caution, given the small size of this segment. Participants flagged as high-impact customers show an estimated 4% increase in DSM participation during the pilot period. The high-impact segment and set of DSM participants have substantial overlap due to smart thermostat purchases.

Figure 3-30. DSM Difference in Differences - Minneapolis



Source: Guidehouse analysis

4. Customer Experience Findings

This section summarizes findings on customers' experience with the pilot, including changes in energy-related attitudes and behaviors, understanding of the pilot, and overall satisfaction. Guidehouse assessed overall participant experience as well as differences by study area and segment when applicable. The research is based on five surveys: the pre-launch survey (2019 Q2), the pre-pilot survey (2019 Q4), the post-heating season survey (2021 Q2), the post-cooling season survey (2021 Q4), and the final survey (2022 Q4).

Most participants report being home on weekday afternoons and exerting moderate effort to reduce consumption during the On-Peak period, favoring low-frequency, structural changes, such as using only LED lightbulbs, rather than higher-frequency, behavioral changes, such as air-drying laundry or unplugging electronics when not in use. Key findings include:

- **The majority of participants are home during weekday afternoons, driven in part by the lasting impact of the COVID-19 pandemic.** Almost a quarter (23%) of final survey respondents are retired, and over a quarter (29%) are primarily working from home, accounting for almost half (44%) of working participants. Prior to the pandemic, 6.5% of Minnesotans primarily worked from home, so this is a drastic difference in household occupancy that may have affected decisions regarding HVAC usage and other end uses during peak periods.[53] This work-from-home rate represents a 16% reduction from the post-cooling season survey, during which 60% of working participants reported doing so from home. In line with broader trends, the number of participants working outside the home is increasing, but may not return to pre-pandemic levels, pointing to new patterns of HVAC usage that may persist if most participants continue to be home on weekday afternoons.
- **The vast majority of respondents correctly understand that their rate depends on the time of day, but only about half have a more nuanced understanding of how weekends and holidays affect their rates.** Nearly all (92%) of final survey respondents correctly stated that their electricity costs vary by time of day, which was up from 85% in the 2021 post-cooling season survey. Just over half (53% and 54%, respectively) correctly stated that there are three different prices on weekdays and that their rate depends on whether it is a weekday, weekend, or holiday. There was relatively little increase in knowledge on these two items from the post-cooling survey. In both cases, 4% more respondents correctly chose those statements to be true. Further education may help participants better understand the rate structure and help them better adjust their behaviors to concentrate load shifting away from the On-Peak periods.
- **Many participants report feeling empowered to take at least a moderate level of effort to reduce On-Peak consumption and generally appear willing to reduce their use of home appliances during the On-Peak period.** Nearly 60% of respondents reported exerting at least moderate effort to reduce On-Peak consumption over the past year, and nearly three-quarters of respondents agreed or strongly agreed with statements that they both feel capable and know what actions to take to manage their household's energy use during On-Peak periods. Survey results show a significant decline in the use of electric appliances such as dishwashers and laundry machines during On-Peak periods relative to the respondents' reported pre-pilot On-Peak period usage. In addition, Pre-Pilot and Post-Cooling survey responses indicate that participants increased their morning and early

[53] Cameron Macht, "Teleworking During the Pandemic," Minnesota Department of Employment and Economic Development, March 2021, **https://mn.gov/deed/newscenter/publications/trends/march-2021/telework-during-pandemic.jsp**

afternoon thermostat setpoints during the cooling season. Participants report little change in their heating habits, perhaps due to a prevalence of non-electric heating sources and/or less willingness to sacrifice comfort during the winter.

- **When asked their perceptions of their electricity bills, most participants report not knowing if their bills were the same, higher than expected, or lower than expected compared to the prior winter and summer.** However, customers who felt that their bills were the same or lower than the previous summer or winter were more likely to highly rate their satisfaction with the pilot. The opposite is also observed, with customers who felt their bills were higher than the previous season reporting lower levels of satisfaction, suggesting participant perception of relative magnitude of electricity bills in comparison to previous years may be a contributing factor to overall satisfaction.
- **Participants overall have limited awareness of tools meant to increase pilot engagement; however, those who utilize those resources find them helpful.** Only 44% of final survey participants were aware that Xcel Energy offered an energy efficiency kit for pilot participants, and of that segment, only 17% reported receiving a kit.[54] The most frequently installed items from the kit were LED light bulbs, rather than items that could enable structural changes, such as smart thermostats or smart water heater controllers. Customers may need additional assistance installing and setting up items such as smart thermostats. Additionally, overall participant engagement with educational resources decreased from the post-cooling season survey to the final survey. Final survey respondents' most frequently utilized educational item was "Emails from Xcel Energy" (55%). Email (55%) also was in the top three most frequently used educational items for high-impact participants along with information included with the bill (56%), and the summer rate reminder postcard (51%). Overall, high-impact participants reported higher utilization of the educational resources, with the starkest difference between the number of participants reporting using none of the available resources (24% of all participants vs 3% of high-impact participants). Overall, of the participants who did utilize available educational resources, they found them at least moderately helpful (at least 7 out of 10, where ten is very helpful).
- **Most participants are satisfied with or neutral about their pilot experiences to date.** In the post-cooling season survey, 86% of participants rated their satisfaction with the pilot as a 5 or higher on a 0 to 10 scale. Final survey respondents reported nearly identical levels of overall satisfaction, with 85% rating their satisfaction as 5 or higher. However, wherein the post-cooling season survey respondents were relatively evenly distributed between 5 and 10, in the final survey there was an increase in respondents choosing 5 (29% vs 15%), indicating neutral feelings towards the pilot. This shift towards neutral does not persist in the high-impact participants, with 57% rating their satisfaction at 8 or higher. Eden Prairie residents have significantly higher average levels of satisfaction (6.30 of 10) than their counterparts in Minneapolis (5.96 of 10), supporting the drop in impact seen in year 2 of the pilot in Minneapolis. This is somewhat expected as participants are now two years into the pilot and may reflect some fatigue or feelings that levels of effort exerted are not manifesting in what participants feel like to be commensurate returns. Customer satisfaction with the TOU pilot is correlated with their expectations about energy bills. A plurality of participants (37%) did not know how the TOU rate impacted their bill, while customers who felt that their bills were the same or lower than in the prior year were more likely to be highly satisfied with

[54] Energy efficiency kits were distributed based on request and on a first-come, first-serve basis. Participants were notified about kit availability via a direct email campaign, community engagement tabling events, and door knocking conversations.

the pilot. Further education on the rate neutral design of this pilot may help participants feel more satisfied.

Customer experience findings are provided throughout the remainder of this section as follows:

1. **Participant Characteristics**: This section provides an overview of customer and home characteristics.
2. **Energy-Related Attitudes and Preferences**: This section provides the key factors that inform household energy use decisions.
3. **Customer Engagement and Satisfaction**: This section provides participants' self-reported level of effort to reduce On-Peak usage, along with customer satisfaction scores.
4. **Pilot Engagement**: This section provides information about participants' understanding of the TOU rate and use of the various tools provided by Xcel Energy.
5. **Self-Reported Changes in Energy Usage Behavior**: This section provides information about participant behavior and use of key equipment, including HVAC systems and EVs.
6. **Customer Experience– High-Impact Participants**: This section provides a selection of customer experience results for high-impact participants.

4.1 Participant Characteristics

This section provides an overview of customer and home characteristics. While pilot participants represent a range of ages and income levels, the majority are college graduates (80%), own their home (81%), and live in single family homes (63%). While most respondents report having central A/C (76%), this varies by study area. Adoption of smart thermostats and EVs increased ruing the pilot period, with 34% owning a smart thermostat and 7% owning an EV.

The majority of participants are home during weekday afternoons, driven in part by the lasting impact of the COVID-19 pandemic. Amongst working participants, 44% report continuing to work from home on the final survey (2022 Q4), down 16% from the post-cooling season survey (60%, 2021 Q4). In line with broader trends, the number of participants working outside the home continue to increase, but may not return to pre-pandemic levels, pointing to new patterns of HVAC usage that may persist if most participants continue to be home on weekday afternoons.

This section is divided into two sections. The first summarizes participant demographic and household composition, and the second summarizes key home characteristics for pilot participants.

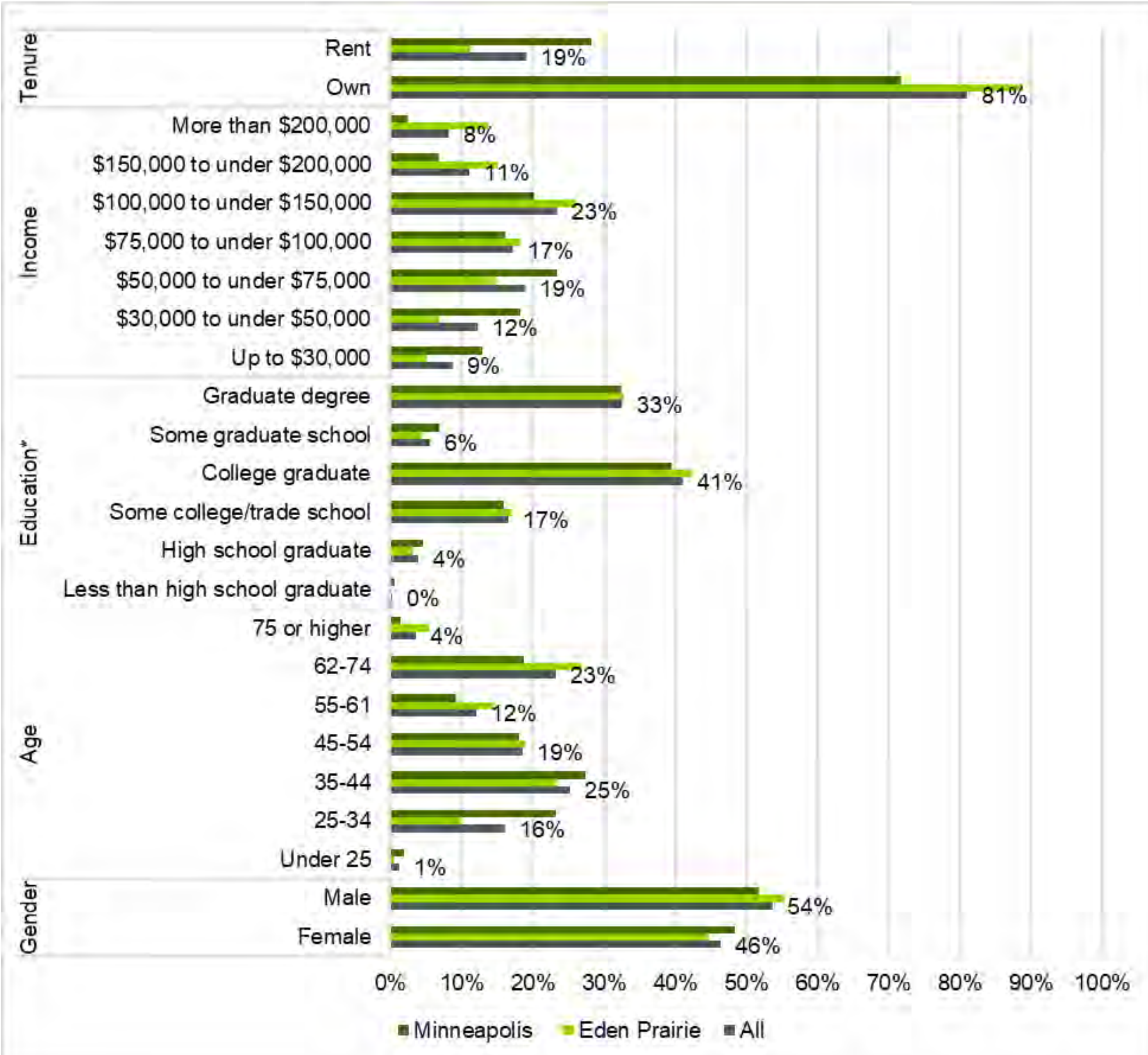
4.1.1 Demographics and Household Composition

Figure 4-1 summarizes the demographics of the participant survey respondents, including gender, age, education, income, home ownership status for the total population, and by neighborhood. Figure 4-1 shows that most participants (80%) are college-educated, having either graduated college (41%) or attended at least some graduate school (39%), which is slightly higher than the U.S. Census Bureau figures for Eden Prairie (65%) and Minneapolis (53%).[55] Additionally, most participants (81%) were homeowners; Eden Prairie respondents

[55] U.S. Census Bureau (2021). QuickFacts: Minnesota; United States. [https://www.census.gov/quickfacts/fact/table/MN,US/EDU685221

were somewhat older than those in Minneapolis, while Minneapolis respondents were more likely to be renters or lower income customers.

Figure 4-1. Participant Demographics



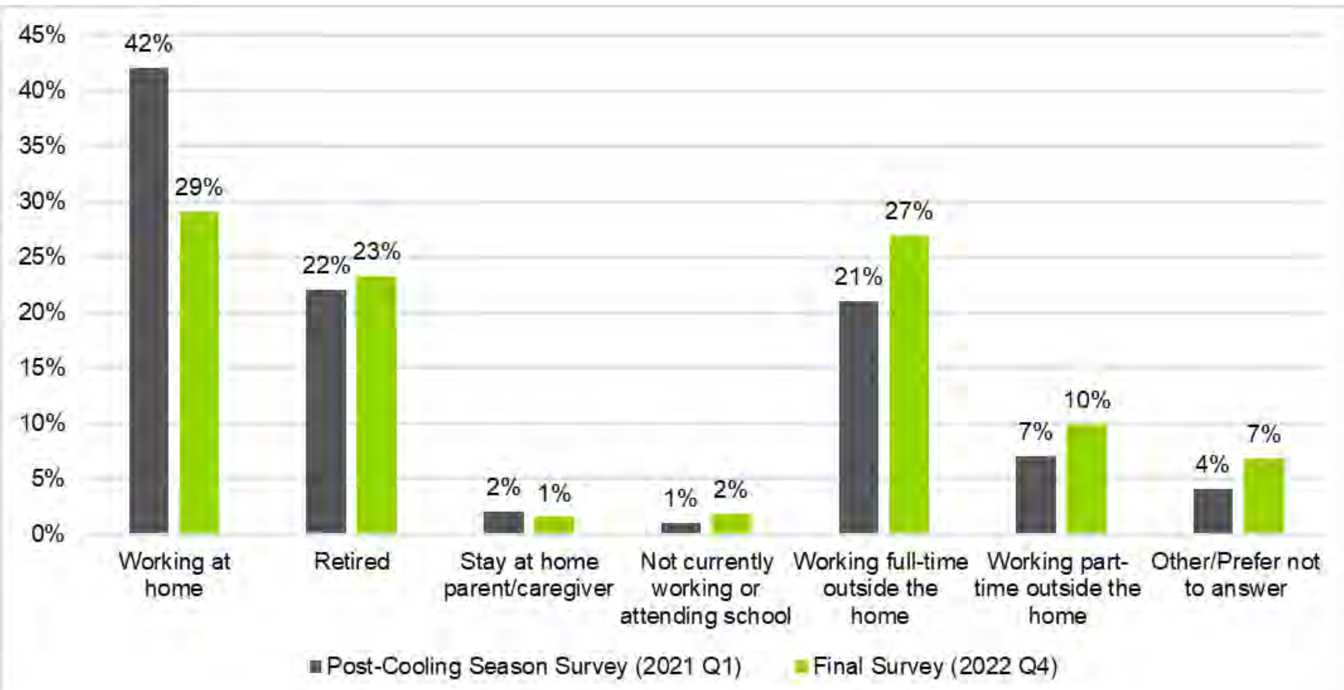
*Source: Guidehouse pre-pilot survey, pre-launch survey, post-heating season survey, post-cooling season survey, and final survey (n=2,603; treatment group only). If a participant completed more than one survey, they only appear once in this analysis and their most recent response to the demographic question was used. *Education was not asked in the final survey.*

Customers responding to the post-cooling season survey or the final survey answered a series of questions about their current occupational status during the previous sixmonths and any changes they anticipated in relation to the COVID-19 pandemic. In both surveys, a majority of participants indicated that they typically have at least one household member at home during weekday On-Peak hours. As shown in Figure 4-2, 67% of post-cooling respondents were home full time, as 42% reported working from home, 24% reported being retired, and 2% and 1%, respectively, reported staying at home as a caregiver or being unemployed.

However, just over half (55%) of final survey participants were home full-time. Those working from home (29%) dropped precipitously, those who reported being retired increased slightly (23%), while those reporting working at home as a caregiver (1%), or currently unemployed (2%) changed little from the post-cooling survey. Just over one-quarter (27%) are working full-time outside of the home, an increase of 5%.

In the post-cooling season survey, more than a quarter (29%) of people working from home anticipated returning to the office in the next 6 months, which aligns with the 31% decrease in those working from home during the period between fielding the post-cooling and final surveys. Work from home trends that began during the pandemic seem to be persisting to some degree with nearly 30% of respondents reported still working from home in 2022; prior to the pandemic, only 6.5% of Minnesotans primarily worked from home.[56] The observed increase in percentage of customers who reported continuing to work from home suggest that customer experiences during the pilot may be more representative of future trends than originally thought, particularly regarding comfort and heating/cooling behavior of participants home during weekdays.

Figure 4-2. Changes in Occupational Status Over Time



Source: Guidehouse post-cooling season survey (n=423) and final survey (n=739)

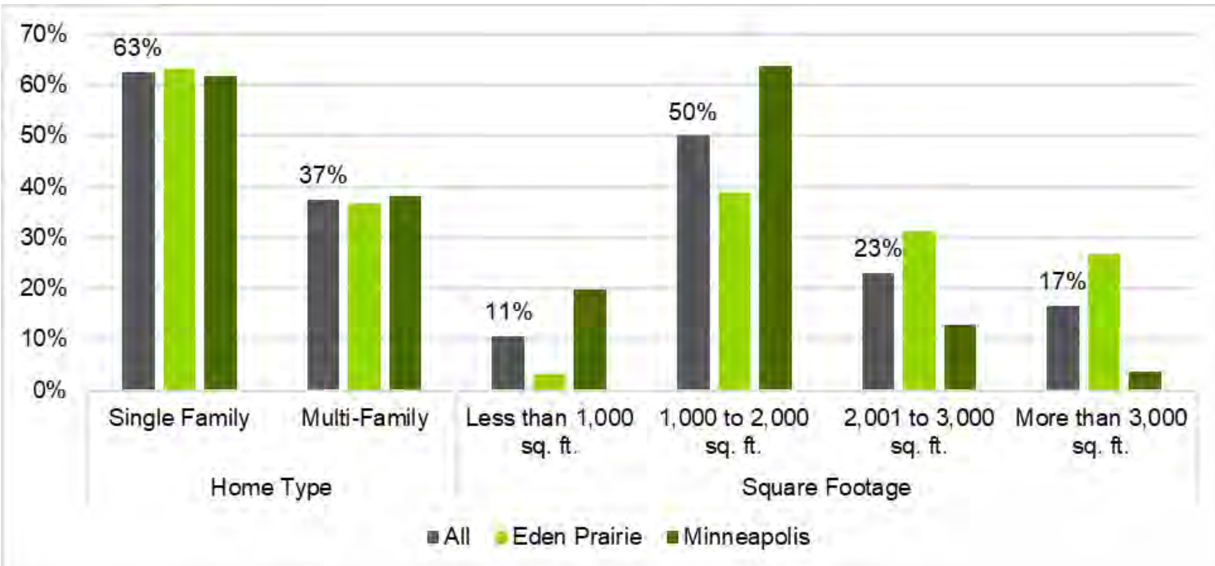
4.1.2 Home Characteristics

Figure 4-3 summarizes the distribution of home types and square footage in the total population and by neighborhood. The distribution of home types is nearly identical in both neighborhoods, with 63% single-family homes and 37% multifamily residences in the total population. However, participants in Eden Prairie tend to have larger homes than those in Minneapolis, suggesting

[56] Cameron Macht, "Teleworking During the Pandemic," Minnesota Department of Employment and Economic Development, March 2021, **https://mn.gov/deed/newscenter/publications/trends/march-2021/telework-during-pandemic.jsp**

that they may have higher heating and cooling loads and thus have more opportunity to shift usage and potentially save money on a TOU rate.

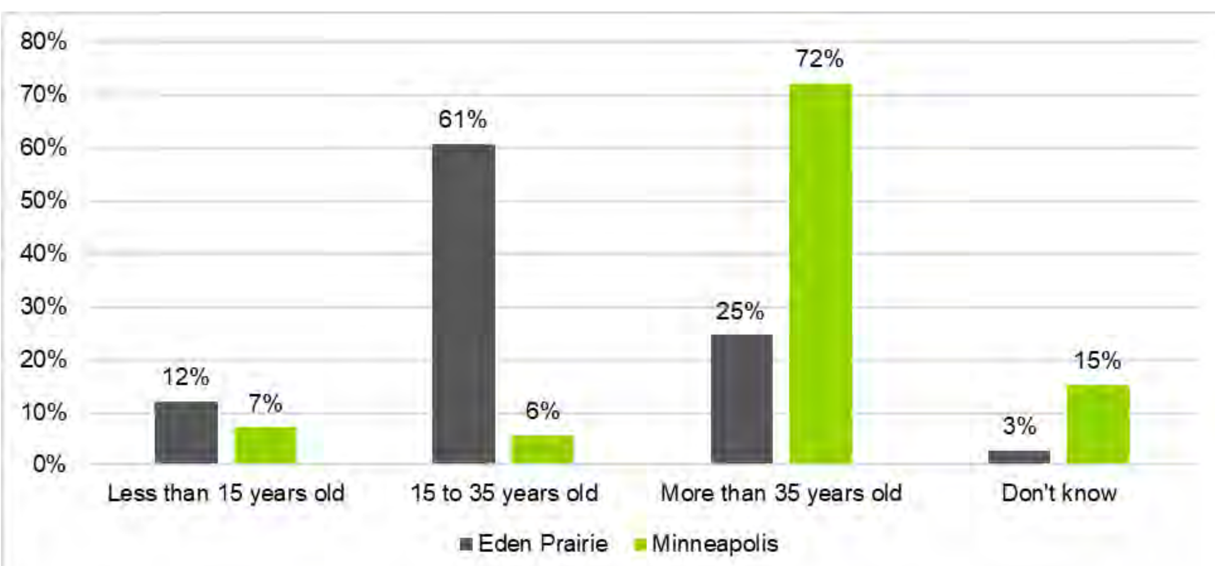
Figure 4-3. Home Type and Square Footage



Source: Guidehouse pre-pilot survey, pre-launch survey, post-heating season survey, and post-cooling season survey (n=1,864; treatment group only). If a participant completed more than one survey, they only appear once in this analysis and their most recent response to the demographic question was used.

On average, Minneapolis participants live in older homes than Eden Prairie participants. Approximately three-quarters of Eden Prairie participants live in homes that are less than 35 years old while a similar proportion of Minneapolis homes are more than 35 years old (Figure 4-4). Over half of Minneapolis homes are over 75 years old. Minneapolis participants are also less likely to know the age of their home, which is more common with older homes and renters.

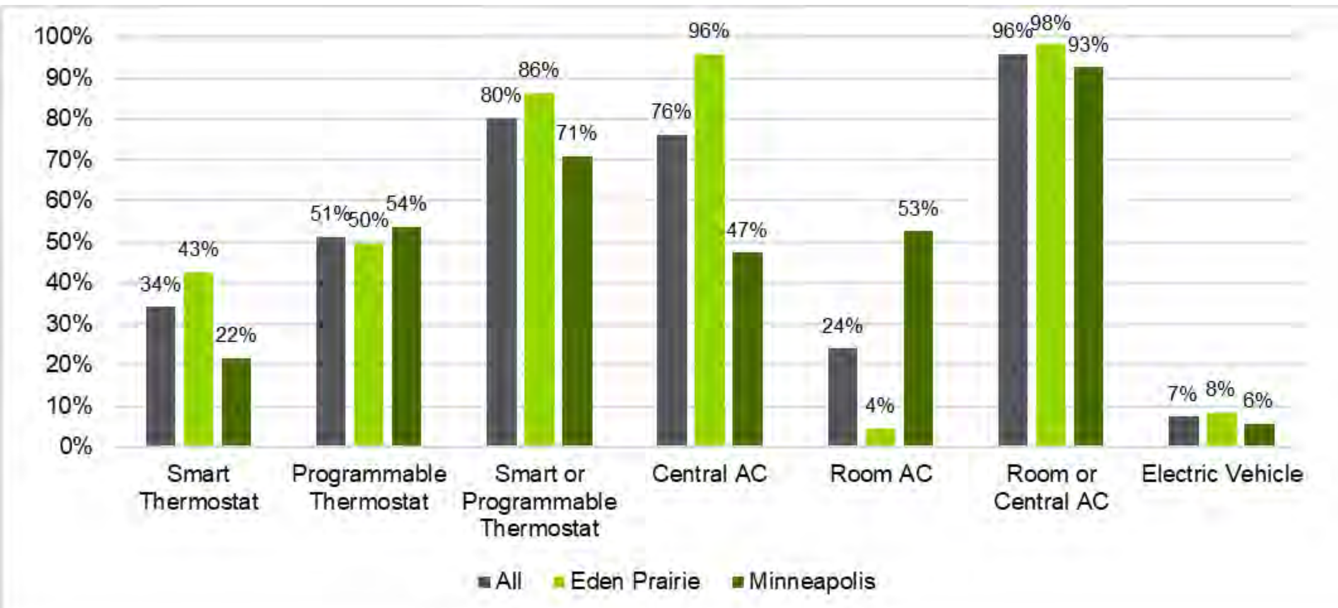
Figure 4-4. Home Age



Source: Guidehouse pre-launch survey (n= 1,113).

There are also significant differences in the prevalence of air conditioners (A/C) and smart or programmable thermostats between Eden Prairie and Minneapolis homes (Figure 4-5). Nearly all Eden Prairie homes (96%) have central A/C, compared to less than half of Minneapolis homes (47%). Minneapolis homes are much more likely to have room A/C. Note that participants may have both central and room A/C, and nearly all homes in both study areas have at least one type of A/C. Eden Prairie participants are also more likely to have a smart thermostat than Minneapolis participants. These differences are likely driven by the higher prevalence of older homes and renters in Minneapolis. The lower prevalence of smart or programmable thermostats in Minneapolis may make it more challenging for some participants to shift their On-Peak HVAC usage because they cannot automate their setbacks. There is very little difference in the prevalence of EVs by study area; 7% of all participants have EVs.

Figure 4-5. Presence of Key Equipment Types



Source: Guidehouse final survey (n=739)

Between previous surveys and the final survey there were significant changes in the prevalence of certain types of key equipment in participants' homes. Importantly, the prevalence of smart or programmable thermostats increased by 12% and EVs increased by 3%. The presence of smart or programmable thermostats and EVs are important to consider when considering participant ability to respond to TOU rates, as these devices make it more convenient for participants to control over their usage.

4.2 Energy-Related Attitudes and Preferences

This section provides findings about the key factors that inform household energy use decisions. Each of the four previous survey efforts (pre-pilot survey, pre-launch survey, post-heating season survey, post-cooling season survey) included a series of questions about the importance of different factors in shaping households' energy use decisions. The six factors in order of average importance from highest to lowest were:

- The **comfort** of my home
- The cost of my monthly electricity **bill**

- The impact of my energy use on the **environment**
- The **convenience** of using appliances and electronics whenever I need to or want to
- Whether my electricity comes from **renewable** resources
- The impact of my energy use on the **reliability** of the electric grid, especially when demand is high

In the final survey, participants were only asked about the importance of the top four. **Most participants consider all these factors to be important in their decision-making**, as shown in Figure 4-6. The level of importance expressed by participants has not changed significantly between the previous surveys and final survey.

Statistically significant differences exist in ratings between customer segments and all customers on the importance of three of the four factors (bills, convenience, and environment) /at the 90% confidence level. There were no significant differences between any segment and all customers on the importance of comfort. Low-income customers, renters, and seniors all rate the importance the amount of their monthly bills and impact of their energy use on the environment higher than customers overall. Renters and low-income customers rate the importance the convenience of using electronics or appliances whenever they need to higher than customers overall, while seniors find convenience significantly less important. Differences across demographic groups in the importance of various factors in making household energy use decisions should be considered when targeting specific groups for education or participation in future pilots. For example, seniors prize convenience less highly than customers overall, which is most likely due to the flexibility of their schedules in comparison to customers who still may have to work outside the home and have less flexibility in using appliances or electronics at off peak times.

Figure 4-6. Importance of Factors in Household Energy Use Decisions

Source: Guidehouse final survey (n=739).

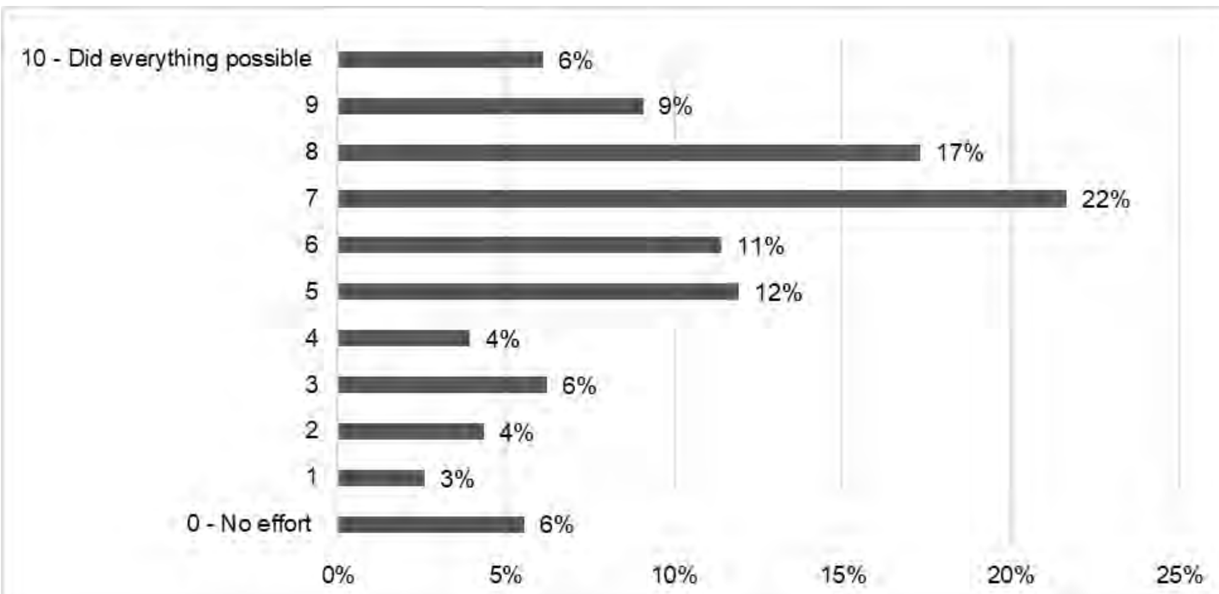
4.3 Customer Engagement and Satisfaction

This section provides participants' self-reported level of effort to reduce On-Peak usage, along with customer satisfaction scores. **Many participants report feeling empowered to take at**

least a moderate level of effort to reduce On-Peak consumption (79%) and generally appear willing to reduce their use of home appliances during the On-Peak period. Most participants are satisfied with or neutral about their pilot experiences to date. While the proportion of customers who reported levels of satisfaction at 5 or greater did not change significantly between the post-cooling season and final surveys, there was a marked downshift towards neutral in the final survey responses, indicating perhaps some disengagement or fatigue.

One measure of customer engagement is the reported level of effort to reduce peak electricity use. Nearly 60% of final survey respondents report exerting a significant level (7/10 or greater) of effort to reduce peak electricity use over the past year (Figure 4-7), and 79% of participants report effort levels of 5 or greater.

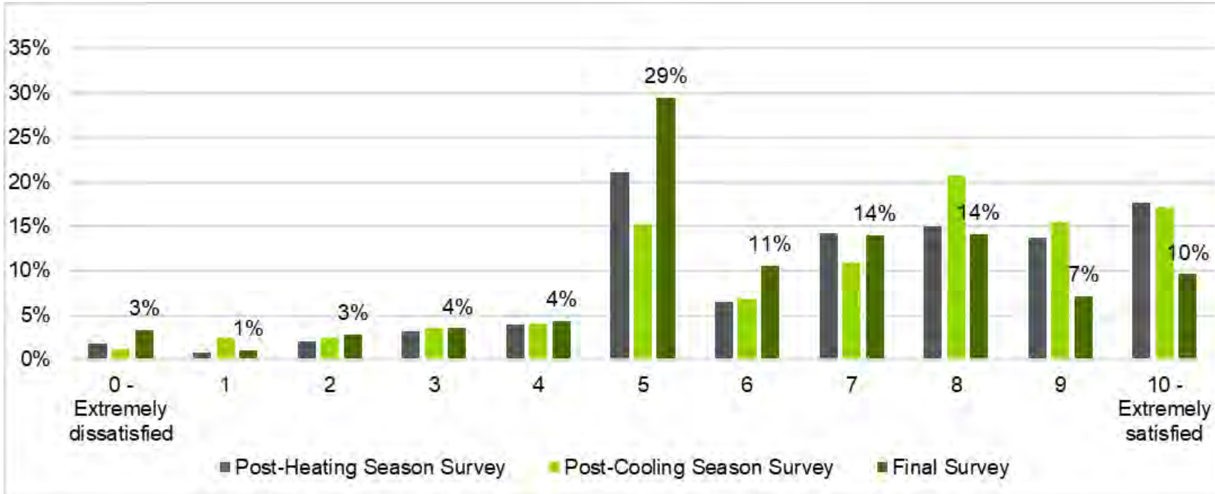
Figure 4-7. Level Of Effort to Reduce Peak Electricity Use



Source: Guidehouse final survey (n=739).

In the post-heating season, post-cooling season, and final surveys, participants were asked to rate their overall satisfaction with the pilot. The results are displayed in Figure 4-8. In the post-heating season, the most common satisfaction rating was a neutral 5 on a scale of 0 to 10, which indicated apathy toward or disengagement with the pilot among a large swath of participants as opposed to dissatisfaction. In the post-cooling season survey, the most common rating was an 8, suggesting that participants were beginning to engage more with the pilot and form opinions, and those opinions are generally positive. However, this shift did not persist at the time of the final survey, where the most common response again was a neutral 5 on a scale of 0 to 10. Outside of "neutral participants" 55% reported being satisfied (6 to 10 out of 10) with the pilot in the final survey versus 15% who reported feelings of dissatisfaction on the final survey (0 to 4 out of 10). As noted above, the large numbers of participants reporting neutrality at the late stage of the pilot may be due to some level of disengagement or even fatigue. While there is certainly some overlap between populations who responded to each survey, it is important to note that some of the differences in level of satisfaction could also be driven by baseline differences between populations who responded to each of the survey. If they exist, we would expect the impact of these differences to be small.

Figure 4-8. Pilot Satisfaction

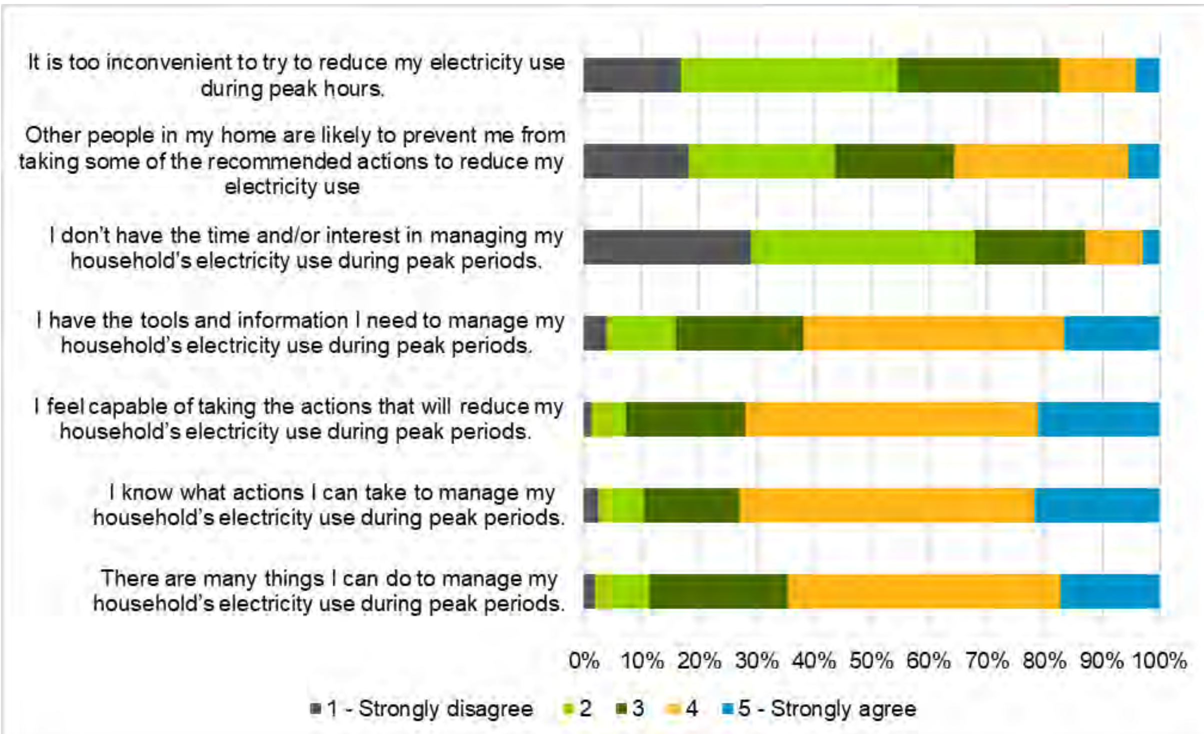


Source: Guidehouse post-heating season survey (n=547), post-cooling season survey (n=423), and final survey (n=739).

In both the post-heating and post-cooling season surveys, seniors were statistically significantly more satisfied than all participants. In the final survey, seniors, renters, smart thermostat owners, and low income customers were statistically significantly more satisfied than the general population. In the post-cooling season survey, customers with smart thermostats were more satisfied than all participants, possibly due to a greater sense of efficacy in automating their household's efforts to reduce A/C usage during peak times. However, this relationship did not hold in the final survey, and smart thermostat owners were less satisfied than the general population, which may be attributed to participants feeling like the structural changes they make in installing a smart thermostat and setting a schedule may not translate to noticeable changes in bills or usage after two years in the pilot. However, it should be noted that while statistically significant, the actual difference in average satisfaction between smart thermostat owners (6.04 of 10) and the general participant population (6.1 of 10) was very small, less than 0.1 out of 10. Eden Prairie residents were more satisfied than the general population, while Minneapolis residents were marginally less satisfied in the final survey. These differences in satisfaction between participating residents of Eden Prairie are important as they track with the impact results showing a lower impact in Minneapolis in year two of the pilot. No other demographic differences in satisfaction were statistically significant.

In the final survey, participants reported feeling knowledgeable and empowered to manage their household's electricity use during peak periods (see Figure 4-9). Specifically, a majority of customers reported there are many actions they can take (65%), they know what those actions are (73%), they feel capable of taking those actions (72%), and they have the tools and information (62%) they need to manage peak electricity use. Participants also disagreed (68%) with the statement that they "don't have time and/or interest in managing my household's electricity use during peak periods".

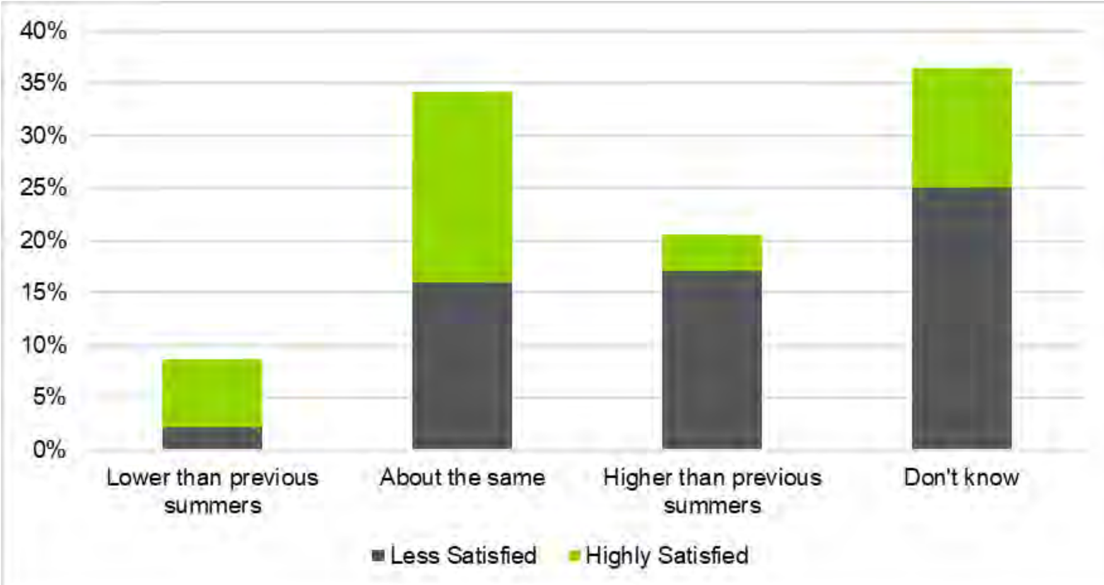
Figure 4-9. Customer Attitudes toward Behavior Change



Source: Guidehouse final survey (n=739)

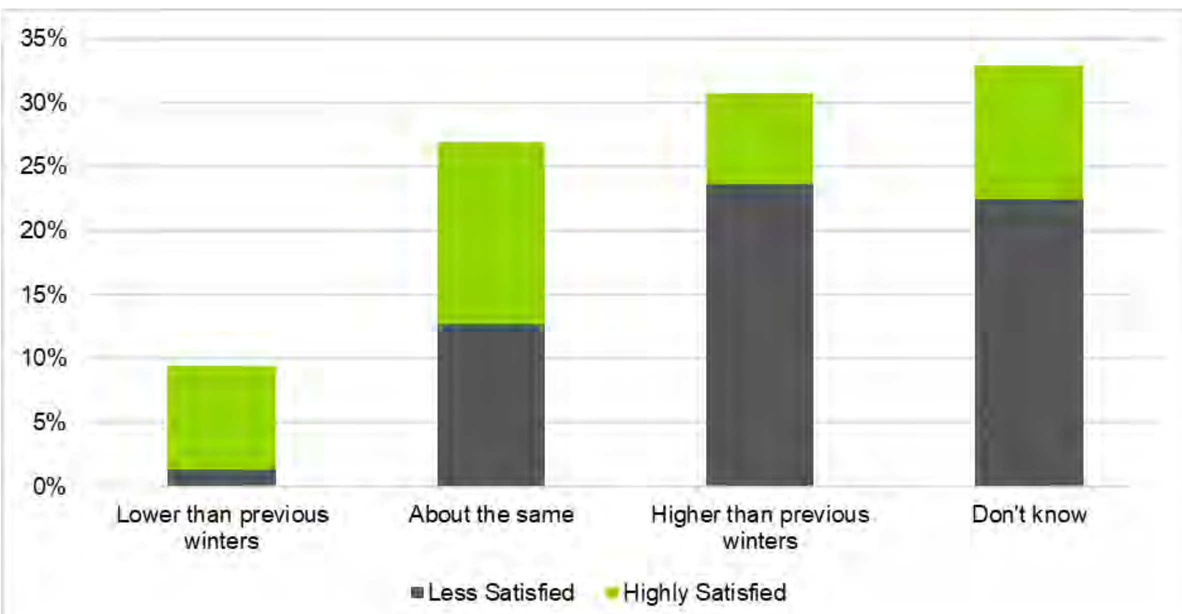
Customers were also asked about their perceptions of their electricity bills in comparison to pre-pilot bills (Figure 4-10 and Figure 4-11). For both summer and winter, the most frequent response was "Don't Know", and as expected, customers who felt that their bills were the same or lower than in the prior summer or winter were more likely to highly rate their satisfaction with the pilot. Customers who felt their bills were higher than the previous season were more likely to report being less satisfied. Lastly, the number of participants who perceive their bills as higher is lower in summer than winter, further supporting the idea that customers generally found it easier to reduce or shift their usage in the summer compared to the winter.

Figure 4-10. Perceived Changes in Electricity Bills Compared to Previous Summers



Source: Guidehouse final survey (n=739). Highly satisfied is defined as a response of 7 or greater to the question "On a scale from 0 to 10, where 0 means "Extremely dissatisfied" and 10 means "Extremely satisfied", how satisfied are you with Xcel Energy's Flex Pricing Pilot overall?" Less satisfied is defined as a response of 0-6 on the same question. Full question text: "Since you began the Flex Pricing Pilot, were your household's electricity bills higher, lower, or about the same as previous years during the summer months?"

Figure 4-11. Perceived Changes in Electricity Bills Compared to Previous Winters



Source: Guidehouse final survey (n=739). Highly satisfied is defined as a response of 7 or greater to the question "On a scale from 0 to 10, where 0 means "Extremely dissatisfied" and 10 means "Extremely satisfied", how satisfied are you with Xcel Energy's Flex Pricing Pilot overall?" Less satisfied is defined as a response of 0-6 on the same question. Full question text: "Since you began the Flex Pricing Pilot, were your household's electricity bills higher, lower, or about the same as previous years during the winter months?"

4.4 Pilot Engagement

This section provides information about participants' understanding of the TOU rate and use of the various tools provided by Xcel Energy. **The vast majority of respondents correctly understand that their rate depends on the time of day, but only about half have a more nuanced understanding of weekends and holidays affect their rates. Participants overall have limited awareness of tools meant to increase pilot engagement; however, those who utilize those resources find them helpful.**

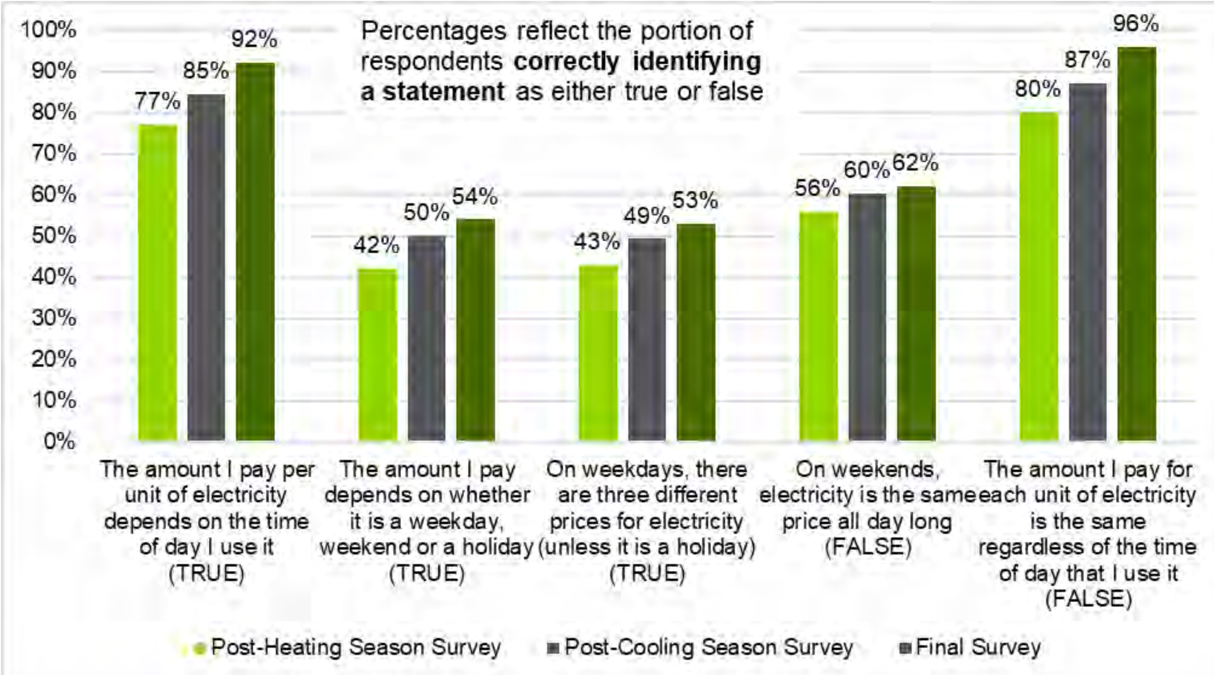
This section is divided into four sections. The first summarizes participants' understanding of the TOU rate design, the second provides participant perceptions about educational materials, the third summarizes participant engagement with their energy bills and the My Account feature, and the fourth section provides participant recall of and engagement with the pilot's energy efficiency kits.

4.4.1 Understanding of Rate Design

The post-heating season, post-cooling season, and final surveys explored participants' understanding of the pilot and their new electricity rates. The surveys asked participants to read a series of statements about the pilot pricing structure (including both true and false statements) and select which statements were true. Most (96%) participants have a firm grasp on the fact that their electricity price is not the same throughout the day, as shown on the far right in Figure 4-12, but they are less certain about how many different pricing periods there are or how their rates are affected on weekends and holidays. The percentage of participants answering correctly increased for each statement from the post-heating season survey (2021 Q2) to the post-cooling season survey (2021 Q4) and again from the post-cooling season survey to the final survey (2022 Q4), suggesting that additional time in the pilot and the ongoing educational efforts have helped participants better understand the pricing structure. However, in lieu of selecting the statements they believed to be true, participants also had the option to select Don't Know. On the final survey, nearly a third of participants chose the Don't Know option indicating either a lack of knowledge to such a degree that they did not even feel comfortable engaging with the question or a lack of engagement. In contrast, less than 1% of participants categorized as "high impact" chose Don't Know, perhaps due to increased engagement with the pilot and suggestive of potentially higher baseline levels of knowledge as well.

However, while participants have shown an increased understanding that their electricity price changed dependent on time of day, there is a lack of understanding on how adjusting usage in accordance with those different prices will ultimately impact their monthly bill. In open responses, multiple participants shared sentiments around confusion on how the TOU pricing and accompanying usage during different periods would affect their monthly bill, and if efforts to reduce On-Peak usage would actually translate to substantial savings. For example, one customer stated "In the beginning it was very confusing, and I don't believe that I have actually saved money. My family has done a lot to conserve energy, but I am not seeing any savings." Further education around the revenue neutral design of this pilot may alleviate some of these customer concerns as well as increase satisfaction if they no longer feel that their efforts to reduce On-Peak usage are going un-rewarded.

Figure 4-12. Participants' Understanding of the Pilot Pricing Structure

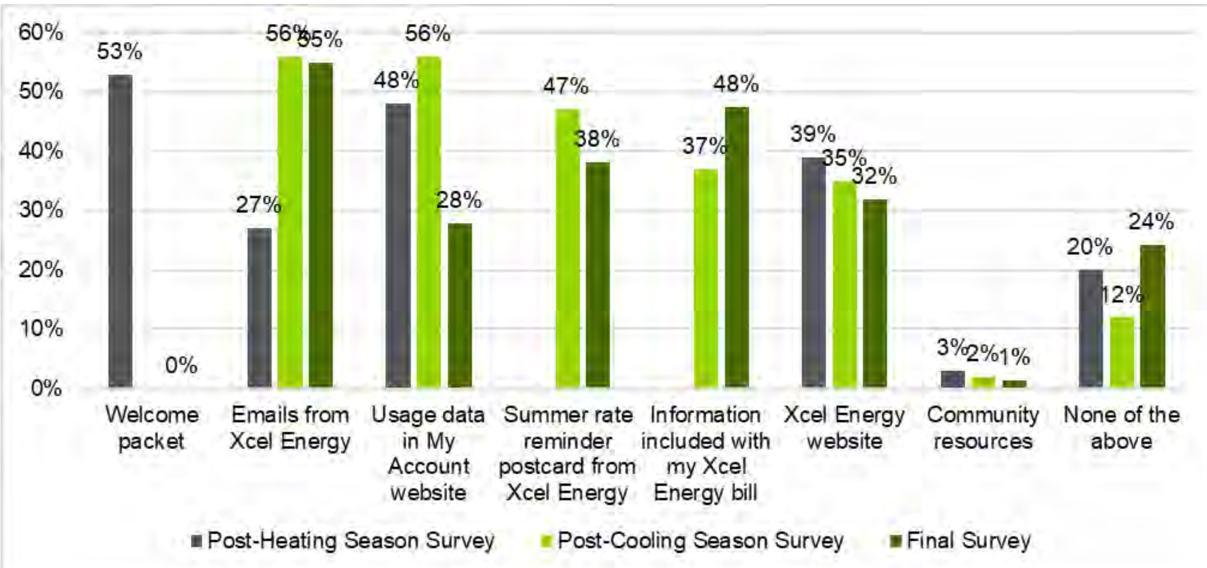


Source: Guidehouse post-heating season survey (n=547), post-cooling season survey (n=423), and final survey (n=739). Full question text: "The following question is designed to assess how well various elements of the Flex Pricing Pilot are being communicated to customers. Which of the following statements would you say accurately represents how you are charged for energy since signing up for the new Flex Pricing Pilot? (Select all statements that are correct)" The bars in this graph show the percentage of customers who answered correctly for each statement (i.e., selected a correct true statement or did not select an incorrect false statement).

4.4.2 Effectiveness of Educational Materials

Participants used a variety of informational resources to learn about the pilot and understand the impacts on their bills (Figure 4-13). After the first heating season, customers reported that they relied primarily on the welcome packet (53%) or resources on the Xcel Energy website (39%). After the first cooling season, the most frequently used resources were emails from Xcel Energy (56%), the My Account website (56%), and the summer rate reminder postcard (47%). At the time of the final survey, the most frequently used resources were the emails (55%) and information included with the bill (48%). In the final survey, more customers chose "None of the above" (24%) than they had in the previous two surveys, potentially indicating a decreased need for information and/or some disengagement at the two-year point in the pilot. Additionally, customers were asked if they remembered receiving a cling from Xcel Energy with information about the TOU pilot, to which 41% responded "Yes".

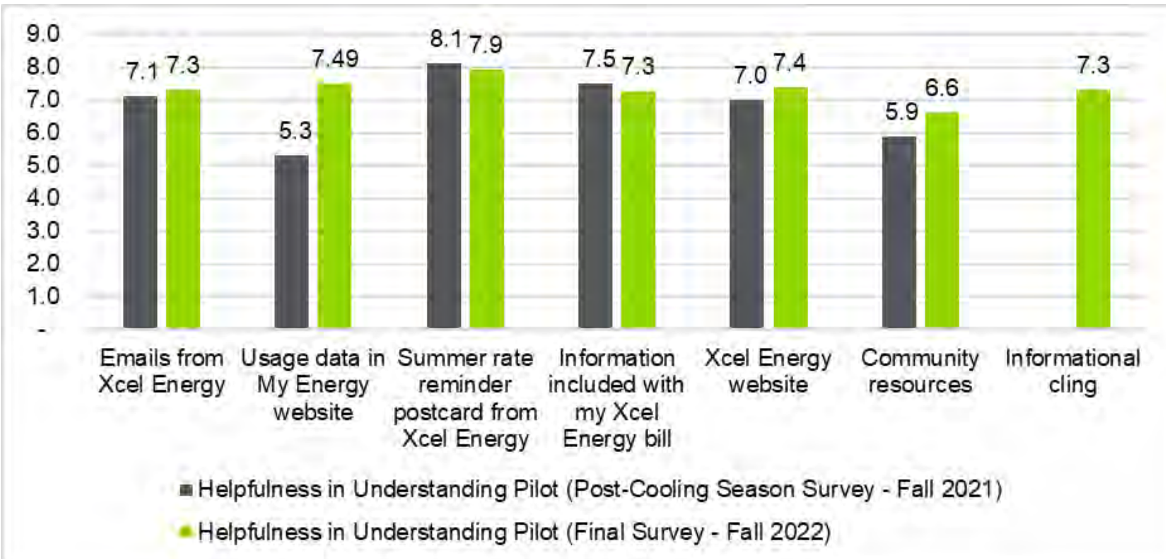
Figure 4-13. Informational Resources Used to Learn About Pilot



Source: Guidehouse post-heating season survey (n=547), post-cooling season survey (n=423), and final survey (n=739). Note the post-heating season survey did not ask about the summer rate reminder postcard or information included with the Xcel Energy bill.

Both post-cooling season and final survey customers rated the summer rate reminder postcard as the most helpful for understanding the pilot (Figure 4-14), though fewer than half (47% post-cooling season survey, and 38% final survey) recalled using the postcards. Final survey customers rated usage data in the My Energy website as much more helpful than post-cooling season respondents, which may indicate an increased understanding of that resource as the pilot continued. While those who utilized it found the usage data much more helpful, the reported use of usage data to learn more about the pilot dropped by half from the post-cooling to final survey (56% to 28%). This drop may at least in part be attributed to issues with the My Account App and/or website. Multiple participants remarked in open comments that the "Xcel app and website did not reliably show time of day utilization" or that "the energy use chart was often not working, or cumbersome to use. A real-time meter or App where I could see current electrical usage would be super useful"; these difficulties may have caused some participants to stop using the usage data. Given that those who used the usage data found it very helpful, modifying the app and website to be more accessible to a majority of customers could help more customers understand and reduce their On-Peak usage. Lastly, the use of the summer rate postcard and information included with the Xcel Energy bill correlated with high pilot satisfaction, potentially indicating that those educational materials helped increase participants' satisfaction with the pilot.

Figure 4-14. Helpfulness of Informational Resources

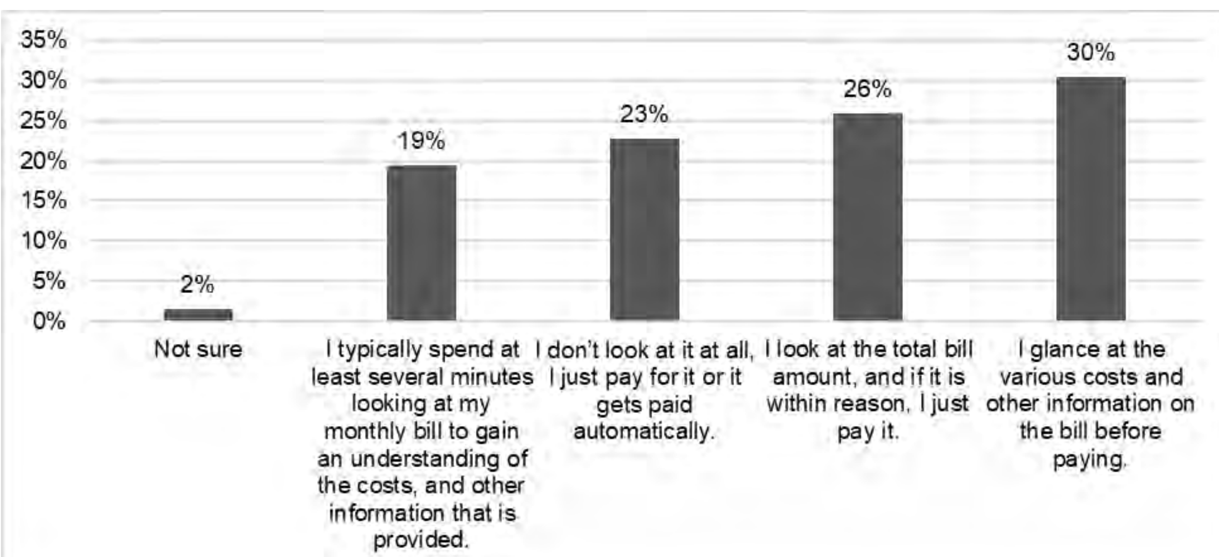


Source: Guidehouse post-cooling season survey (n=423) and final survey (n=739). Participants only rated the usefulness of information resources that they recalled receiving or interacting with.

4.4.3 Bill and My Account Engagement

To supplement questions about educational resources in previous surveys, the final survey asked participants more thorough questions regarding their typical engagement with their bill and the My Account service on the Xcel Energy website or mobile app. Over three-quarters of customers either glanced at the information (30%), only looked at the total amount (26%), or paid their bill automatically without looking (23%). Conversely, only 19% report spending enough time with their bill to understand the costs and other information that is provided.

Figure 4-15. Typical Customer Response to Electricity Bill

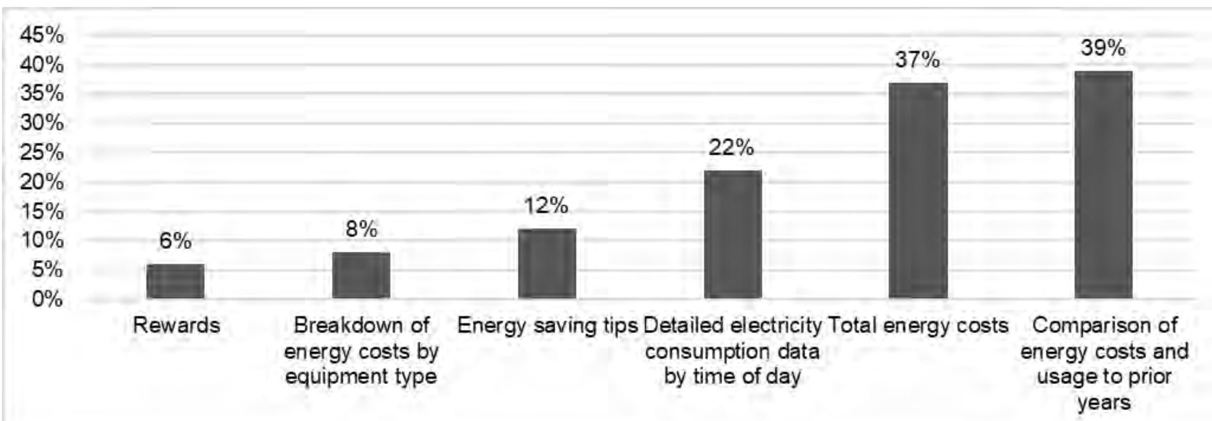


Source: Guidehouse final survey (n=739).

Limited bill engagement may contribute to level of understanding; on the final survey, 50% of customers report having only a basic understanding of their new energy bills, with equal percentages (22%) reporting either not understanding their new bills at all or having a fairly complete understanding of new energy bills. Only 5% of customers report having a complete understanding of their new bills.

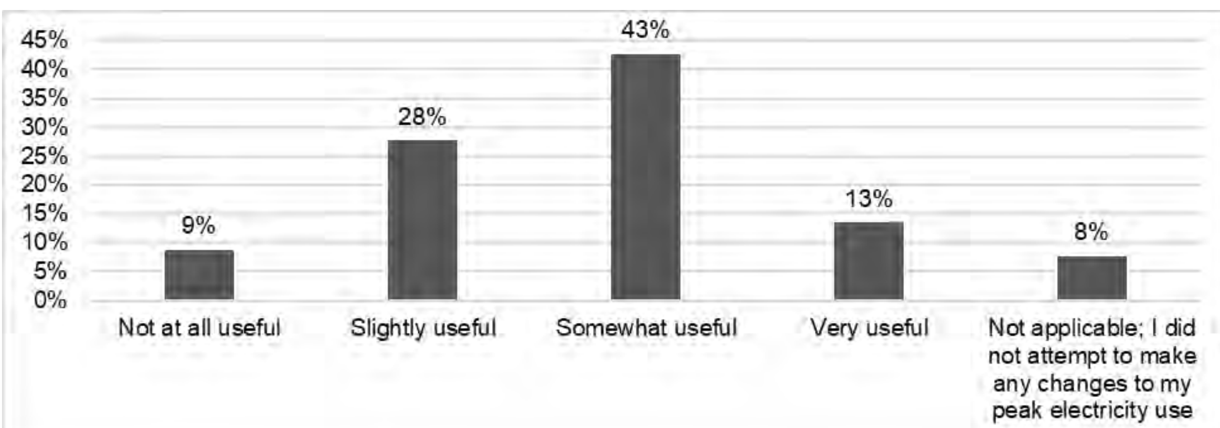
In addition to their bill, customers also were able to engage with the My Account website or app for information on their new energy bills. 53% of final survey respondents report using the My Account website or application. Of those who use the service, customers tend to review the comparison of their energy costs and usage to prior years (39%) and their total energy costs (37%) most (Figure 4-16). A majority of respondents (56%) found this information at least somewhat useful (Figure 4-17).

Figure 4-16. My Account Information



Source: Guidehouse final survey (n=739).

Figure 4-17. Usefulness of My Account Information to Reduce Peak Electricity Use

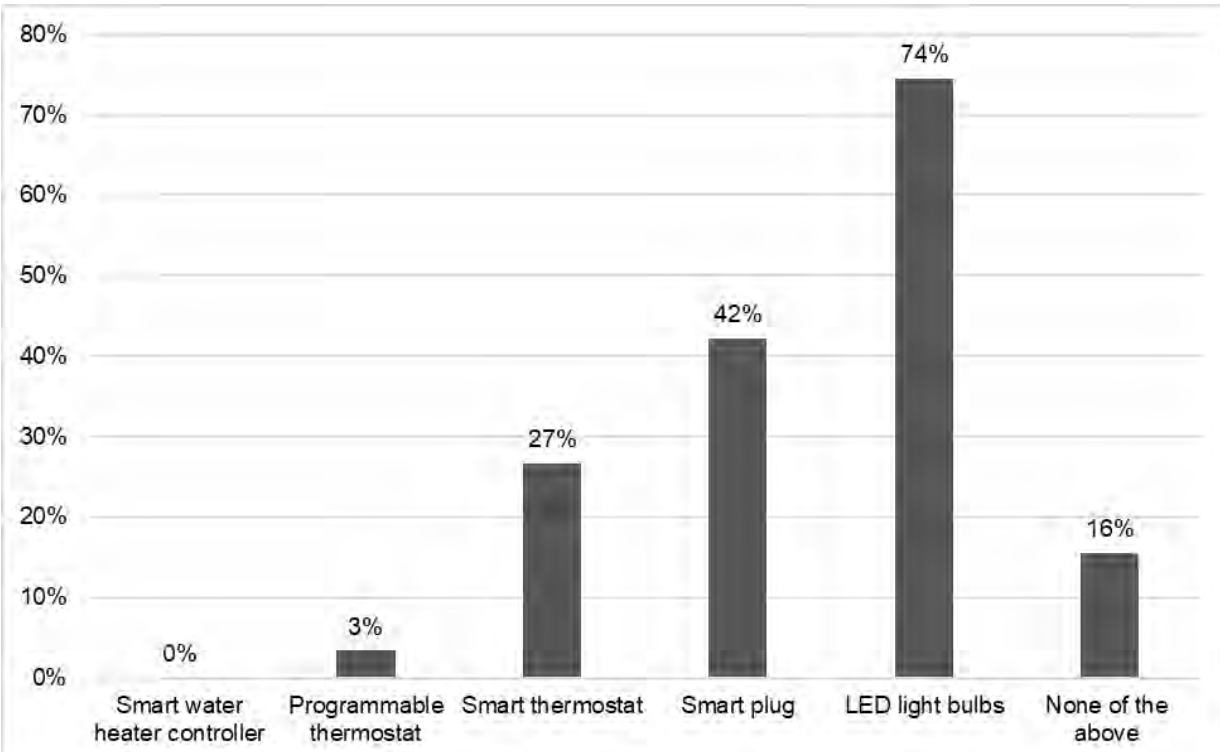


Source: Guidehouse final survey (n=739).

4.4.4 Flex Pricing Pilot Kits

Xcel Energy offered energy efficiency kits to participants of the TOU pilot in 2022 to assist them in more easily managing their electricity use during peak periods. At the time of the final survey, 44% of participants were aware of these kits and 17% reported receiving a kit. Of those who received a kit, the most installed items were LED light bulbs (74%), followed by smart plugs (42%) and smart thermostats (27%), as shown in Figure 4-18. Relatively few (16%) participants did not install any item they received in the kit.

Figure 4-18. Most Installed Items from Pilot Kit



Source: Guidehouse final survey (n=739). Participants only asked if they had reported receiving a kit (n=90).

4.5 Self-Reported Changes in Energy Usage Behavior

This section provides information about participant behavior and use of key equipment, including HVAC systems and EVs. The majority of participants with programmable and smart thermostats report using the device to control both heating and air conditioning (for customers with central A/C). Almost three-quarters of participants (72%) report using thermostat setpoint schedules in the summer, however only 38% of those changed the setpoint schedule to align better with the pilot On-Peak period. Amongst participants with electric heat (only 5% of all participants), about half report using thermostat setpoint schedules, most of which align with TOU rate periods. Customers reported reduced use of dishwashers and clothes dryers during the On-Peak period. However, use of kitchen appliances during the On-Peak period remains unchanged. **The majority of EV owners (74%) report never or rarely charging their EV during the On-Peak period.**

This section is divided into five sections. The first summarizes ownership and use of smart and programmable thermostats, the second and third summarize participant heating and cooling behaviors, respectively, the fourth describes participant use of other equipment, and the fifth section discusses EV owners' charging schedules.

4.5.1 Thermostat Control

If they reported having a smart or programmable thermostats, customers were asked if those thermostats were used to control heating, air conditioning, or both. Of the customers who reported having one or more smart thermostats in the final survey, 97% report using it to control both heating and air conditioning. The levels slightly differ by geography, with 99% of respondents with smart thermostats in Eden Prairie and 89% in Minneapolis using the device for control of both systems; 9% of respondents in Minneapolis use it for heating control only, which is likely due to the difference in prevalence of central A/C in the two study areas.

Customers in Eden Prairie had similar usage patterns for programmable thermostats; 97% reported their thermostat controlled both heating and cooling. However, customers in Minneapolis reported an almost even split between their thermostat controlling heating only (47%) or both heating and cooling (49%), reflecting lower penetration of central A/C in Minneapolis compared to Eden Prairie.

4.5.2 Heating Behaviors

The final survey asked participants which fuel is used for heating their home; only 38 (5%) reported having an electric heating source. In addition, nearly 40% of participants report having a space heater, and of those, 72% only have a single space heater, suggesting it is not their main method of heating but instead an auxiliary heat source for an individual room or area. Rates of space heater use do differ slightly between Minneapolis (42%) and Eden Prairie (34%), which may be attributable to the older average home age in Minneapolis.

Customers who reported having an electric heat source were asked their normal heating set points (Table 4-1) and if they use a thermostat setpoint schedule, both in general and in accordance with the TOU rate periods. Relatively even amounts reported using thermostat setpoint schedules in general (51%) and of those who did, nearly all made those changes to better align with TOU rate periods (93%).

Table 4-1. Average Temperature Settings: Winter 2021-2022

Time Period	Temperature Setting (°F)
Weekday Mornings	69.76
Weekday Afternoons	69.92
Weekday Evenings	70.11
Nights	68.87
Weekends	69.87
When no one is home	67.76

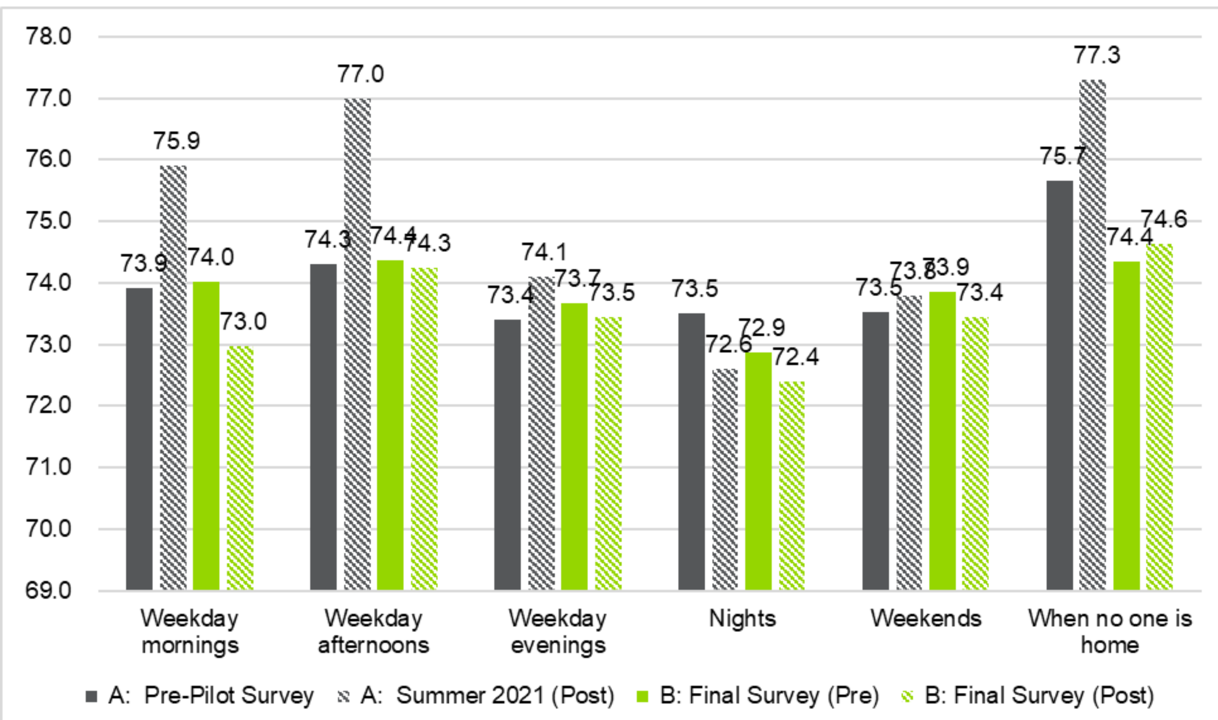
Source: Guidehouse final survey (n=739). Participants only asked if they reported having electric heat (n=38).

4.5.3 Cooling Behaviors

The pre-pilot survey, post-cooling season survey, and final survey included questions about participants' typical cooling behaviors. Responses indicate that many participants tried to reduce their use of cooling during On-Peak hours relative to their pre-pilot habits.

A comparison of participants' average preferred A/C setpoints between the pre-pilot survey and the post-cooling season survey indicates that they increased their setpoints for nearly every time of day except overnight, with the most significant difference during the weekday On-Peak period (Figure 4-19). A similar comparison of participants' average preferred temperature when asked on the final survey to reflect on their pre-pilot setpoints versus their post-pilot setpoint employed during the past year does not reflect the same increase in setpoints. The fact that typical temperatures during the weekday morning periods also increased during the pilot suggests that many participants are not employing a pre-cooling strategy. Additional education around pre-cooling may help participants be more comfortable and increase impacts during On-Peak hours. Additionally, while the previous comparison between pre-pilot and post-cooling surveys reflects a true pre post comparison, the comparison between the pre post on the final survey does not. These respondents were asked to recall retrospectively their pre-pilot setpoints, which at the time of survey deployment was almost two years prior, which may bias the results. Moreover, participants were only asked this question on the final survey if they had not responded to it on previous surveys, which may also impact the results due to baseline differences amongst those survey respondents.

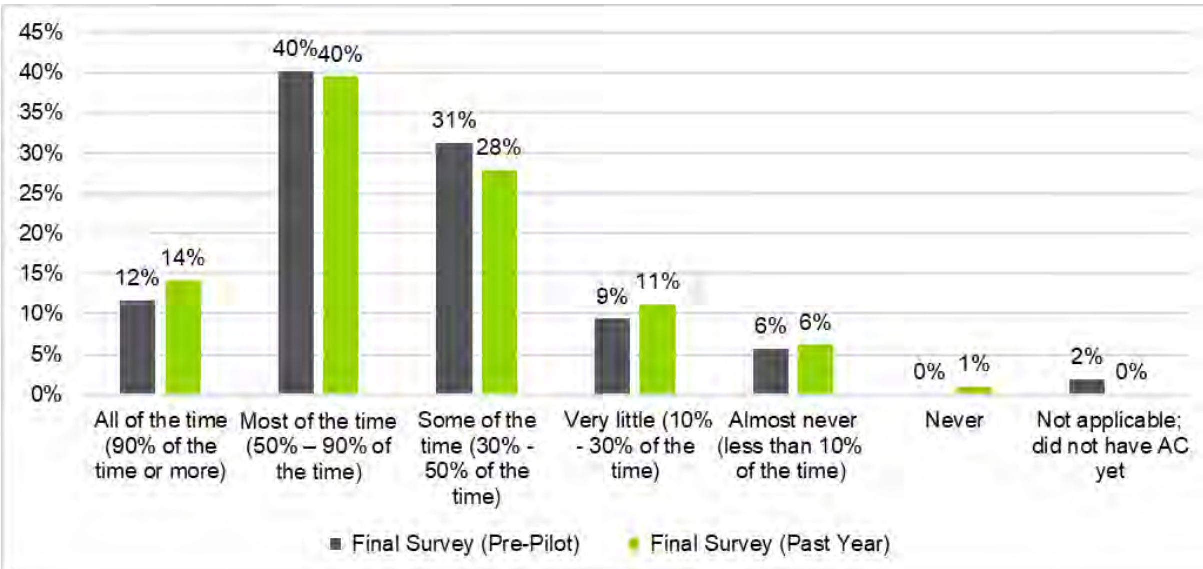
Figure 4-19. Change in Typical Summer Setpoints by Time of Day



Source: Guidehouse pre-pilot survey (n=884), post-cooling season survey (n=423), and final survey (n=739). Group A denotes the population of respondents for whom we have a true pre post comparison: they were asked before the pilot began what their current setpoint was and then again after one cooling season what their new setpoint was. B denotes participants of the final survey who were asked to think back two years to what their setpoint was before the pilot and what their setpoint was in the past year (year 2 of the program).

Nearly all final survey respondents have either room or central A/C, and a majority of them reported using A/C 50% of the time or more during the cooling season (52-54%). The frequency of A/C use was relatively unchanged pre- and post-pilot, as shown in Figure 4-20. This indicates that stressing modifications in A/C usage, such as pre-cooling before On-Peak periods or increasing the temperature by 1-2 degrees, rather than total cessation in program promotional materials may be an effective way to effect On-Peak period consumption behavior, and that there is significant savings potential in this behavior modification. Of participants with smart or programmable thermostats, nearly three-quarters (72%) programmed cooling setpoints during the summer. However, only 38% of those participants changed their setpoints to better align with On-Peak period, suggesting there is room for increased impacts through the education of participants on the importance of aligning their programmed cooling setpoints with On-Peak periods and using pre-cooling strategies before an On-Peak period begins.

Figure 4-20. Frequency of Air Conditioning Use



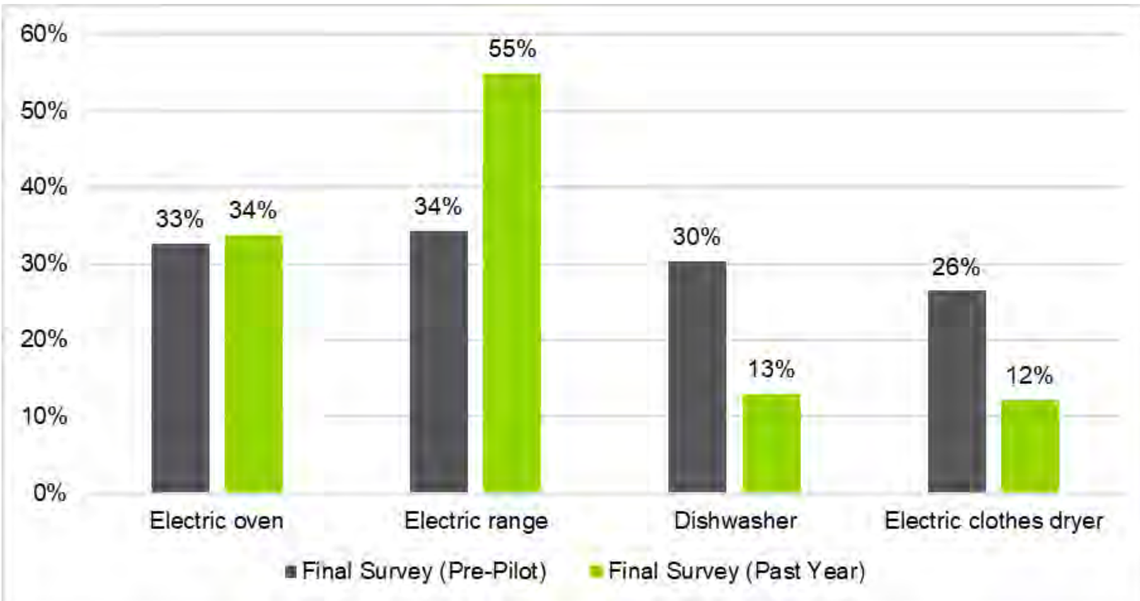
Source: Guidehouse final survey (n=739)

Nearly all customers who reported owning a smart or programmable thermostat used it to schedule changes in temperature during the summer. However, only two-thirds of those customers adjusted the programmed schedule to better align with the TOU pilot rate periods during the summer.

4.5.4 Other Equipment Behaviors

The final survey, like previous surveys, also included questions about participants' usage of other electric end uses during the On-Peak period. Figure 4-21 demonstrates that many participants reduced the frequency of appliance usage during the On-Peak period, particularly dishwashers and clothes dryers, likely because their use is generally not time-sensitive. However, customers showed less willingness to reduce their use of electric ovens and ranges during the On-Peak period, perhaps due to the On-Peak period coinciding with the time when most people choose to prepare dinner.

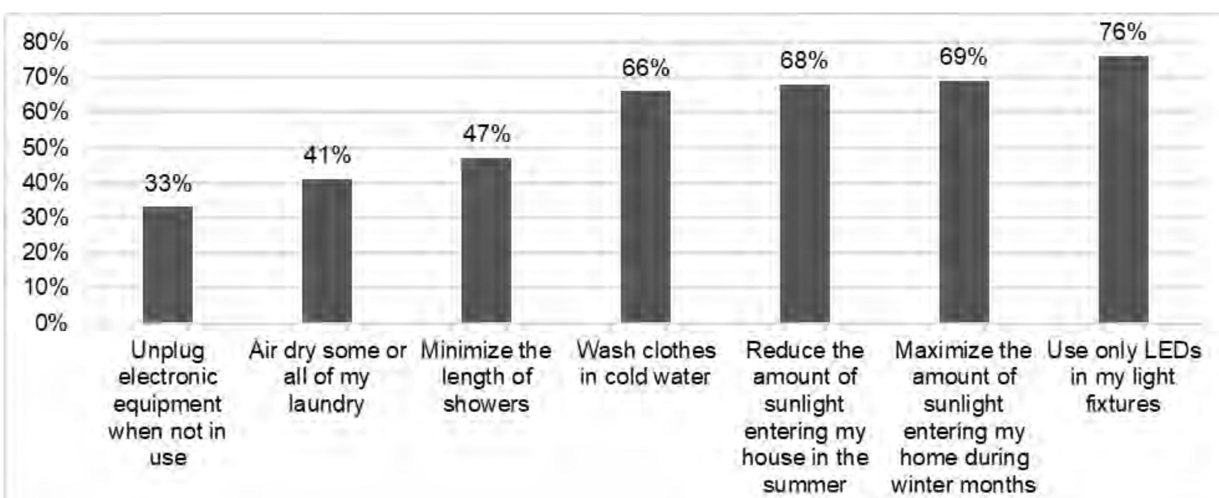
Figure 4-21. Changes in Equipment Usage During On-Peak Period



Source: Guidehouse final survey (n=739). Note that participants were only asked about their usage of electric equipment types that they had in their home.

When asked what people in their household frequently do to save energy, respondents to the final survey most frequently reported making relatively high-effort, low-impact changes, such as using only LEDs (76%), maximizing or minimizing the amount of sunlight entering their house during winter (69%) and summer (68%) respectively, and washing clothes in cold water (66%), as shown in Figure 4-22. Respondents were least likely unplug electronics when not in use (33%) or change habits around length of showers (47%) or air-drying laundry (41%), which may be higher impact than the actions most households are taking. Convenience and habit may be driving this discrepancy, and further education may motivate customers to take higher-impact actions to save energy.

Figure 4-22. Household Actions Taken to Save Energy

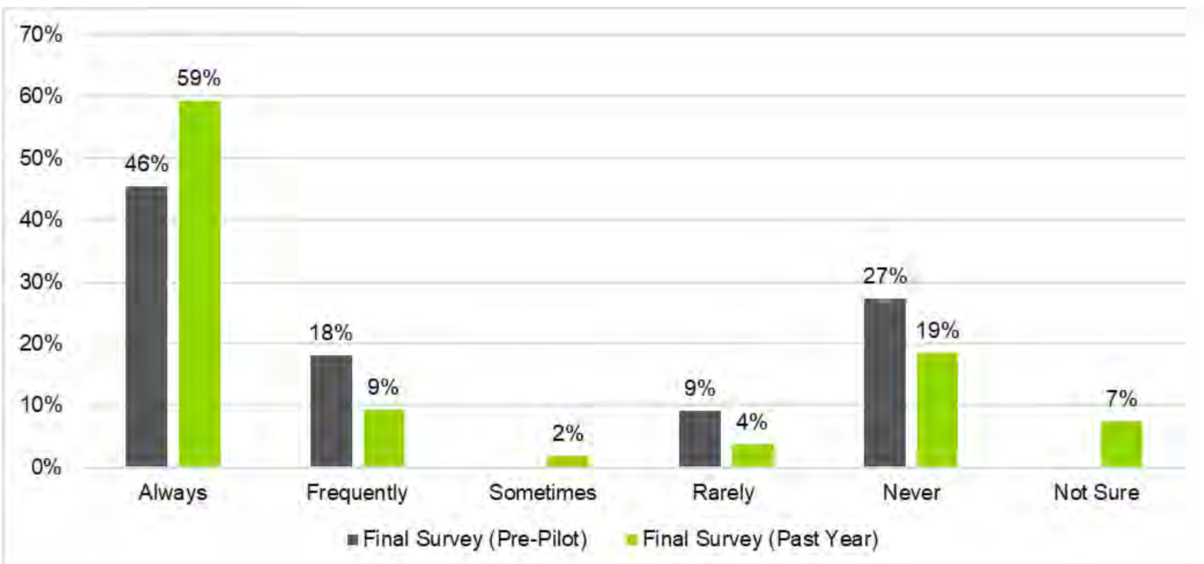


Source: Guidehouse final survey (n=739).

4.5.5 Electric Vehicle Behaviors

Relative to previous surveys, the prevalence of EVs has not changed significantly, increasing from 4% to 7%. EV owners still comprise a relatively small portion of final survey respondents; only 11 participants reported owning and EV before the pilot began in November 2020 and 54 reported owning an EV in the past year. Of those who indicated they owned an electric vehicle, nearly half purchased their vehicle after the pilot started in November 2020. Similar to cooling behaviors, participants of the final survey were asked If they used scheduled charging in general (Figure 4-23) and during peak periods (Figure 4-24). Compared to pre-pilot, 13% more respondents reported "Always" using the EV charger scheduling function.

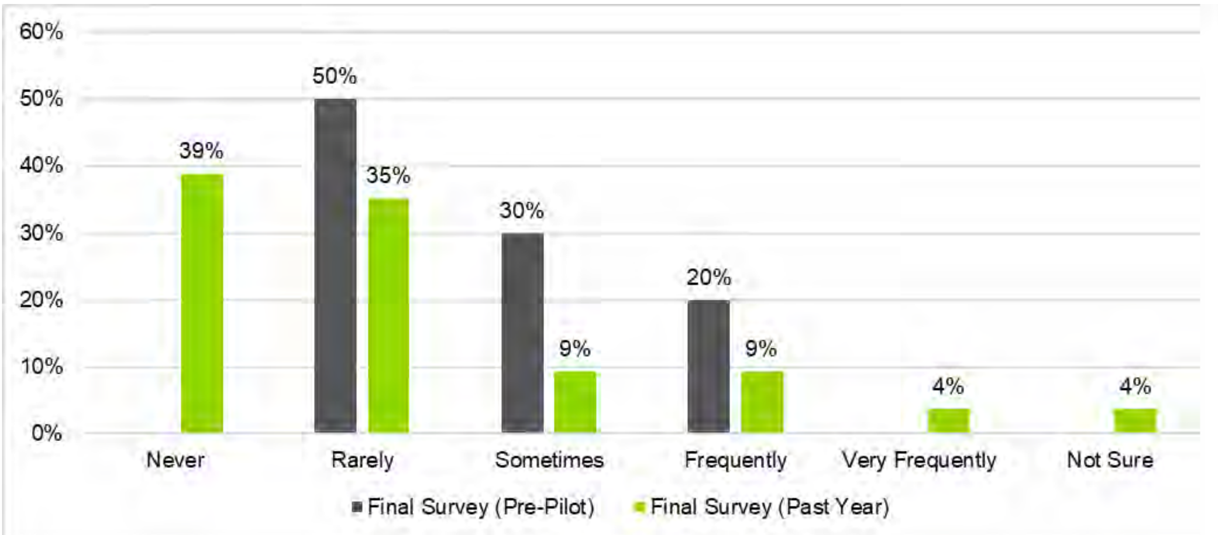
Figure 4-23. Use of EV Charger Scheduling Function



Source: Guidehouse final survey (n=739), Final Survey (Pre-Pilot) n = 11; Final Survey (Past Year) n = 54.

When asked how often they charged their EV during the peak period, customers appear to charge their EV during peak periods less frequently in the past year than they reported doing during the pre-pilot period. The most frequent responses for past year respondents were "Never" (39%) or "Rarely" (35%).

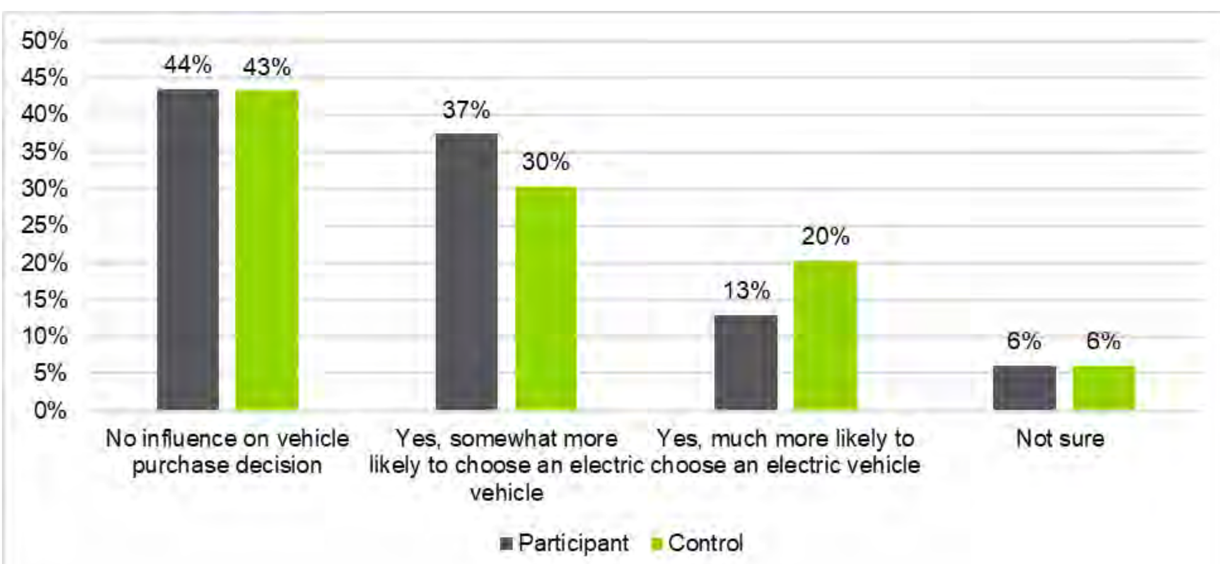
Figure 4-24. EV Charging between 3 pm and 8 pm



Source: Guidehouse final survey (n=739), Final Survey (Pre-Pilot) n = 10 Final Survey (Past Year) n = 54.

In addition to charging behavior, final survey respondents were also asked about potential new vehicle purchases in the next five years, and if that purchase was influenced by the TOU pilot. If they intended to purchase a new vehicle in the next five years, respondents were asked a series of questions around whether that vehicle would be an EV, how much, if any, influence the TOU pilot had on their decision, and how much if at all would the continuation of a TOU rate have on that decision. Almost 40% of customers reported intending to purchase a new vehicle in the next five years. Of those, over half reported it was somewhat (32%) or very likely (23%) that that vehicle would be an EV. For both pilot participants and controls, the TOU rate would not influence their vehicle purchase decision for the plurality of participants, as shown in Figure 4-25. However, more pilot participants reported that they were much more likely to choose an EV, compared to control customers.

Figure 4-25. Continuation of TOU Rate Influence on Potential Future EV Purchase



Source: Guidehouse final survey (n=739), Participant (n=179); Control (n=148). Control Question: If you were offered an electricity rate that varied by time of day so that you could have lower electricity rates during nights and weekends, would that make you more likely to choose a plug-in electric vehicle for your next vehicle purchase? Participant Question: If you knew that the Flex Pricing Pilot would continue to offer lower electricity rates at night and on weekends, would that make you more likely to choose a plug-in electric vehicle for you next vehicle purchase?

4.6 Customer Experience– High-Impact Participants

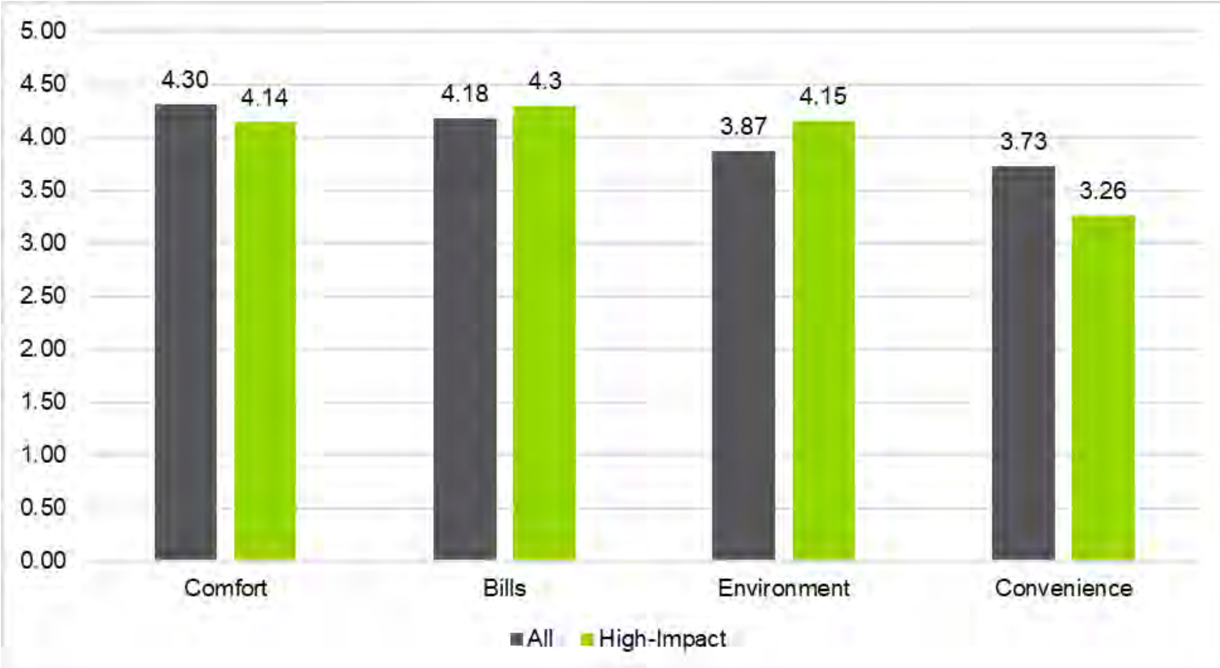
As noted above in Section 3.3, there is a growing body of evidence that suggests that a disproportionate amount of price response in electricity customers comes from a relatively small group of the most enthusiastic participants. This is the implicit conclusion of the DOE meta-analysis' finding that when TOU is deployed with opt-out enrollment, the average per-participant impact falls considerably.[57] In short, opt-out enrollment reduces the proportion of very enthusiastic participants in the sample.

This section presents a selection of customer experience results for high-impact participants. High-impact participants were identified using a two-stage analysis, which involved the use of both survey and AMI data. The characteristics used to define high-impact participants are discussed in greater detail in Section 2.1.4 but include high awareness of rates, energy bill engagement, knowledge of Xcel Energy resources (pilot materials, My Account), and self-reported efforts to reduce peak load.

High-impact participants report differing levels of importance than all customers for the following factors that inform household energy decisions: the cost of my monthly electricity **bill**, the impact of my energy use on the **environment**, and the **convenience** of using appliances and electronics whenever I need to or want to; they did not differ significantly on the importance of the comfort of their home (Figure 4-26). In comparison to all customers, high-impact participants rate the environmental and financial as significantly more important when considering energy use. In contrast, high-impact customers rated convenience of using electronics at their leisure as a less important factor to energy use decisions than all customers. This may be reflective of, similar to seniors, greater flexibility amongst participants in the high-impact segment to adapt to better fit the TOU rate schedule.

[57] U.S. Department of Energy, Electricity Delivery & Energy Reliability, *American Recovery and Reinvestment Act of 2009: Customer Acceptance, Retention, and Response to Time-Based Rates from the Consumer Behavior Studies*, Smart Grid Investment Program, November 2016 **https://www.energy.gov/sites/prod/files/2016/12/f34/CBS_Final_Program_Impact_Report_Draft_20161101_0.pdf**

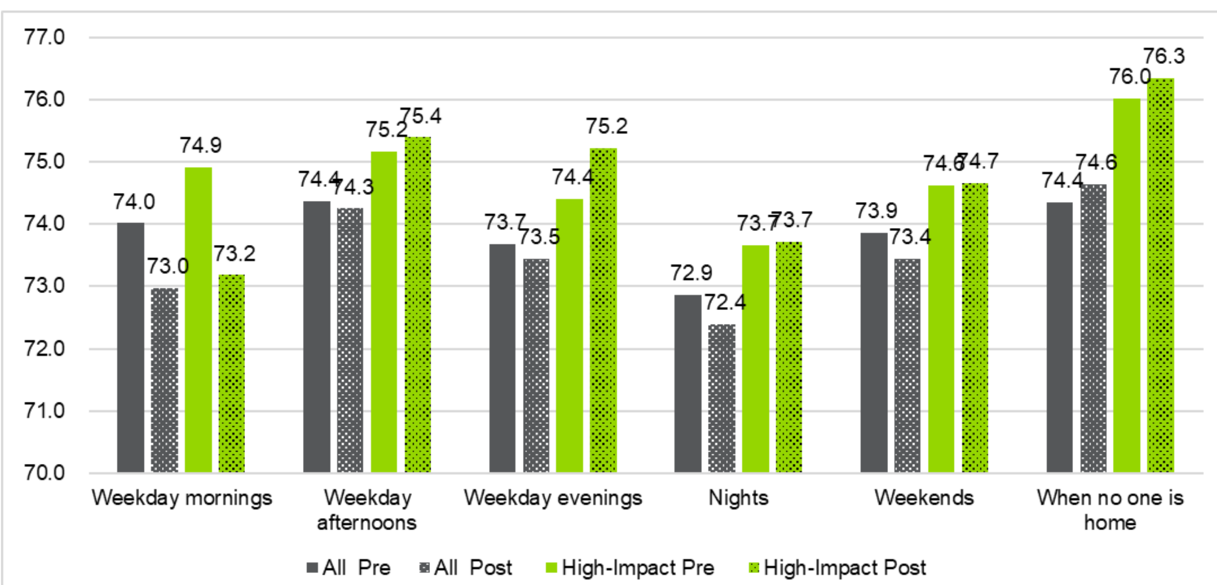
Figure 4-26. Importance of Factors in Household Energy Use Decisions



Source: Guidehouse final survey (n=739)

When asked about preferred cooling setpoints, high-impact customers reported higher cooling setpoints both before and after the pilot (Figure 4-27). Similarly, high-impact participants also reported heating setpoints on average 5°F lower than their standard counterparts (Figure 4-28) regardless of time of day, lending explanatory evidence for baseline differences in energy use between the two groups discovered during the impact analysis.

Figure 4-27. Cooling Setpoints – High-Impact Participants



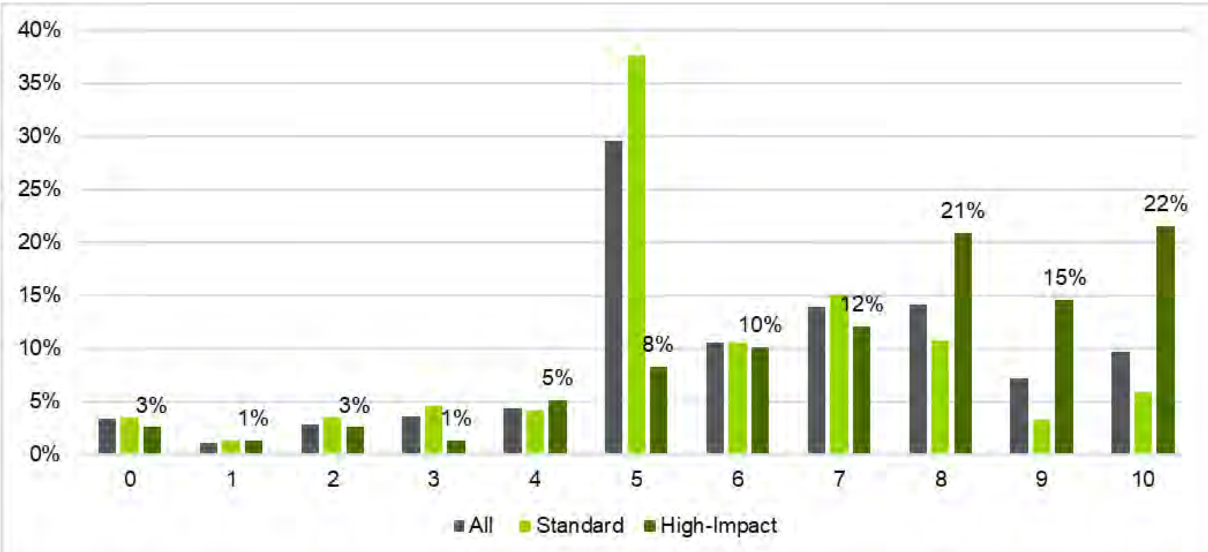
Source: Guidehouse final survey (n=739)

Figure 4-28. Heating Setpoints – High-Impact Participants

Source: Guidehouse final survey (n=739)

High-impact participants also reported higher levels of satisfaction with the pilot (Figure 4-29). While a plurality of all customers reported neutral feelings of satisfaction with the pilot (5 out of 10), a majority (52%) of high-impact customers were at least moderately satisfied (at least 8 out of 10). Interestingly, high-impact customers also had the greatest proportion with a satisfaction score of 0 out of 10, which perhaps is an artifact of their increased engagement coupled with a high level of effort to reduce peak electricity use that did not meet their expectations in terms of savings due to the revenue neutral rate design.

Figure 4-29. Pilot Satisfaction – High-Impact Participants



Source: Guidehouse final survey (n=739)

5. Review and Recommendations

This evaluation of Xcel Energy's TOU pilot found that the TOU rate successfully impacted residential customer demand patterns. In aggregate, the TOU rate delivered statistically significant summer On-Peak and coincident peak demand reductions, with the magnitude of the response varying by study area, season, and year of the pilot.

Lessons from this pilot can help Xcel Energy achieve deeper and longer-lasting TOU rate impacts, generating even greater system benefits from the TOU rate design. This section of the report recommends six sets of actions which may help to make the wider deployment of a default (opt-out) TOU rate even more effective at achieving the desired outcomes. These recommendations focus on actions to enhance participant behavioral response during the summer On-Peak TOU period and at the time of system peak.

1. **Consider a general awareness campaign to accompany a wider deployment of the residential TOU rate.** Emphasize the revenue-neutral rate design to mitigate potential backlash from customers.
    a. *A general awareness campaign was not appropriate for the TOU pilot but is appropriate for a wider deployment of the TOU rate*. Such an effort could have contaminated the pilot control group, so was purposefully avoided.
    b. *Evidence from this evaluation shows that impacts declined in year 2 of the pilot. A general awareness campaign can motivate continued customer response.* A general awareness campaign has the potential to reach more customers by leveraging mass communication channels, such as Xcel Energy's website, billboards, and commercials on local radio and TV stations.
    c. *Customer messaging must be carefully crafted to drive impacts and maintain customer satisfaction.* Default or opt-out rates have a potential to negatively impact customer satisfaction. A well-executed, widespread marketing campaign increases customer awareness while helping Xcel Energy control the narrative about electricity rates. Messaging to customers can highlight that on average, bills will be similar on the Standard and TOU rates for customers who do not change their usage patterns.
2. **Fine-tune customer messaging and develop tools to help customers set realistic expectations about the potential for bill impacts.** Focus on high-impact, low-effort actions, such as programming a thermostat schedule or adjusting thermostat setpoints. Develop customer-facing tools that provide realistic expected bill impacts for recommended actions (e.g., action A could save $X on average).
    a. *Estimated bill impacts from the TOU pilot are modest, less than $1.50 per month on average.*[58] Survey responses indicate respondents feel that they exerted substantial levels of effort, but that they are not seeing commensurate benefits in terms of bill reductions, leading many to feel neutral or even dissatisfied and disengaged after two years in the pilot.

[58] For even the most engaged ("high impact") participants, bill savings were approximately $3 per month on average, equivalent to a 4.5% reduction in their electricity bills (including the average monthly customer charge).

b. *"Right-sizing" customer expectations may lead to habit formation that drives long-lasting impacts.* Manage customer expectations by highlighting only the most impactful actions and providing estimates of average bill savings that customers can expect from these actions.

c. *Simplify messaging about TOU rate periods to help customers understand the key components.* While the majority of participants are aware that the price of electricity changes based on the time of day, only about half of participants were familiar with the specific elements of the TOU rate. Devise heuristics for less engaged customers (e.g., the price of electricity is nearly 10 times as expensive in the late afternoon and evening hours as it is overnight).

d. *Do not emphasize inconvenient actions that are likely to drop off over time.* Customers are unlikely to form lasting habits around high-effort, low-impact actions (e.g., shifting laundry and dish-washing schedules).

e. *Focus on high-impact, low-effort actions that leverage existing equipment.* Making structural changes to customers' electricity usage (e.g., programming thermostat schedules with efficient set points) will lead to long-lasting impacts.

f. *Identify longer-term benefits of structural changes and equipment investments, leveraging Xcel Energy's existing DSM program infrastructure.* Encourage customers to make high-impact, low-effort structural changes to their usage patterns now, while encouraging customers to take advantage of DSM programs when considering equipment upgrades in the future. TOU rates will improve the participant cost-effectiveness of DSM measures that maximize system benefits, and longer-term investment in such equipment at time of replacement is a low-effort and convenient way for customers to benefit from the TOU rate.

3. **Coordinate DSM program offerings and educational materials with the TOU rate design to deliver deeper impacts.** Ensure DSM program offerings and educational materials address the benefits they offer under the TOU rate.

   a. *If Xcel Energy provides certainty about future rate structures, customers will be incentivized to make long-term equipment investments, delivering deeper impacts.*

   b. *Existing DSM programs include rebates for smart and programmable thermostats, which can enable substantial impacts* when customers set an efficient set point schedule, a low-effort action. Modify DSM program materials to emphasize actions related to HVAC usage, including using higher setpoints in general, programming thermostats to allow higher setpoints during the On-Peak period, or adjusting smart thermostat settings to optimize response, and how a TOU rate enables customer bill savings.

   c. *Reduce customer barriers for efficient thermostat use* by communicating the estimated time to set up a thermostat schedule, providing suggested schedules and setpoints (including pre-cooling in summer months), and links to technical support and setup guides on manufacturers' websites. Nearly three-quarters customers who reported owning a smart or programmable thermostat used it to schedule changes in temperature during the summer. However, only 40% of those customers adjusted the programmed schedule to better align with the TOU pilot rate periods during the summer.

d. *Reflect on DSM and other offerings, focusing on initiatives that pair particularly well with a TOU rate.* Communicate to customers the potential synergies between TOU rates and DSM programs. Recognize that TOU rates make other programs, practices, and equipment even more cost-effective for customers.

4. **Target EV owners.** Add language to the EV website landing page about the potential for substantial bill savings when customers are on a TOU rate (or TOU-aligned EV rate) and EV charging occurs during the Off-Peak period.

   a. *Emphasize to EV owners the potentially substantial benefits of the TOU rate (or TOU-aligned EV rate) and provide resources to assist response.* Inform EV owners about potential bill savings when they program EV charging to occur during the Off-Peak TOU period. This study and others have shown that EV owners are highly price sensitive and are likely to respond to messaging from Xcel Energy.

   b. *Inform EV owners about TOU-aligned rates tailored to EV owners, including EV Accelerate at Home (A80, A81) and Residential Electric Vehicle Service (A08).* The EV Accelerate at Home webpage (**https://ev.xcelenergy.com/ev-accelerate-at-home-mn**) is not currently linked from the EV landing page (**https://ev.xcelenergy.com/**), so EV owners may be unaware of this rate offering.

   c. *Consider developing DSM programs targeting EV owners.* Provide links to videos or other articles focused on helping EV owners manage the timing of their charging (e.g., through the use of timers).

5. **Conduct focus groups with key subsets of participants to learn more about their motivations, barriers to making structural changes, and preferred communication channels.**

   a. *Study high impact participants* to learn more about their motivations and actions taken to achieve meaningful impacts. Identify opportunities to convert standard participants to high impact participants via increased engagement.

   b. *Study standard participants* to learn more about their barriers to making structural changes and preferred communication channels. Identify opportunities to convert standard participants to high impact participants via increased engagement.

   c. *Study renters* to learn more about their barriers to making structural changes. Identify opportunities to increase the proportion of rental properties that participate in DSM program offerings.

   d. *Study new movers* to learn more about their barriers to making structural changes and preferred communication channels. Identify communication strategies that encourage new movers to take efficient actions (e.g., program thermostat schedules with efficient set points) soon after moving in—when new habit formation may be easiest—and to purchase efficient equipment when upgrading appliances.

6. **Further education may help participants better understand the rate structure and help them better adjust their behaviors to concentrate load shifting away from the On-Peak periods.**

    a. *Almost a quarter of participants (23%) reported using none of the available resources to learn about the pilot*, which is almost double the rate of respondents in the post-cooling season survey. Whether a sign of disengagement two years into the pilot or a missing type of educational resource, it is vital to ensure customers are informed so that they can best take action to reduce their peak electricity use.

    b. *Final survey participants identified saving more money and having better information as top motivating factors*, in response to open ended questions about what would motivate them to reduce energy use during On-Peak periods. Similarly, having better information was the top response to how to make it more convenient to reduce On-Peak usage.

    c. *Final survey participants requested more information on the pilot, real time usage data, and information on how actions translate into costs*, when asked about tips or tools that Xcel Energy could provide that would help them better manage usage energy saving tips. While Xcel Energy has already provided many of these in some form throughout the pilot, this points to a need to consider how customers are engaging with educational materials and any barriers that may decrease overall engagement.

Appendix A. Impact Approach Detail

This appendix presents the model specifications used to estimate TOU period and coincident peak demand impacts. In addition, it provides the methodology and model specifications for estimating impacts for the new move-in and high-impact participant analyses. All impacts provided in this report are derived from the estimated parameters of the models described below.

A.1 TOU Period Model

The approach to estimating the core impacts of the evaluation – the average demand impact of the TOU rate by TOU period, season, and segment – remains similar to that used in the interim reporting, provided in Section A.1 of Appendix A.1 of the interim report. The regression approach is a lagged dependent variable (LDV) approach, which compares pre-pilot period demand data to year 1 and year 2 demand data. The only difference from the prior approach used in interim reporting is that the two terms interacted with the “move-in” binary variable have been removed, simplifying the core model (below). A separate analysis was conducted to more precisely evaluate the impact of TOU rates on customers that have recently moved in; refer to Appendix X1.

The model below was estimated eight times, once for each study area, season, and year combination. The data used are daily in frequency by TOU period, so there could be as many as three observations per customer per weekday: average On-Peak demand, average Mid-Peak demand, and average Off-Peak demand. On weekends and holidays, there can be a maximum of two observations per customer per day: average Mid-Peak demand and average Off-Peak demand.

The regression model specification is defined in Equation A-1 below.

Equation A-1: TOU Period Model Specification

$$\begin{aligned} y_{itr} = & \sum_{p=1}^{P=5} \beta_1^p \cdot tou_{tr}^p + \sum_{p=1}^{P=5} \beta_2^p \cdot tou_{tr}^p \cdot prekW_{ir} + \sum_{p=1}^{P=5} \beta_3^p \cdot tou_{tr}^p \cdot cdh_{tr} + \\ & \sum_{p=1}^{P=5} \beta_4^p \cdot tou_{tr}^p \cdot hdh_{tr} + \sum_{p=1}^{P=5} \beta_5^p \cdot tou_{tr}^p \cdot hbu_{tr} + \sum_{p=1}^{P=5} \beta_6^p \cdot tou_{tr}^p \cdot cbu_{tr} + \\ & \sum_{s=1}^{S=5} \sum_{p=1}^{P=5} \beta_7^{ps} \cdot tou_{tr}^p \cdot seg_{is} + \sum_{p=1}^{P=5} \gamma_1^p \cdot tou_{tr}^p \cdot treat_i + \sum_{s=1}^{S=5} \sum_{p=1}^{P=5} \gamma_2^{ps} \cdot tou_{tr}^p \cdot treat_i \cdot seg_{is} + \varepsilon_{itr} \end{aligned}$$

Where:

y_{itr}	=	Premise *i*’s average demand (kW) in TOU period *p* (On-Peak Weekdays, Mid-Peak Weekdays, Off-Peak Weekdays, Mid-Peak Weekends/Holidays, Off-Peak Weekends/Holidays) of day of sample *t*.

tou_{tr}^{p} = A set of five binary variables. Each one is equal to one when the demand value on the LHS of the equation is in the same TOU period (subscript r) as that flagged by the binary. For example: when $y_{itr=it1}$ then, $tou_{t1}^{1}=1$, $tou_{t1}^{2}=0$, $tou_{t1}^{3}=0$, $tou_{t1}^{4}=0$, and $tou_{t1}^{5}=0$.

$prekW_{ir}$ = The average pre-period demand in TOU period *r*, for premise *i*. This is the LDV. The purpose of this variable is described in greater detail in the text below.

cdh_{tr} = The average of the cooling degree hours (base 65° Fahrenheit) observed in TOU period *r* of day of sample *t*.

hdh_{tr} = The average of the heating degree hours (base 65° Fahrenheit) observed in TOU period *r* of day of sample *t*.

$treat_{i}$ = A binary variable that takes a value of 1 if premise *i* is subject to TOU prices, and zero otherwise.

seg_{is} = A set of five binary variables identifying to which segment *s* or segments premise *i* is allocated. Segments are overlapping, so a single premise may be allocated to multiple segments. The five segments included in this analysis are: low income, seniors, renters, smart thermostats, and electric vehicles.

hbu_{tr} = The average heat build-up observed in the hours that fall within TOU period *r*, on day of sample *t*. This is a 72-hour geometrically decaying average of the NOAA heat index, as observed in hour of sample *s*. It is calculated in the following manner: $cbu_{t}=\sum_{h=1}^{72}0.96^{h}\cdot heatIndex_{s-h} \Big/ 1{,}000$. Where $heatIndex_{s-h}$ is calculated as laid out immediately below.

$heatIndex_{s}$ = This value is calculated using the following equation provided by the NOAA:[59]

$$
\begin{aligned}
&-42.379+2.04901523\cdot T_{s}+10.14333127\cdot RH_{s}\\
&-0.22475541\cdot T_{s}\cdot RH_{t}-0.00683783\cdot T_{s}^{2}-0.05481717\cdot RH_{s}^{2}\\
&+0.00122874\cdot T_{s}^{2}\cdot RH_{s}+0.00085282\cdot T\cdot RH_{s}^{2}-0.00000199\cdot T_{s}^{2}\cdot RH_{s}^{2}
\end{aligned}
$$

[59] NOAA, *The Heat Index Equation*, page last modified May 2014, accessed October 2021, **https://www.wpc.ncep.noaa.gov/html/heatindex_equation.shtml**

		Where RH is relative humidity and T is dry bulb temperature in Fahrenheit. When the variable was calculated, the following adjustment is subtracted from the $heatIndex_s$ when the RH was less than 13% and the dry bulb temperature was between 80° and 112° Fahrenheit: $\left[{(13-RH_s)}/{4} \right] \cdot \sqrt{\frac{17-\lvert T_s-95 \rvert}{17}} S$
cbu_{tr}	=	The average cold build-up observed in the hours that fall within TOU period *r*, on day of sample *t*. This is calculated in the same way as $hbu_{t,r}$, except that the heat index values are replaced by wind chill.
ε_{itr}	=	The cluster-robust error term for customer *i* within TOU period *r,* on day of sample *t*; cluster-robust errors account for heteroskedasticity and autocorrelation at the customer level.

In accordance with the interim report methodology, the evaluation team excluded customers who had opted out of the pilot from the impact analysis. As a sensitivity test, Guidehouse estimated TOU period impacts including customers who had opted out of the pilot and found no statistically or practically significant impact on results.

A.2 Coincident Peak Demand Model

The model below was estimated four times: once for each study area and year of the pilot. Only a single observation per year was included for each customer: their peak demand during the hour of the system peak in the summer of 2021 and 2022.

Equation A-2: Summer Coincident Peak Demand Model Specification

$$y_i = \beta_1 + \beta_2 \cdot prekW_i + \sum_{s=1}^{S=5} \beta_7^s \cdot seg_{is} + \gamma_1 \cdot treat_i + \sum_{s=1}^{S=6} \gamma_2^s \cdot treat_i \cdot seg_{is} + \varepsilon_i$$

Where:

y_i	=	Premise *i*'s average demand (kW) during the hour of the system peak in summer of 2021 or summer 2022.
$prekW_i$	=	The lagged dependent variable, corresponding to the average pre-period demand for premise *i*, observed during the hour coincident with the system peak in the summer of 2020.

The rest of the variables are as defined above.

A.3 New Move-In Analysis

For the final report, Guidehouse undertook a more in-depth examination of new premise occupants. While the core analysis (described in Section A.1) includes new occupants (along with all other participants and control customers), this additional analysis focuses exclusively on those customers who recently moved in. This analysis was completed to test the hypothesis generated during the initial analysis that longer-term exposure to the TOU rate will increase impacts.

The model used to estimate new occupant impacts (shown below) is similar to the core model for estimating TOU period demand impacts for the entire sample (provided in Equation A-1). The principal differences are:

- Only customers who have moved into the premise since the pilot began are included in the estimation set.

- An interaction between an individual customer’s tenure (or length of occupancy) and the treatment variable is included to capture the degree to which TOU response changes over time – i.e., to test the hypothesis that a customer’s TOU response will increase the longer the customer has lived at their new premise.

- Segmentation interactions with the treatment variable have been removed. This is to avoid introducing multi-collinearity that could bias the impact of interest (i.e., how TOU impacts change over time for new occupants).

The new move-in model was estimated four times, once for each study area and season combination. Data for the entire pilot period was included in the estimation set, meaning that estimated impacts are the average across the entire pilot period. This differs from the core analysis, which splits year 1 and year 2, and is intended the quantity of data available for the model.

The regression used for the new move-in analysis is specified in Equation A-3.

Equation A-3: New Move-In Model Specification

$$
\begin{aligned}
y_{itr} = & \sum_{p=1}^{P=5} \beta_1^p \cdot tou_{tr}^p + \sum_{p=1}^{P=5} \beta_2^p \cdot tou_{tr}^p \cdot prekW_{ir} + \sum_{p=1}^{P=5} \beta_3^p \cdot tou_{tr}^p \cdot cdh_{tr} + \\
& \sum_{p=1}^{P=5} \beta_4^p \cdot tou_{tr}^p \cdot hdh_{tr} + \sum_{p=1}^{P=5} \beta_5^p \cdot tou_{tr}^p \cdot hbu_{tr} + \sum_{p=1}^{P=5} \beta_6^p \cdot tou_{tr}^p \cdot cbu_{tr} + \\
& + \sum_{p=1}^{P=5} \gamma_1^p \cdot tou_{tr}^p \cdot treat_i + \sum_{p=1}^{P=5} \gamma_2^{ps} \cdot tou_{tr}^p \cdot treat_i \cdot tenure_{it} + \varepsilon_{itr}
\end{aligned}
$$

Where:

$tenure_{itm}$	=	A linear trend specific to customer *i* that identifies the number of calendar months since customer *i* moved into the premise. So, for example, if customer *i* moved into the premise on January 16, this variable would take (for the given customer) a value of 1 in the rest of January, a value of 2 in the subsequent month, etc.

And all other variables are as described in Section A.1.

As with the core model, this regression is an LDV model. This modeling approach requires the use of pre-pilot period demand data (to allow for the comparison of pre/post differences between control customers and participants). The fact that the pre-pilot data are demand values generated by a different customer may increase the variance of the parameter estimate (hence the importance of the longer time-period for the sample, noted above), but should not, under the RCT framework, bias results.

Likewise, although the LDV will not be as accurate a predictor of demand for new move-ins (due to differences in behavior between the new move-in and the former occupant), the LDV will continue to capture the effects of dwelling characteristics (e.g., size of dwelling, efficiency of HVAC equipment, etc.)

In addition to the impacts presented in Section 3.2, Guidehouse conducted additional exploratory analysis. Detailed findings are available in Appendix X1.

A.4 High-Impact Participant Analysis

This section describes how high-impact participants were identified using AMI and survey data, and how impacts were estimated for these participants. There are three steps to this process.

- Stage 1 participant identification.
- Stage 2 survey review & identification of defining characteristics
- Estimate and test results for likely high-impact participants.

A.4.1 Stage 1 Participant Identification

Stage 1 is a coarse filter used to identify participants who are most likely to be high-impact customers and is intended to support the exploratory analysis of survey data. Only customers who had not moved since the pilot began were included. For each customer fitting that criterion, pre-pilot and pilot period demand during the summer On-Peak period were compared.[60] The evaluation team examined a frequency distribution of these results, then selected a threshold to be applied to these results to define the stage 1 high-impact participants. Guidehouse set the threshold such that the top 15 percent of participants with the largest reductions in summer On-Peak demand are designated as the stage 1 high-impact customers.[61]

[60] The Guidehouse team used summer demand to identify likely high-impact participants based on the year 1 findings, which indicated statistically significant reductions in demand during On-Peak hours for both study areas.
[61] The high-impact threshold was determined based on visual inspection of load shapes.

A.4.2 Stage 2 Survey Review & Identification of Defining Characteristics

In stage 2, survey responses of likely high-impact participants identified in stage 1 were compared to those of standard participants to identify customer characteristics or behaviors that appear to be predictive of high-impacts. Responses from all five surveys were considered in the stage 2 analysis. For questions which respondents may have answered in multiple surveys, the most recent response was prioritized for all variables except those regarding pre-pilot behaviors, for which the earliest available survey response was prioritized.

After compiling the full survey data set, the Guidehouse team conducted t-tests on all available variables to identify statistically significant differences between likely high-impact and standard participants. This analysis examined survey responses related to customer demographics, home characteristics, appliance and equipment types and uses (with many questions focusing on ACs, smart thermostats, and EVs), use of Xcel Energy tools and features, engagement with and understanding of customer bills and the TOU rate structure, and respondents' self-assessment of their efforts to reduce electricity use during the On-Peak period.

Guidehouse concluded that the most significant indicators of likely high-impact status were related to customer engagement with their energy bills and with the TOU pilot. This led to additional exploration of customer demographics, home characteristics, and behavioral indicators of being highly engaged with energy bills and the TOU pilot, and eventually to the development of several indices to identify high-impact participants. After additional exploratory analysis, the evaluation team selected the index described in the table below, which captures customer engagement. Participants with a score of six or higher (out of ten possible points) are designated as high-impact participants. Guidehouse used this set of high-impact participants for further quantitative analysis, as described in the next section.

Table A-1. Index to Identify Stage 2 High-Impact Participants

Engagement Index	Question Text	Response	Scoring
Bill Engagement (2 pts.)	Which of the following statements best describes your typical response to your electricity bill over the past year?	I typically spend at least several minutes looking at my monthly bill to gain an understanding of the costs and other information that is provided	2
		I glance at the various costs and other information on the bill before paying	1
		(Any other response)	0
Rate Understanding (3 pts.)	Which of the following statements would you say accurately represents how you are charged for energy since the new Flex Pricing Pilot began? *(multiple responses accepted)*	The amount I pay per unit of electricity depends on the time of day I use it	1
		The amount I pay depends on whether it is a weekday, weekend or a holiday	1
		On weekdays, there are three different prices for electricity (unless it is a holiday)	1
Materials (3 pts.)	Do you remember receiving a cling from Xcel Energy with information about the Flex Pricing Pilot (see image below)?	Yes	1
	Which of the following resources have you used to learn more about the Flex Pricing Pilot or how you can manage electricity use during peak periods? *(multiple responses accepted)*	Summer rate reminder postcard (respondents to post-cooling or final survey only)	1
		Xcel website (all other participants)	1
	Have you used the My Account service on the Xcel website or mobile app to review your electricity usage in the past year?	Yes, often	1
Effort (2 pts.)	On a scale of 0-10, how would you characterize your household's efforts to reduce your peak electricity use over the past year?	8, 9, 10	2
		6, 7	1
		0, 1, 2, 3, 4, 5	0

A.4.3 Estimate and Test Results for High-Impact Participants

Using the indicator for high-impact customers identified in stage 2, the Guidehouse team estimated the regression model displayed below four times: once for each unique combination of season and study area.

Equation A-4: High-Impact Participant TOU Period Summer Model Specification[62]

$$y_{itr} = \sum_{p=1}^{P=5} \beta_1^p \cdot tou_{tr}^p + \sum_{p=1}^{P=5} \beta_2^p \cdot tou_{tr}^p \cdot prekW_{ir} + \sum_{p=1}^{P=5} \beta_3^p \cdot tou_{tr}^p \cdot cdh_{tr} +$$
$$\sum_{p=1}^{P=5} \beta_4^p \cdot tou_{tr}^p \cdot hdh_{tr} + \sum_{p=1}^{P=5} \beta_5^p \cdot tou_{tr}^p \cdot hbu_{tr} + \sum_{p=1}^{P=5} \gamma_1^p \cdot tou_{tr}^p \cdot treat_i +$$
$$\sum_{p=1}^{P=5} \gamma_1^p \cdot tou_{tr}^p \cdot treat_i \cdot high_i + \varepsilon_{itr}$$

Where:

$high_i$	=	Is a binary variable equal to 1 if customer *i* is a stage 2 high-impact participant and zero otherwise.

This model is similar to the core TOU period demand model (see Section A.1). The principal differences are:

- Only participants and controls that have responded to a survey are included in the estimation set.
- An interaction between the treatment effect and the flag identifying a stage 2 high-impact customer is included. This allows the model to identify both the average impact of TOU rates on survey respondents (which may differ from that of the participant sample as a whole) and the incremental effect of being identified as a stage 2 high-impact participant.
- Segmentation interactions with the treatment variable have been removed. Given the larger sample results of segment-specific impacts, segment specificity for the much smaller survey-group sample is unlikely to provide meaningful segment-specific results.

Impacts for the final set of high-impact participants are included in Section 3.3, as well as the proportion of survey respondents in each segment that have been identified as such high-impact participants.

[62] The winter model uses the same model specification as the summer model, apart from one additional weather term: the average cold build-up observed in the hours that fall within TOU period *r* on day of sample *t*. This term is excluded from the summer model specification for simplicity, given the limited explanatory power of cold build-up on demand during the summer months.

Appendix B. Segmentation

This appendix describes updates made to customer segment assignments and the impact of such updates on the distribution of participants and controls across segments.

Segmentation was initially performed using pre-pilot survey data for a pool of 20,000 customers, rental property license data, and a machine learning technique known as Support Vector Machines (SVM). The SVM algorithm was used to make probabilistic segment assignments based on the data in hand to assign each customer included in the study to some - or none - of the segments. Customers belonging to none of the segments are referred to as belonging to the "General Population." The evaluation team updated the estimated segment assignments with each customer survey fielded.

Xcel Energy defined five segments:

- Electric Vehicles
- Low Income
- Renters
- Seniors
- Smart Thermostat (owners)

For all segments except electric vehicle owners and low income, a premise's segment assignment is updated only if they responded to a segmentation question in a survey and that response differed from the original pre-launch segment assignment. For electric vehicle owners, only those participants and controls who explicitly identified that they had an EV were assigned to this segment. This more restrictive approach was used for this segment given the limited market penetration of EVs. For the low-income segment, Guidehouse updated a premise's segment assignment based on LIHEAP recipient data received during and after the pilot.[63]

As Figure B-1 shows, the overall distribution changed minimally after pilot period survey updates. However, as a result of the strict requirement that only participants and controls who positively identify themselves as owning or leasing an EV, the electric vehicle share of premises drops considerably from approximately 9% of the sample to approximately 1%.[64]

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[63] More specifically, premises were assigned to the low income segment if they were listed as a LIHEAP recipient in the latest LIHEAP data, but were not a survey respondent and had not been identified as low income using the SVM model.

[64] For context, the Alternative Fuels Data Center estimates that Minnesota had approximately 10,000 light duty EV registrations in 2020. This is approximately 0.6% of the total (1.8 million) automobile vehicle registrations in the state in the same year. Given the expectation that EV registrations as a percentage of total registrations would be materially less than the percentage of vehicles on the road that are EVs because of ongoing growth in the share of sales, this suggests that the somewhat restrictive updating approach used delivers a more accurate representation of the population than the initial estimate.

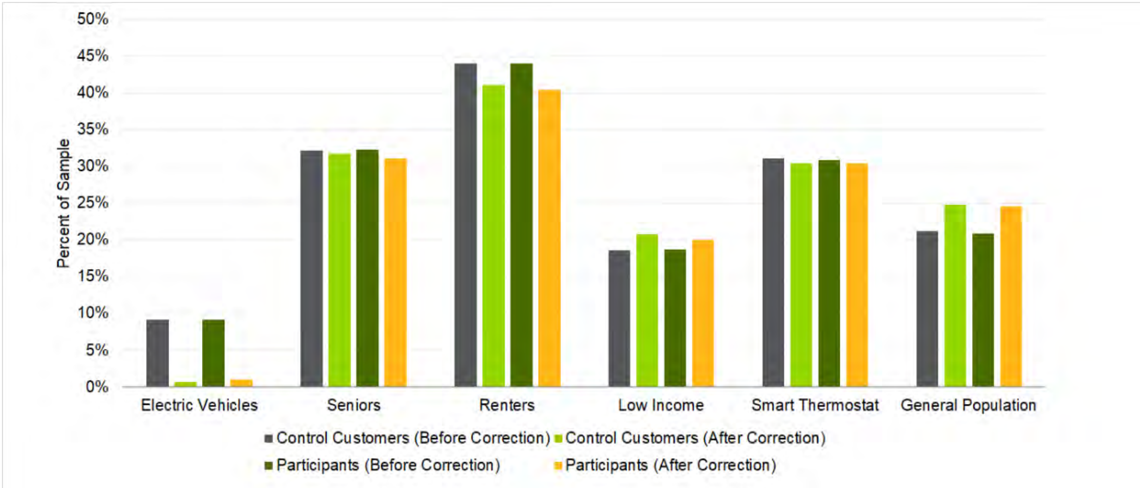
U.S. Department of Energy, Alternative Fuels Data Center, *Electric Vehicle Registrations by State*, last updated June 2021, accessed 2022-01-05

https://afdc.energy.gov/data/10962.

U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics Series: Highway Statistics 2020 State Motor-Vehicle Registrations – 2020*, updated December 2021, accessed 2022-01-05

https://www.fhwa.dot.gov/policyinformation/statistics/2020/mv1.cfm.

Figure B-1. Distribution of Participants and Controls by Segment



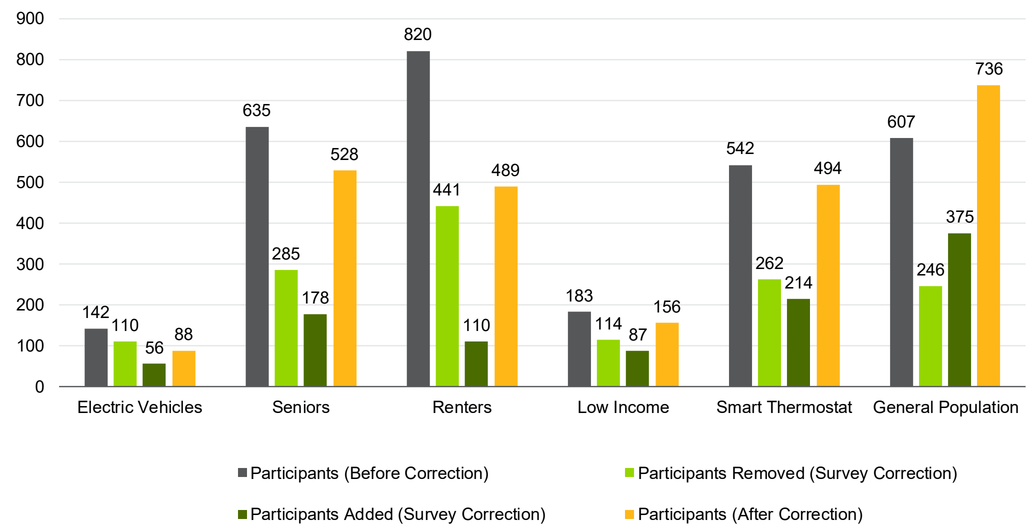
Source: Guidehouse analysis

Figure B-2 illustrates the effects of survey-based data updates on participant customer segments from a slightly different perspective. Figure B-3 illustrates the effects of the same updates on control customer segments. Both figures show four bars for each segment.

- The first (grey) bar is the count of the number of customers from the given segment who responded to the survey question that is used to establish the segment assignment.
- The second (light green) bar is the count of the number of customers who were removed from the segment based on their answer to that question.
- The third (dark green) bar is the count of the number of customers who were *added* to the segment based on their response to the survey question.
- The fourth and final (yellow) bar for each segment is the total count of customers who both answered the pilot period survey question required to assign them to a segment and are assigned to the given segment.

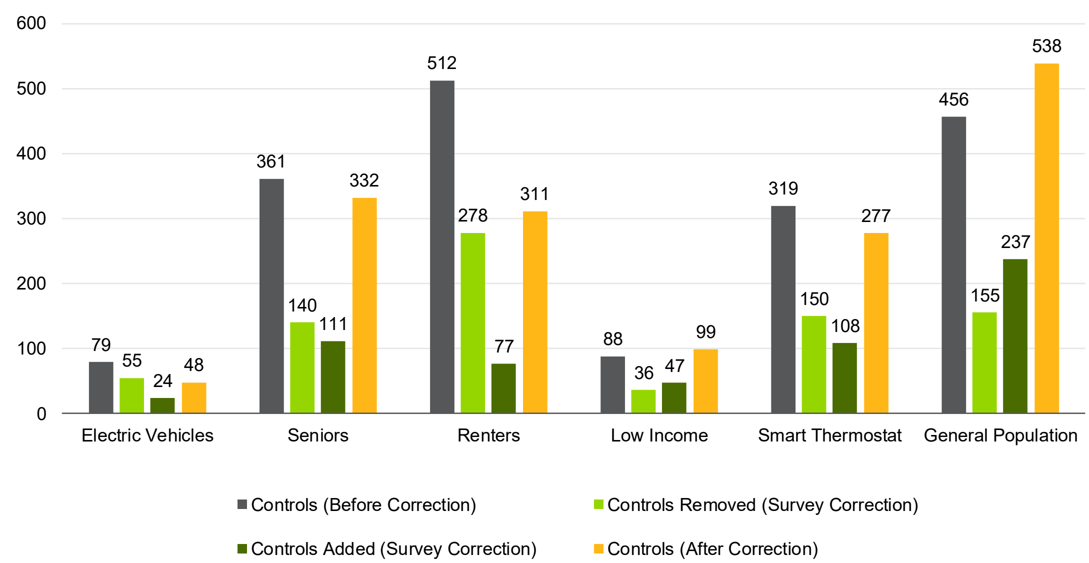
For clarity, note that while the figure below identifies customers as “removed” or “added,” this refers purely to the segment assignment. All customers below are included in the original sample of premises, and all were included in the impact analysis. Figure B-3 illustrates the effects of survey-based data of control segmentation.

Figure B-2. Summary of Survey-Based Segmentation Updates on Participants



Source: Guidehouse analysis

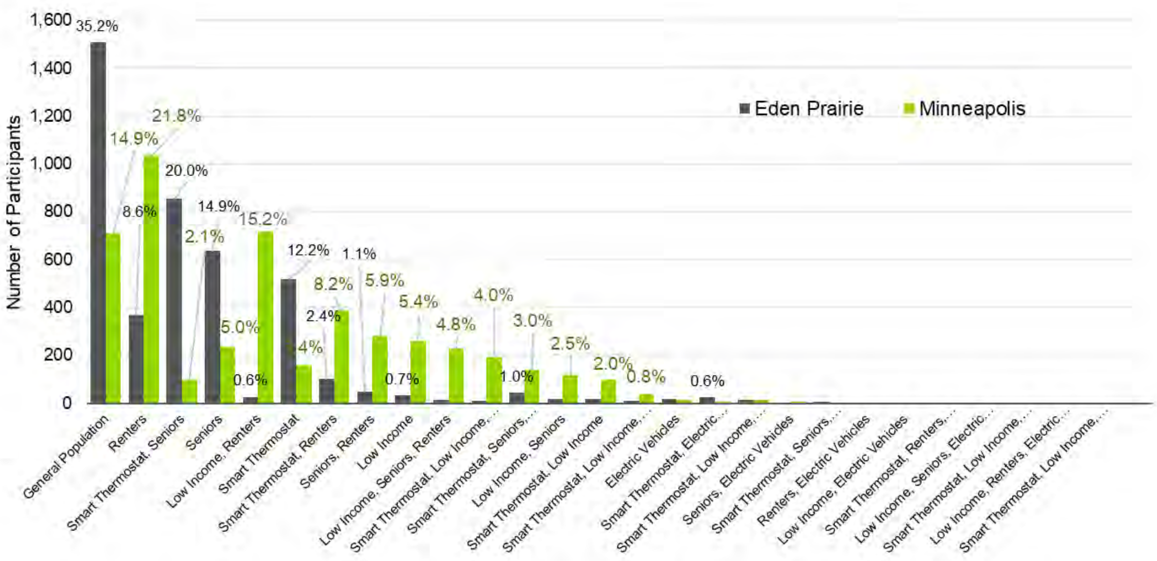
Figure B-3. Summary of Survey-Based Segmentation Updates on Controls



Source: Guidehouse analysis

Since customers can belong to multiple segments, examining the distribution in Figure B-2 may distort the picture of what the overall distribution of participants looks like. As such, Figure B-4 presents the distribution of individuals by mutually exclusive combinations of segments by study area, with the percentages by study area summing to 100%.[65] Referencing this figure, the largest group of participants does not belong to any segment at all ("general population"). The second largest group is participants who are uniquely renters (and not, for example, low income renters, smart thermostat renters, or any other combination), and so on. The distribution above matches the expectations of the study areas, with Eden Prairie having far fewer customers classified as low income, renters, or combination renter segments than Minneapolis. Additional demographic information (obtained from survey respondents) may be found in Section 4.1.

Figure B-4. Distribution of Unique Segment Combinations of Participants



Source: Guidehouse analysis

65 Percentage call-out values are suppressed for groups accounting for less than 0.5% of the sample.

Xcel Energy Minnesota Time-of-Use Pilot Evaluation – Final Report

Appendix X1 – New Move-In Analysis Memorandum

Prepared for:

Submitted by:

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Reference No.: 207260
2023-01-06

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Memorandum

To:	**Nikki Caicedo**
From:	**Grace Sauter, Bethany Glinsmann, Peter Steele-Mosey, Stuart Schare**
Date:	**November 22, 2022**
Re:	**Xcel Energy MN TOU Year 2 New Move-In Analysis**

In Fall 2021, Guidehouse explored the impact of participants who moved into their dwelling after the pilot began ("new move-in tenants"). The results of this initial analysis indicated that on-peak summer impacts were higher when excluding new move-in tenants, and that new move-in tenants consume more electricity in all summer periods compared with participants who have vacated the premise. These interim findings suggested that longer-term exposure to the TOU rate (including Xcel Energy's messaging) may have a meaningful impact in participant TOU response.

As part of a further examination of new move-in tenants, Guidehouse conducted an in-depth examination of load shapes and TOU period demand impacts using data from the full pilot period. This analysis was completed to test the **hypothesis generated during the initial analysis that longer-term exposure to the TOU rate will increase impacts**. This memorandum summarizes the results of the new move-in analysis.

Findings. We see little or no evidence that new move-in tenants respond to the TOU rate. While it is possible that new tenants would eventually respond to TOU prices over time, this effect is not observed in aggregate over the evaluation period. Moreover, the inclusion of a regression model term to capture tenure yielded no evidence of increasing savings over time – in most cases, it suggested the opposite effect.

Looking at data for move-in and move-out dates, we found high turnover and average length of occupancy of 9 months. At the time of the final evaluation, most new move-in tenants have not or do not remain in their premise for a sufficiently long period to detect a statistically significant effect from the TOU rate. When comparing usage patterns for previous and current tenants, we see noticeable differences in the magnitude and shape of the load that may be obfuscating impacts where they do occur.

These findings do not support the hypothesis that longer-term exposure to the TOU rate will increase impacts. Furthermore, despite receiving similar information from Xcel Energy via the Welcome Kit, new move-in tenants are not responding to the TOU rate on average. New move-in tenants are included in the core analysis of the final evaluation, with the effect of reducing overall on-peak impacts.

Methodology. The premises included in the new move-in analysis are a subset of those included in the core analysis: only those customers who have moved into the premise since the pilot began. Guidehouse examined AMI data for the new move-in tenants and conducted the following analyses: a) high-impact participant analysis to identify new move-in customers whose AMI data indicated a significant reduction in demand between peak hours in 2022 as compared to 2021, b) load shape review of all new move-in participants, and c) regression analysis to estimate average load impacts across all new move-in participants. See the Appendix for more detail on the methodology.

The remainder of this memo contains a discussion of the findings, followed by an appendix that includes the details on the data, methodology, and TOU rate.

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Findings

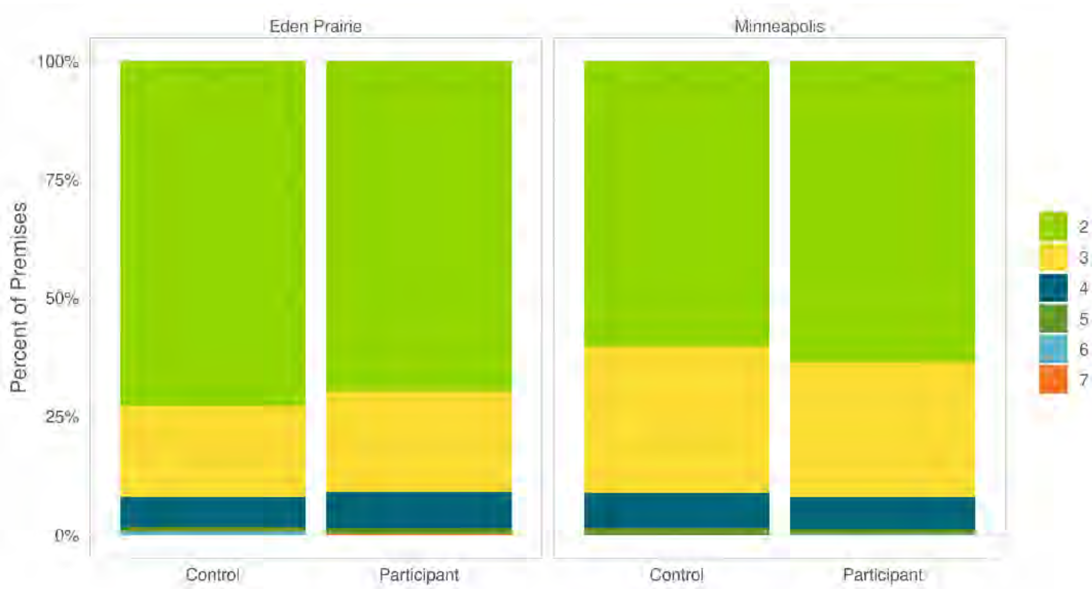
This section contains the findings from the various analyses that Guidehouse undertook to investigate impacts for new move-in tenants. Descriptions of the methodology are available in the Appendix at the end of this memo.

Exploratory Data Analysis

Looking at data for move-in and move-out dates, we found high turnover and average length of occupancy of 9 months. When comparing usage patterns for previous and current tenants, we see noticeable differences in the magnitude and shape of the load.

Guidehouse first explored the distribution of number of tenants per premise for the subset of customers who had moved in during the pilot. Approximately 23% of premises included in the Year 2 analysis had a new tenant move-in during the pilot. The number of tenants per premise ranged between 2 and 7, with most premises having 2 or 3 tenants. In Minneapolis, approximately 40% of control premises and 36% of treatment premises with new move-in tenants had more than 2 tenants. For Eden Prairie, 27% of control premises and 30% of treatment premises with new move-in tenants had more than 2 tenants, as illustrated in Figure 1.

Figure 1. Number of Unique Tenants per Premise During the Pilot for Premises with a New Move-In



For premises with multiple unique tenants during the pilot, the average maximum length of occupancy was 8.8 months in Minneapolis and 8.9 months in Eden Prairie. Maximum length of occupancy represents the amount of time a tenant spent in a premise at the end of the evaluation period. The greater the rate of turnover a premise has, the lower the average maximum length of occupancy. For example, when examining premises with more than 2 new tenants, the average maximum length of occupancy falls to 6 months. The greatest possible length of occupancy for a new move-in is 23 months – this includes tenants who moved into a premise during November 2020 and have remained in the premise ever since.

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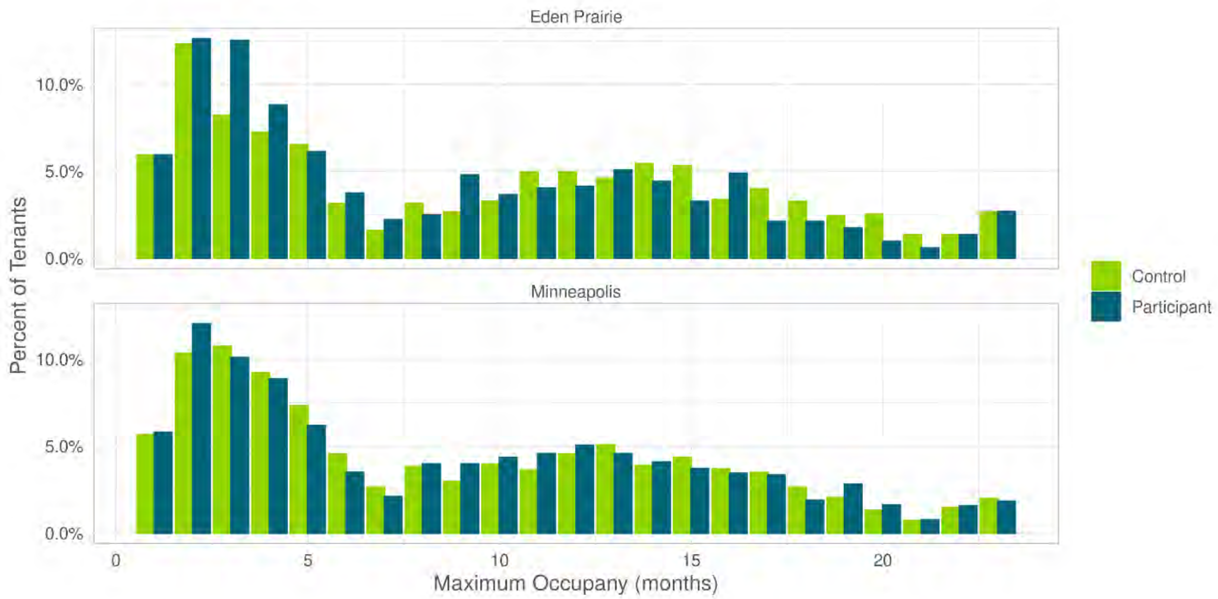
Figure 2 illustrates the distribution of maximum length of occupancy per tenant for premises in the new move-in analysis. Less than 5% of new move-in tenants in each study area reached 23 months of occupancy at the end of the evaluation period.

Figure 2. Distribution of Maximum Occupancy per Tenant



Guidehouse also compared average hourly demand for tenants who lived at the same premise. In most cases, average hourly demand varies widely across tenants at the same premise. Each panel of Figure 3 illustrates average hourly demand during summer for two unique tenants at the same premise. For all premises, load shapes differ noticeably between tenants. The first panel in Figure 3 contains two tenants with very different load shapes, likely attributed to differing behavioral patterns of the tenants. For example, the first tenant may work at home, while the other may work outside of the premise, resulting in lower average demand during the day. In the second panel, both tenants also have different average load shapes. Notably, the second tenant has a visible response to the on-peak TOU period, while the first tenant has no observable response. In the last panel, the average load shape for the two tenants is similar, but the magnitude of load differs. Similarities in load shapes may exist due to fixed characteristics of the premise, such as square footage, insulation, and heating/cooling technology. However, load is consistently higher for one tenant compared to the other. Neither tenant in panel 3 of Figure 3 has an observable response to the TOU periods.

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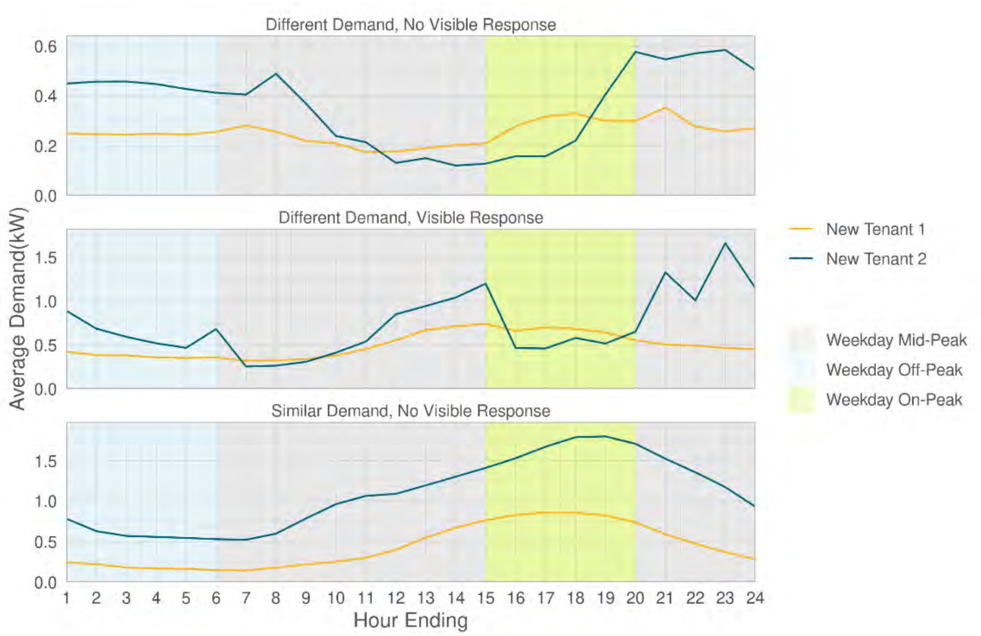
Figure 3. Average Load Shapes for Multiple Tenants at the Same Premise



Guidehouse found that substantial differences between tenant load shapes were common, as seen in the first two panels of Figure 3. As a result, the lagged dependent variable may be only loosely correlated with post-period demand, given that for new move-in tenants, pre-period usage is that of a prior tenant. Moreover, while some tenants showed a response to the TOU price, it is uncommon for multiple new tenants to all show a response to the TOU price. In this case, the ability to capture impacts via a regression model may have been reduced depending on which tenant remained in the premise for the greatest length of time.

High Impact New Move-in Analysis

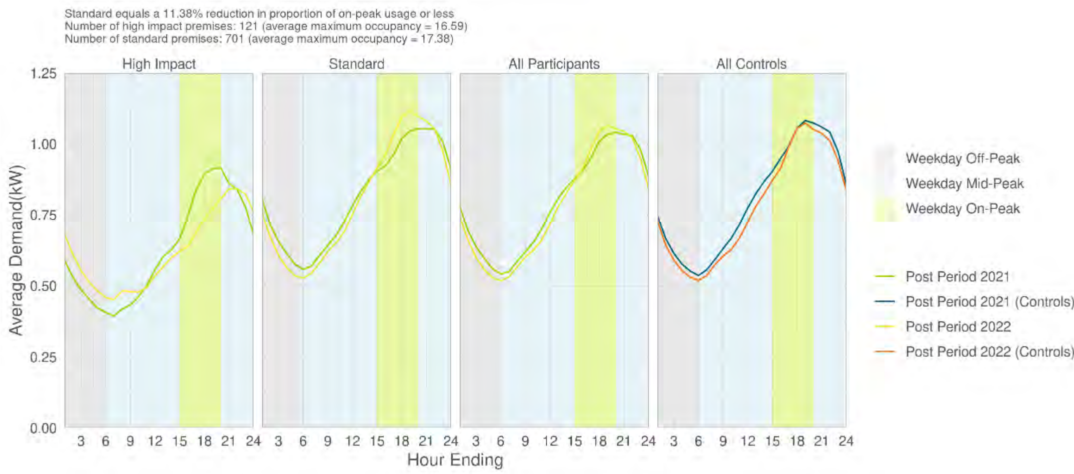
For new move-in tenants with sufficient data, we compared impacts during the on-peak period in summer 2021 and summer 2022 to examine whether participants eventually show a response to the TOU rate. Guidehouse found that only a small number of premises qualified as high impact (11.38% reduction or larger) and less than half of participants experienced any reduction in proportion of on-peak usage over time.

Similar to Stage 1 of the high impact analysis outlined in the evaluation plan, Guidehouse analyzed hourly AMI data for new move-in tenants to identify shifts in average demand between a tenant's first and second year on the TOU rate. Guidehouse hypothesized that shifts in consumption patterns were likely to occur for participants in response to price signals from the TOU rate that accumulate over time, leading to increasing savings over time. Guidehouse applied the same thresholds as used in Stage 1 of the high impact analysis to identify high impact new move-in tenants.[1] For example, the 85th percentile for the Stage 1 high impact analysis was equal to an 11.38% reduction in proportion of summer on-peak usage. Using a subset of new move-in tenants, Guidehouse identified all participants who had an 11.38% or greater reduction in proportion of on-peak usage from their first summer on the TOU rate (2021) to their second summer on the TOU rate (2022). Figure 4 illustrates the average load shapes of standard and

[1] The year 2 final report will contain a detailed description of the high impact analysis for all participants.

high impact participants using this classification system, as well as the average load shape for all new move-in participants and controls.

Figure 4. High Impact New Move-In's – (Threshold = 11.38% Reduction)



This process was repeated for a series of predetermined thresholds. Guidehouse found that only a small number of premises exhibited a reduction in on-peak usage from their first year on the TOU rate to their second year on the TOU rate. At the 11.38% threshold, only 121 premises qualified as high impact – not a sufficiently large sample for regression analysis. Less than half of participants experienced any reduction in proportion of on-peak usage over time.

In addition, the average maximum length of occupancy for standard and high impact customers was similar at all thresholds, suggesting that shifts in load shape are unrelated to accumulating price signals over time (a learning effect). The average length of occupancy for standard and high impact premises at each threshold, along with the total number of premises in each group, is included in Table 1.

Table 1. New Move-In High Impact and Standard Premises

High Impact Premises	Standard Premises	Average Months Occupancy* (High Impact)	Average Months Occupancy* (Standard)	On-Peak Reduction Threshold
121	701	16.59	17.38	11.38%

**Average occupancy is calculated using the maximum length of occupancy for each tenant.*

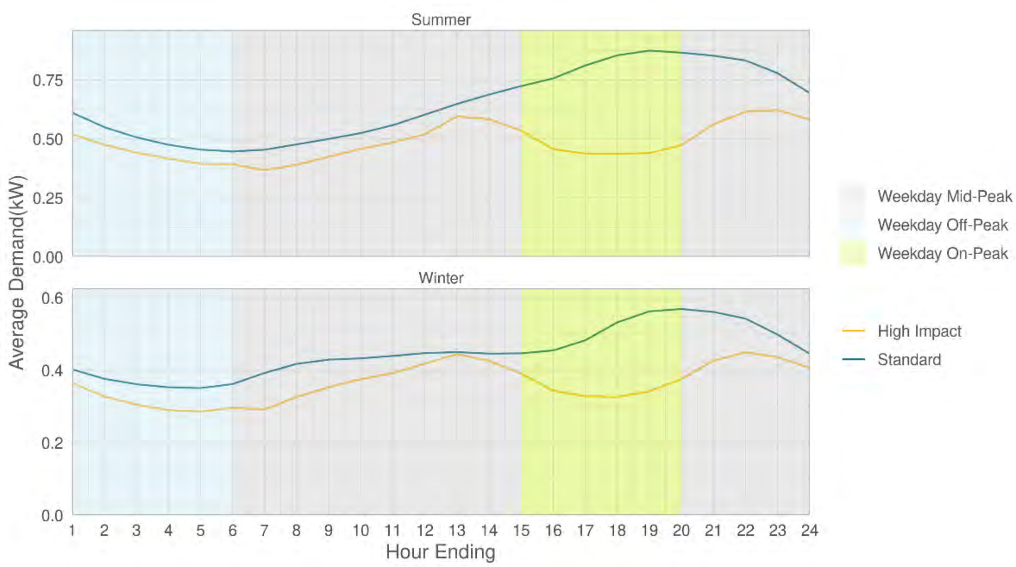
Load Shape Review

In addition to looking at changes in load shapes over time, Guidehouse also looked for evidence of reduced load during the on-peak period. Approximately 10% of premises have load shapes with an observable response.

As an alternative to the high impact analysis methodology for identifying stage 1 high impact participants, which compared load shapes across the first and second summers of the pilot, Guidehouse examined changes in the magnitude of new move-in tenants' average load shapes during the pilot period. Guidehouse identified a small number of tenants that exhibited a response to the TOU period pricing.

However, the number of accounts with an observable response was not large enough to detect impacts when evaluating the new move-in group in aggregate. Figure 5 illustrates the average load shape of high impact vs. standard participants in the post-period when using this approach. In Minneapolis, 152 tenants (143 premises) are considered High Impact and 1811 tenants (1261 premises) are considered Standard. In Eden Prairie, 78 tenants (75 premises) are considered High Impact and 1013 tenants (727 premises) are considered Standard.

Figure 5. High Impact Tenants - All Eligible, by Season



Regression Modeling

Guidehouse estimated several regression models in an attempt to identify savings for new move-in tenants and explore whether savings may increase over time. The models found no evidence of statistically significant savings during the on-peak period.

Guidehouse estimated the regression model originally defined in the evaluation plan, as well as several additional model specifications, in an attempt to detect TOU period savings attributable to premises with new move-in tenants. Impacts from the core model by TOU period, season, and region are included in Table 2 and Table 3, below. For new move-in tenants, no evidence of statistically significant savings during the on-peak period was found.

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Table 2. Core Regression Model - Summer Estimates

Study Area	TOU Period	Estimate	Standard Error	Percent Savings	Relative Precision
Minneapolis	Non Weekday Mid-Peak	0.003	0.016	-1%	763%
	Non Weekday Off-Peak	0.002	0.014	0%	1151%
	Weekday Mid-Peak	0.005	0.015	-1%	484%
	Weekday Off-Peak	0.000	0.014	0%	8746%
	Weekday On-Peak	0.004	0.019	-1%	784%
Eden Prairie	Non Weekday Mid-Peak	0.036	0.028	-4%	131%
	Non Weekday Off-Peak	0.041	0.023	-7%	92%
	Weekday Mid-Peak	0.038	0.027	-4%	118%
	Weekday Off-Peak	0.046	0.023	-7%	83%
	Weekday On-Peak	0.043	0.036	-3%	140%

Table 3. Core Regression Model - Winter Estimates

Study Area	TOU Period	Estimate	Standard Error	Percent Savings	Relative Precision
Minneapolis	Non Weekday Mid-Peak	0.004	0.014	-1%	600%
	Non Weekday Off-Peak	0.005	0.013	-1%	475%
	Weekday Mid-Peak	0.001	0.013	0%	4130%
	Weekday Off-Peak	0.001	0.013	0%	2974%
	Weekday On-Peak	-0.001	0.015	0%	1948%
Eden Prairie	Non Weekday Mid-Peak	0.040	0.023	-6%	96%
	Non Weekday Off-Peak	0.052	0.020	-11%	65%
	Weekday Mid-Peak	0.037	0.022	-6%	98%
	Weekday Off-Peak	0.042	0.019	-9%	75%
	Weekday On-Peak	0.035	0.026	-5%	121%

In addition, Guidehouse found that for all regions and seasons, the month of tenure and treatment interaction term had a positive effect that was not statistically significant. This result does not support the hypothesis that savings would increase over time due to a learning effect.

Results for the additional model specifications provide a robustness check on the outputs described above. Estimates were similar across all models, in most cases finding insignificant but positive impacts across all TOU periods for the new move-in tenants. In addition, most parameter estimates on terms capturing tenure at a premise indicated increasing participant demand over time.

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Appendix

This appendix is divided into the following sections: data, methodology, and rate details.

Data

The premises included in the new move-in analysis are a subset of those included in the core analysis: only those customers who have moved into the premise since the pilot began. Table 4 shows the total number of premises remaining after cleaning and aggregating the AMI data provided by Xcel Energy, along with the number of premises eligible for the new move-in analysis. Guidehouse further subset this group of premises for a supplementary high impact move-in analysis. This subset was limited to new move-in tenants who remained in a premise for at least 12 months and had AMI data available in both summers of the pilot period (2021 and 2022). These counts are also included in Table 4.

Table 4. Eligible Participant and Control Premises

Sample	Jurisdiction	Participants	Controls
Year 2 Core Analysis	Minneapolis	4,633	3,619
	Eden Prairie	4,200	3,289
New Move-In Analysis	Minneapolis	1,278	1,012
	Eden Prairie	742	603
High Impact Move-In Analysis	Minneapolis	574	456
	Eden Prairie	293	295

Methodology

This section describes the various analyses that Guidehouse conducted to investigate the impacts of new move-in tenants.

Exploratory Data Analysis

Guidehouse examined AMI data and move dates for the new move-in tenants. In particular, we reviewed the number of tenancy changes for premises with more than one tenant during the pilot, maximum length of occupancy per tenant, and average load shapes for different tenants in the same premise.

High Impact New Move-in Analysis

For this analysis, Guidehouse limited the data to include only those premises with a new tenant who has remained in the premise for at least 12 months and has available AMI data in the summer of 2021 and the summer of 2022. As such, only a single tenant for each premise was eligible for this component of the analysis. Tenants were grouped into “High Impact” and “Standard” categories by comparing TOU period demand in their first and second summers during the pilot period. Specifically, Guidehouse calculated the percentage change in proportion of on-peak usage from summer 2021 to summer 2022 for each eligible tenant. The goal of this approach was to identify change *over time* compared to a baseline (the baseline being 2021, the customer’s first summer in the pilot).

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Guidehouse used the resulting metric to select various thresholds for assignment of premises to the “High Impact” and “Standard” categories. Guidehouse then compared average hourly demand across the high impact and standard groups and used this to investigate the hypothesis of a time-sensitive price response.

Load Shape Review

Using all new move-in tenants, Guidehouse also assessed the AMI data for evidence of reduced demand during the on-peak periods. Using average hourly non-holiday weekday demand, Guidehouse identified tenants with average demand in the three hours before and after the on-peak period of at least 5% greater than average demand during the on-peak period. This filter was used to identify participating tenants with an observable reduction in on-peak usage compared to the typical residential load shape. Note that unlike the high impact analysis, this approach was less precise and did not account for changes in usage over time.

Regression Analysis

Guidehouse estimated a lagged dependent variable (LDV) regression model, shown in Equation 1.

Equation 1. New Move-In Model Specification

$$y_{itr} = \sum_{p=1}^{P=5} \beta_1^p \cdot tou_{tr}^p + \sum_{p=1}^{P=5} \beta_2^p \cdot tou_{tr}^p \cdot prekW_{ir} + \sum_{p=1}^{P=5} \beta_3^p \cdot tou_{tr}^p \cdot cdh_{tr} +$$

$$\sum_{p=1}^{P=5} \beta_4^p \cdot tou_{tr}^p \cdot hdh_{tr} + \sum_{p=1}^{P=5} \beta_5^p \cdot tou_{tr}^p \cdot hbu_{tr} + \sum_{p=1}^{P=5} \beta_6^p \cdot tou_{tr}^p \cdot cbu_{tr} +$$

$$\sum_{p=1}^{P=5} \gamma_1^p \cdot tou_{tr}^p \cdot treat_i + + \sum_{p=1}^{P=5} \gamma_2^p \cdot tou_{tr}^p \cdot treat_i \cdot tenure_{it} + \varepsilon_{itr}$$

Where:

y_{itr}	= Premise *i*’s average demand (kW) in TOU period *r* (On-Peak, Mid-Peak Weekdays, Off Peak Weekdays, Mid-Peak Weekends/Holidays, Off-Peak Weekends/Holidays) of day of sample *t*.
tou_{tr}^p	= A set of five binary variables. Each one is equal to one when the demand value on the left-hand side of the equation is in the same TOU period (subscript *r*) as that flagged by the binary. For example: when $y_{itr=it1}$ then, $tou_{t1}^1 = 1$, $tou_{t1}^2 = 0$, $tou_{t1}^3 = 0$, $tou_{t1}^4 = 0$, and $tou_{t1}^5 = 0$.
$prekW_{ir}$	= The average pre-period demand in TOU period *r*, for premise *i*. This is the LDV.
cdh_{tr}	= The average of the cooling degree hours (base of 65° Fahrenheit) observed in TOU period *r* of day of sample *t*.

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hdh_{tr} = The average of the heating degree hours (base of 65° Fahrenheit) observed in TOU period *r* of day of sample *t*.

hbu_{tr} = The average heat build-up observed in the hours that fall within TOU period *r*, on day of sample *t*. This is a 72-hour geometrically decaying average of the NOAA heat index[2], as observed in hour of sample *s*. It is calculated in the following manner:
$cbu_t = \frac{\sum_{h=1}^{72} 0.96^h \cdot heatIndex_{s-h}}{1{,}000}$.

cbu_{tr} = The average cold build-up observed in the hours that fall within TOU period *r*, on day of sample *t*. This is calculated in the same way as $hbu_{t,r}$, except that the heat index values are replaced by wind chill.

$treat_i$ = A binary variable that takes a value of 1 if premise *i* is subject to TOU prices, and zero otherwise.

$tenure_{it}$ = A linear trend specific to customer *i* that identifies the number of calendar months since customer *i* moved into the premise on day of sample *t.* So, for example, if customer *i* moved into the premise on January 16, this variable would take (for the given customer) a value of 1 in the rest of January, a value of 2 in the subsequent month, etc.

ε_{itr} = Errors.

The primary model used to estimate new move-in tenant impacts is very similar to the core model for estimating TOU period demand impacts for the entire sample. The principal differences are:

- An interaction between length of tenure and the treatment variable is included to capture the degree to which TOU response changes over time. This variable allows us to test the hypothesis that TOU response will increase the longer the customer has lived at their new premise.
- Segmentation interactions with the treatment variable have been removed. The new move-in dataset is too small to include both segmentation interactions and the tenure interaction.

Guidehouse tested several additional models which used similar specifications to Equation 1, but involved slight modifications to the model terms and/or subset of customers included. These modifications are described below, with each bullet point referencing a single model.

- Exclusion of the $tenure_{it}$ term
- Exclusion of tenants with a maximum tenancy of less than 6 months
- Exclusion of tenants prior to the date they reach 6 months of tenancy
- Replacement of the $tenure_{it}$ term with a categorical variable indicating months of residence (1 – 6 months, 7 – 12 months, > 12 months)
- Replacement of the $tenure_{it}$ term with an indicator variable for before and after a specified length of tenancy

Each model used for the new move-in analysis was estimated four times, once for each unique combination of season (winter, summer) and geography (Eden Prairie, Minneapolis). Data for the entire pilot period was included in the estimation set, meaning that estimated impacts are the average across the entire pilot period (after the first move in).

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2 $heatIndex_s$ = Heat index, calculated using the equation provided by NOAA.

NOAA, *The Heat Index Equation*, page last modified May 2014, accessed October 2021, https://www.wpc.ncep.noaa.gov/html/heatindex_equation.shtml

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Rate Details

All new move-in tenants participating in the pilot resided in premises with tenants originally subject to the residential Standard rate (A01—overhead connections, and A03—underground connections).

The piloted TOU rate includes three periods across two seasons, exposing participants to six different energy charges. The timing of these periods, the energy charges applied, and the ratio of these charges to the seasonal Off-Peak price as well as the Standard seasonal energy are shown in Table 5. The On-Peak energy charge is slightly more than twice the Standard energy charge, the Mid-Peak energy charge is nearly the same as the Standard charge, and the Off-Peak energy charge is approximately one-third of the Standard charge.

Table 5. Residential TOU Rate Energy Charges and Ratios

Season	Months	Period Name	Non-Holiday Weekday Times	Weekend and Holiday Times	Energy Charge ($/kWh)	Ratio of Charge to Seasonal Off-Peak	Ratio to Standard Charge
Summer	June - September	On-Peak	3pm - 8pm	N/A	$0.22576	8.1	2.2
		Mid-Peak	6am - 3pm, 8pm - Midnight	6am - Midnight	$0.09013	3.2	0.9
		Off-Peak	Midnight - 6am	Midnight - 6am	$0.02784	1.0	0.3
Winter	October – May	On-Peak	3pm - 8pm	N/A	$0.19266	6.9	2.2
		Mid-Peak	6am - 3pm, 8pm - Midnight	6am - Midnight	$0.07515	2.7	0.9
		Off-Peak	Midnight - 6am	Midnight - 6am	$0.02784	1.0	0.3

Source: Guidehouse analysis

Xcel Energy Minnesota Time-of-Use Pilot Evaluation – Final Report

Appendix X2 – Average Load Profiles

Prepared for:

Xcel Energy®

Submitted by:

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Emi Moore
Sam Anderson
Jane Hummer
Abby Mayer

Reference No.: 207260
2023-01-06

guidehouse.com

Introduction

This appendix provides a compilation of average participant and control customer load profiles during the TOU pilot period and in the data collection period preceding the pilot.

There are three sets of plots:

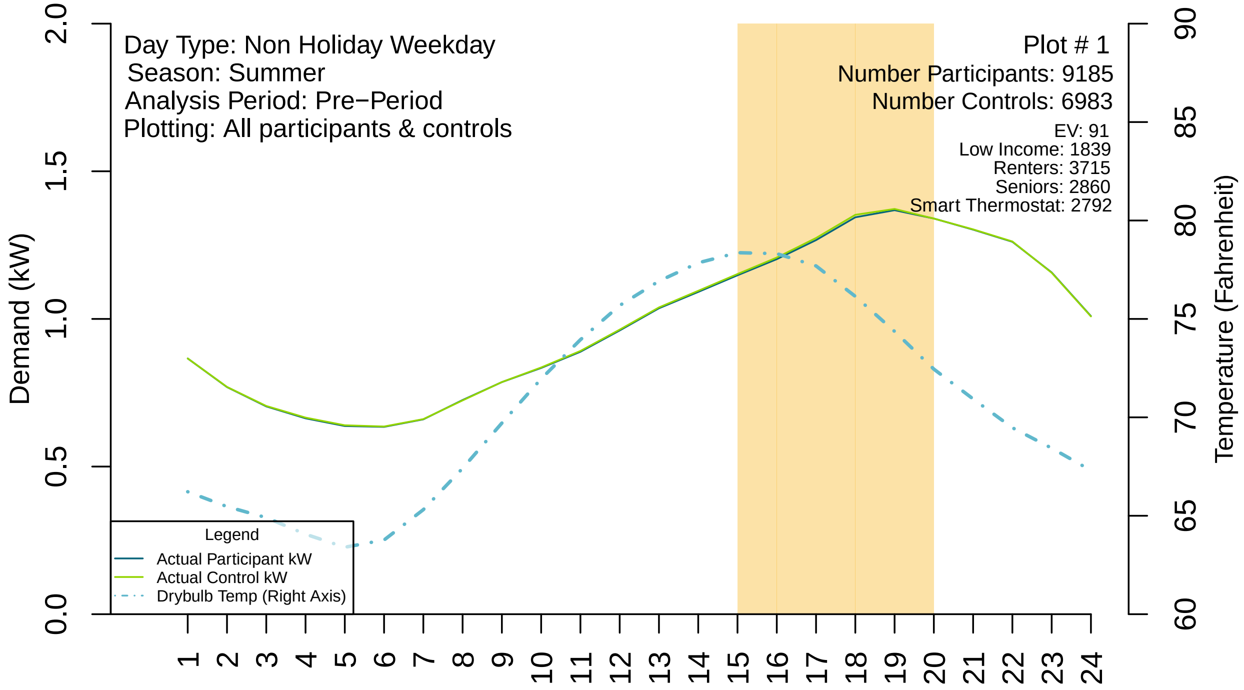
- The first set of 21 pages (each displaying 4 plots) provides average load profiles across both geographies.
- The second set of 21 pages provides average load profiles within Eden Prairie
- The third set of 21 pages provides average load profiles within Minneapolis

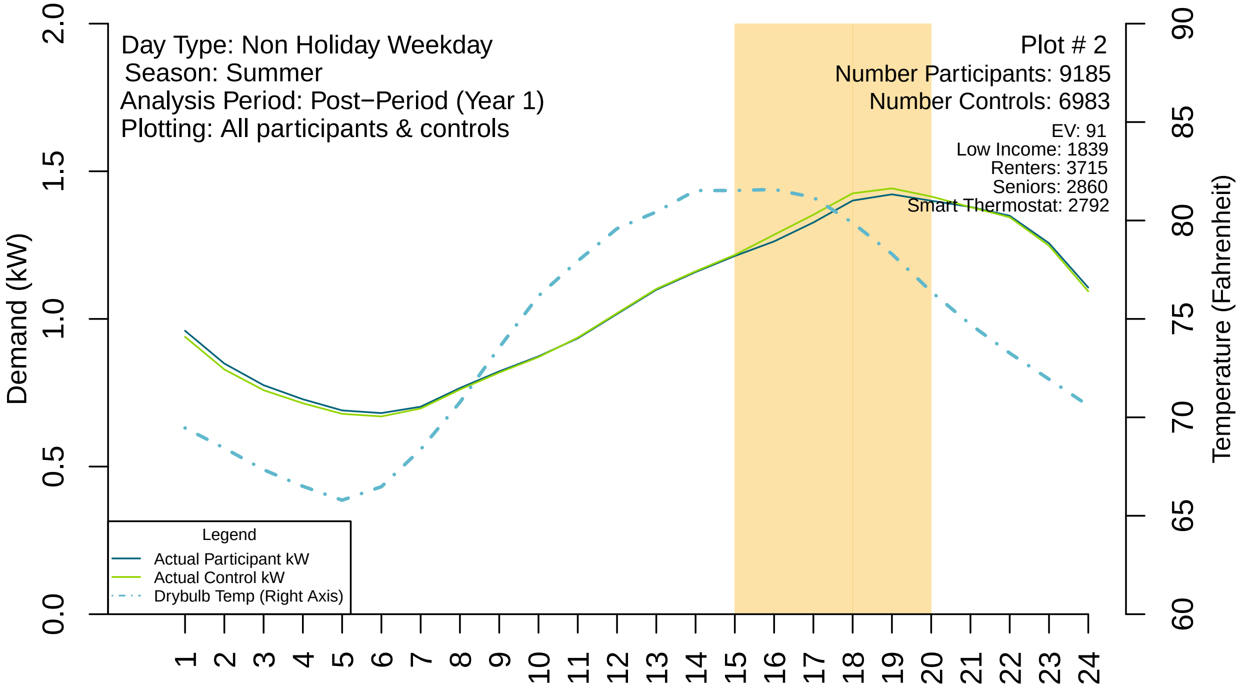
Separate profiles are provided for:

- non-holiday weekdays and weekends/holidays;
- winter and summer;
- the pre-period, TOU pilot period (Year 1), and TOU pilot period (Year 2); and,
- across all participants on average and by segment.

Note that segment-specific plots include all participants or controls assigned to a given segment, so since customers could be assigned to multiple segments, segment-specific plotted profiles are not exclusive of other segments.

The On-Peak period on each plot is identified by a series of semi-transparent orange columns. Each plot indicates how many participants and controls are have contributed to the average profile, and how many participants in each segment have contributed to the participant load profile.


Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Pre−Period
Plotting: All participants & controls
Plot # 1
Number Participants: 9185
Number Controls: 6983
EV: 91
Low Income: 1839
Renters: 3715
Seniors: 2860
Smart Thermostat: 2792
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)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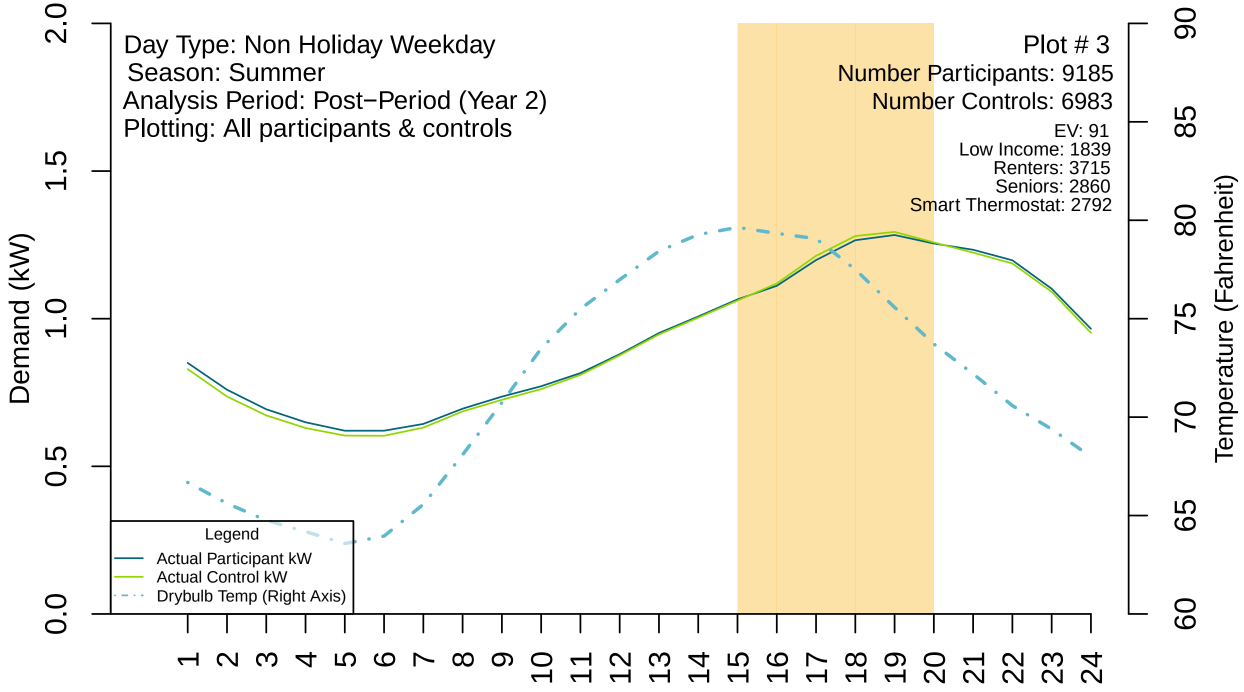
Number Participants: 9185
Number Controls: 6983
EV: 91
Low Income: 1839
Renters: 3715
Seniors: 2860
Smart Thermostat: 2792
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)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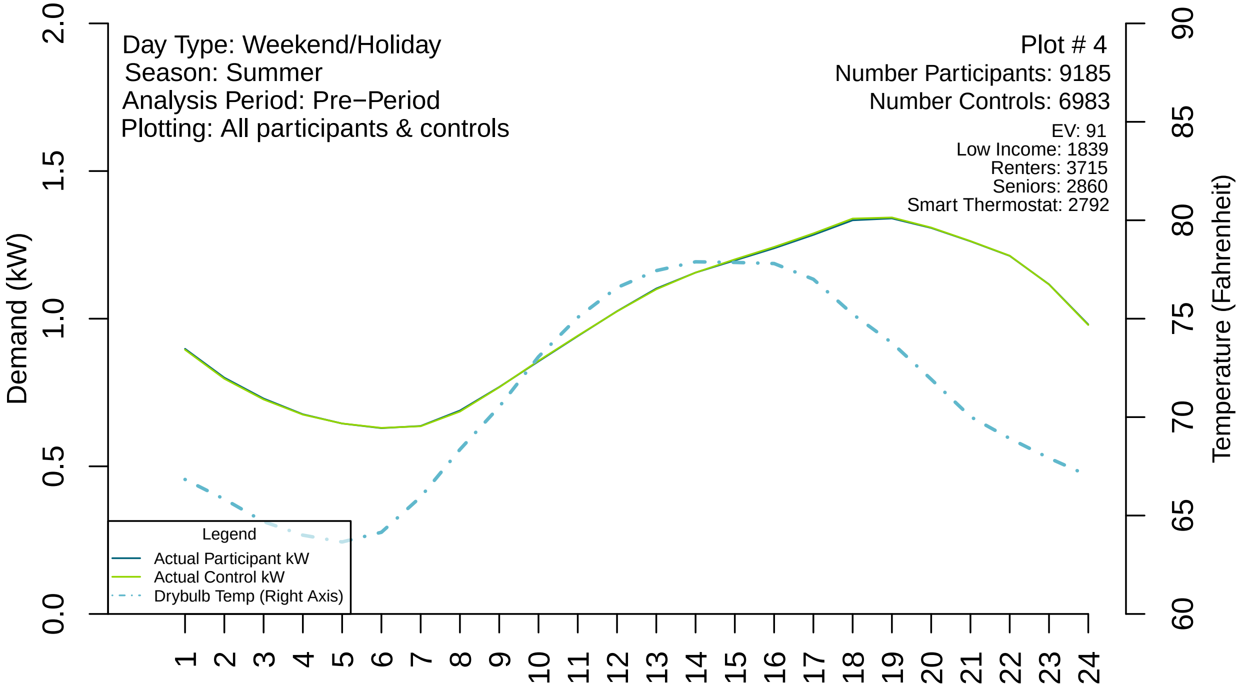
Low Income: 1839
Renters: 3715
Seniors: 2860
Smart Thermostat: 2792
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)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Analysis Period: Pre−Period
Plotting: All participants & controls
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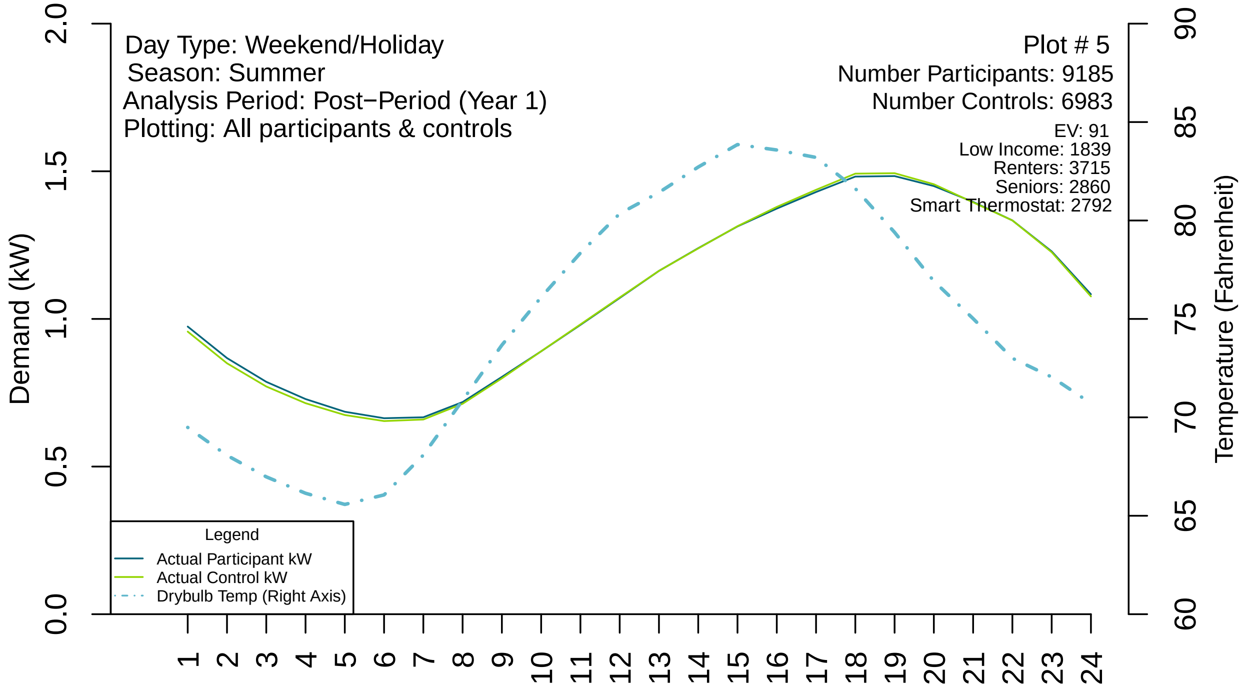
Number Participants: 9185
Number Controls: 6983
EV: 91
Low Income: 1839
Renters: 3715
Seniors: 2860
Smart Thermostat: 2792
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)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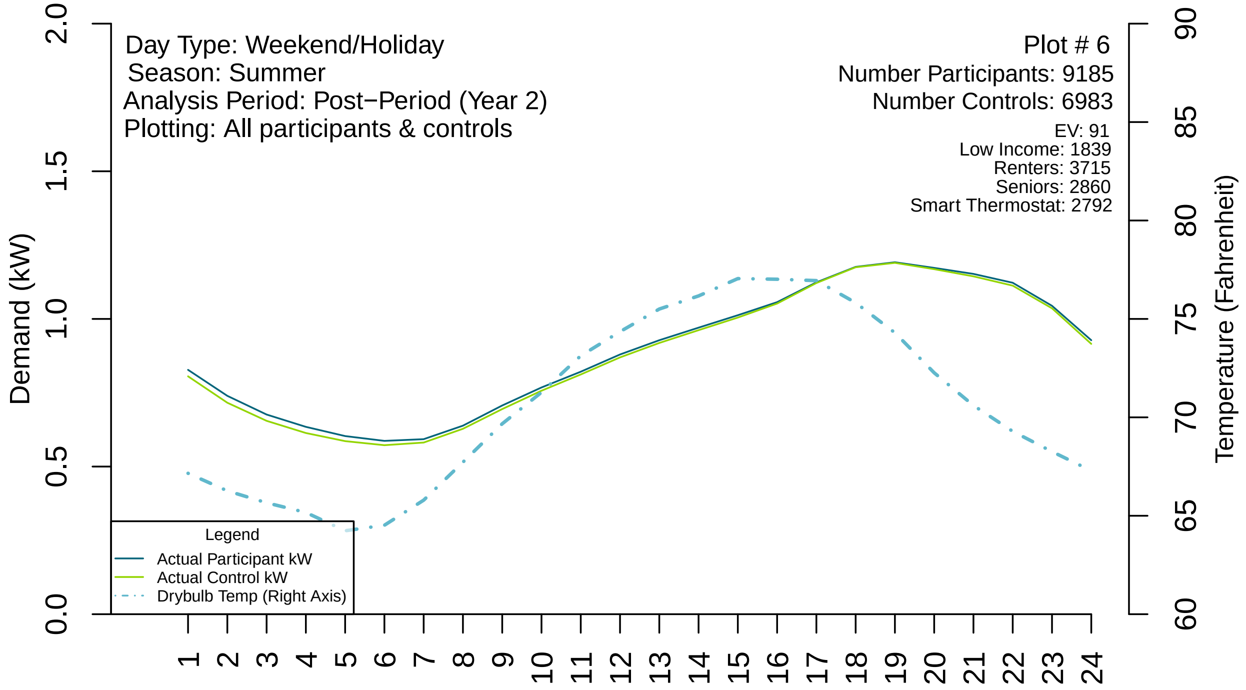
Number Participants: 9185
Number Controls: 6983
EV: 91
Low Income: 1839
Renters: 3715
Seniors: 2860
Smart Thermostat: 2792
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)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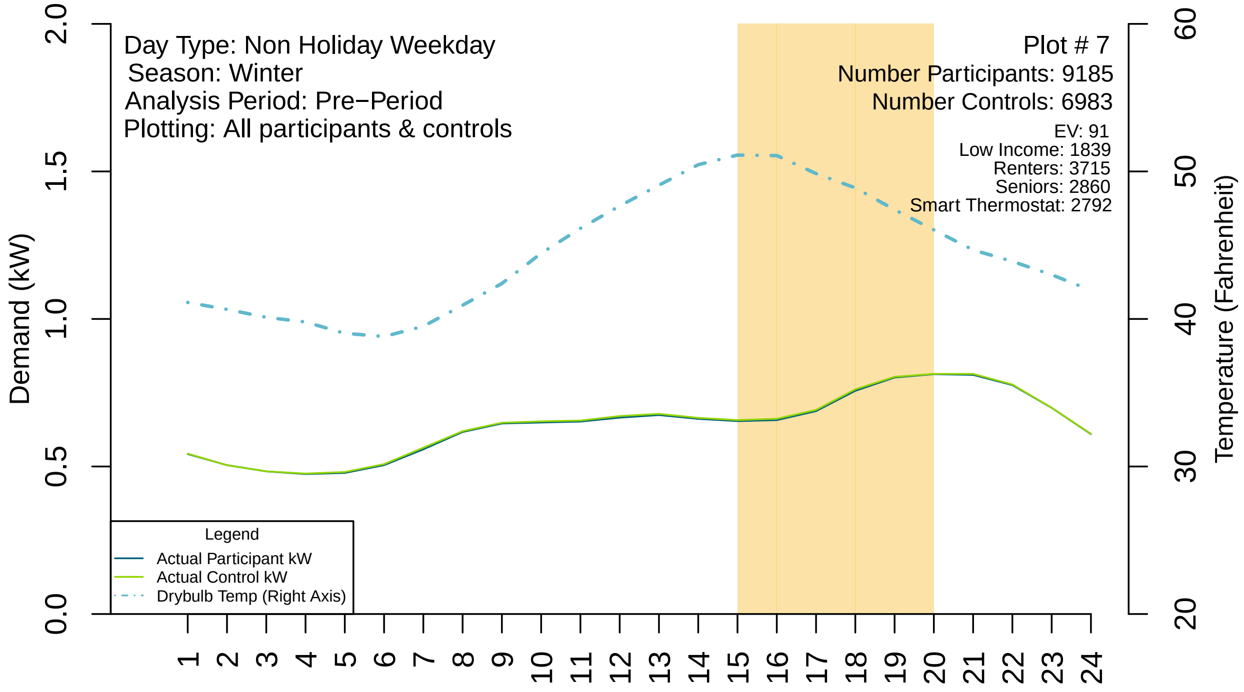
Number Controls: 6983
EV: 91
Low Income: 1839
Renters: 3715
Seniors: 2860
Smart Thermostat: 2792
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)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Season: Winter
Analysis Period: Pre−Period
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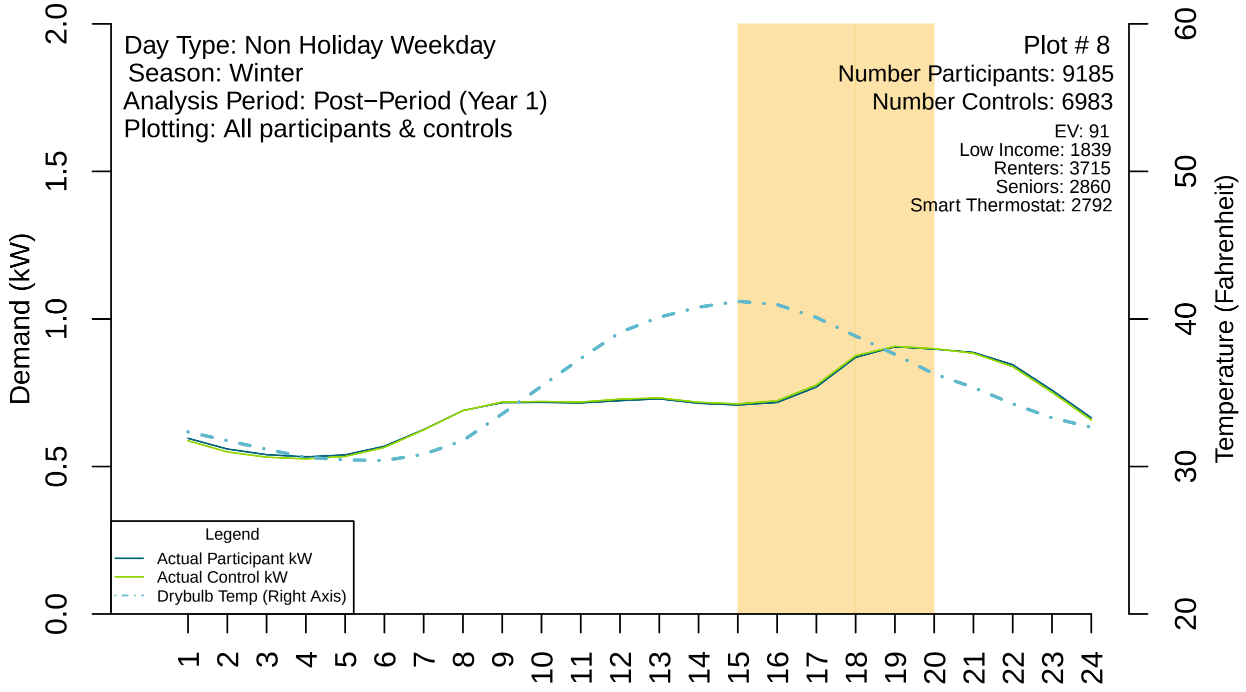
Plot # 7
Number Participants: 9185
Number Controls: 6983
EV: 91
Low Income: 1839
Renters: 3715
Seniors: 2860
Smart Thermostat: 2792
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)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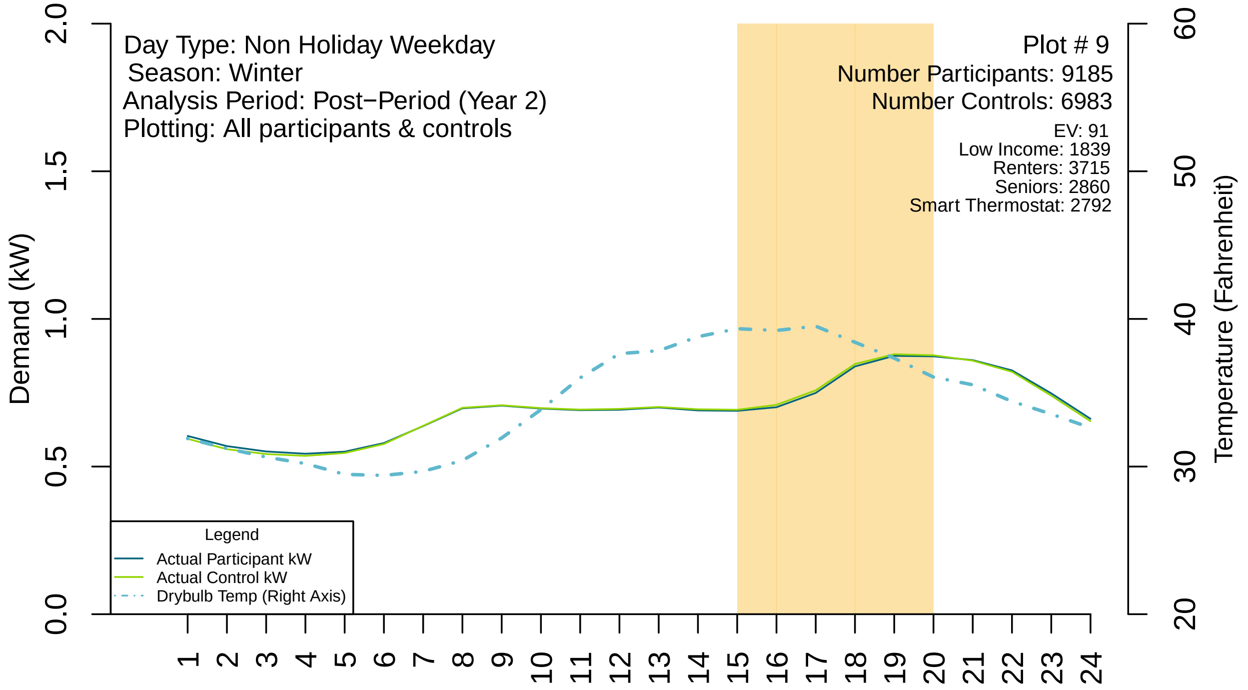
Number Controls: 6983
EV: 91
Low Income: 1839
Renters: 3715
Seniors: 2860
Smart Thermostat: 2792
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)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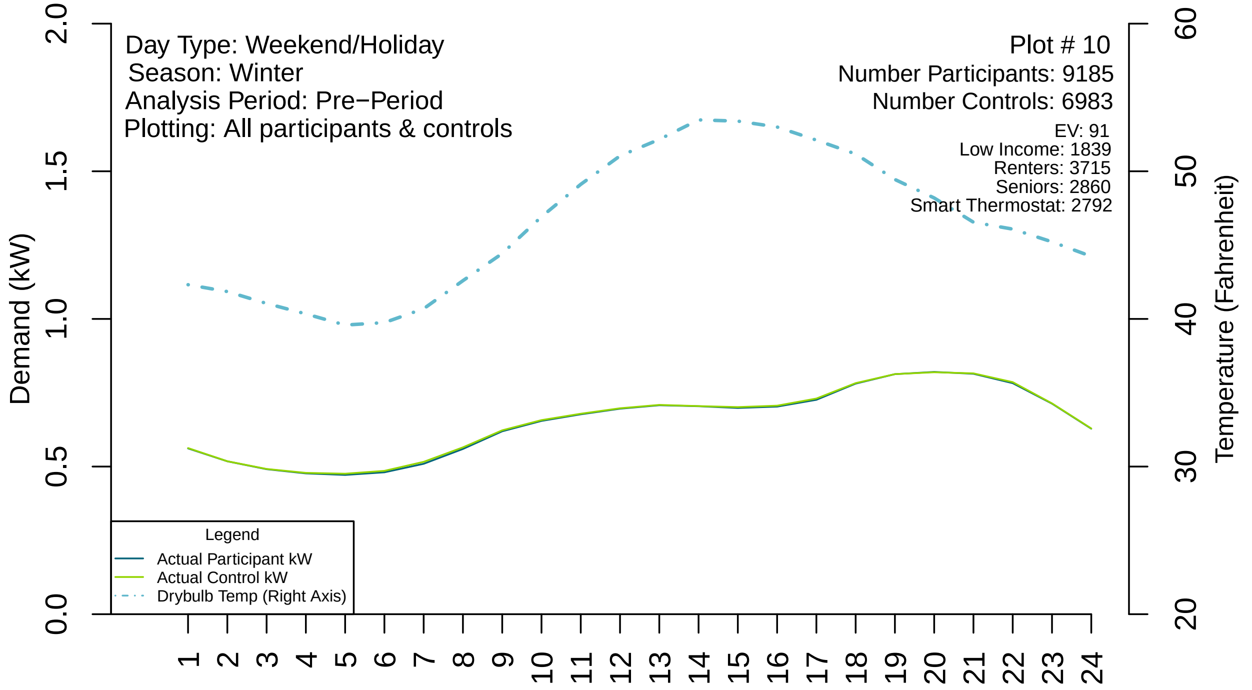
Plot # 9
Number Participants: 9185
Number Controls: 6983
EV: 91
Low Income: 1839
Renters: 3715
Seniors: 2860
Smart Thermostat: 2792
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)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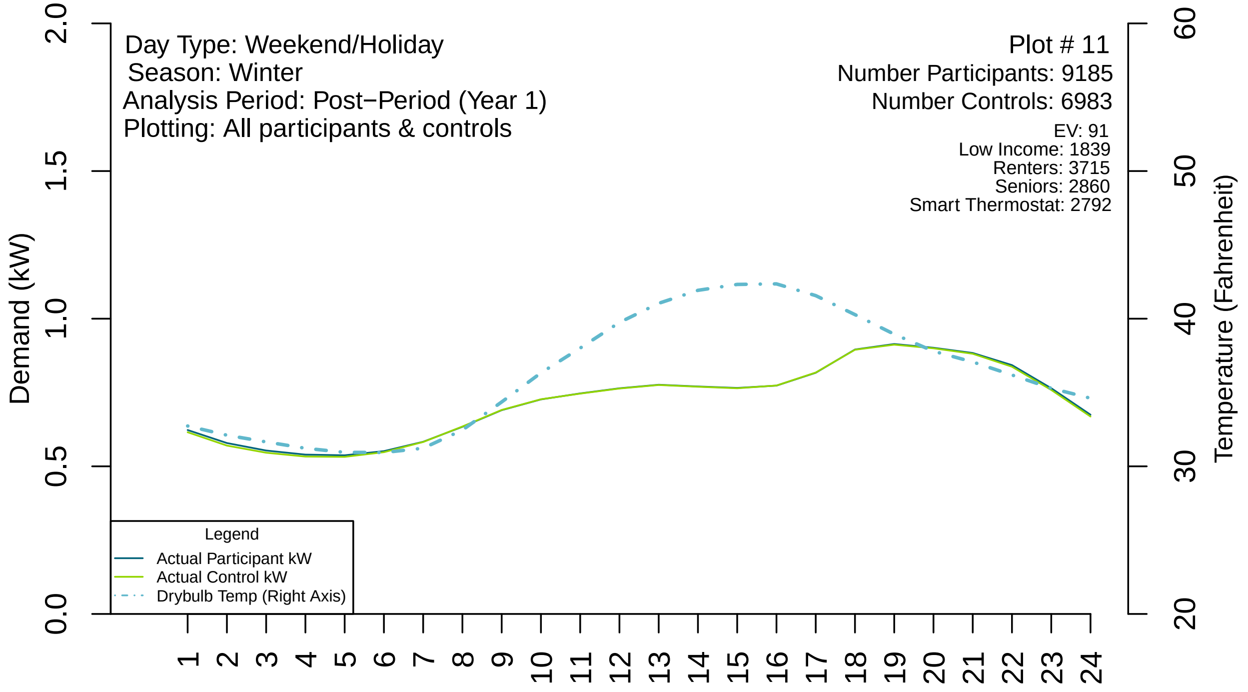
Season: Winter
Analysis Period: Pre−Period
Plotting: All participants & controls
Plot # 10
Number Participants: 9185
Number Controls: 6983
EV: 91
Low Income: 1839
Renters: 3715
Seniors: 2860
Smart Thermostat: 2792
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)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Plot # 11
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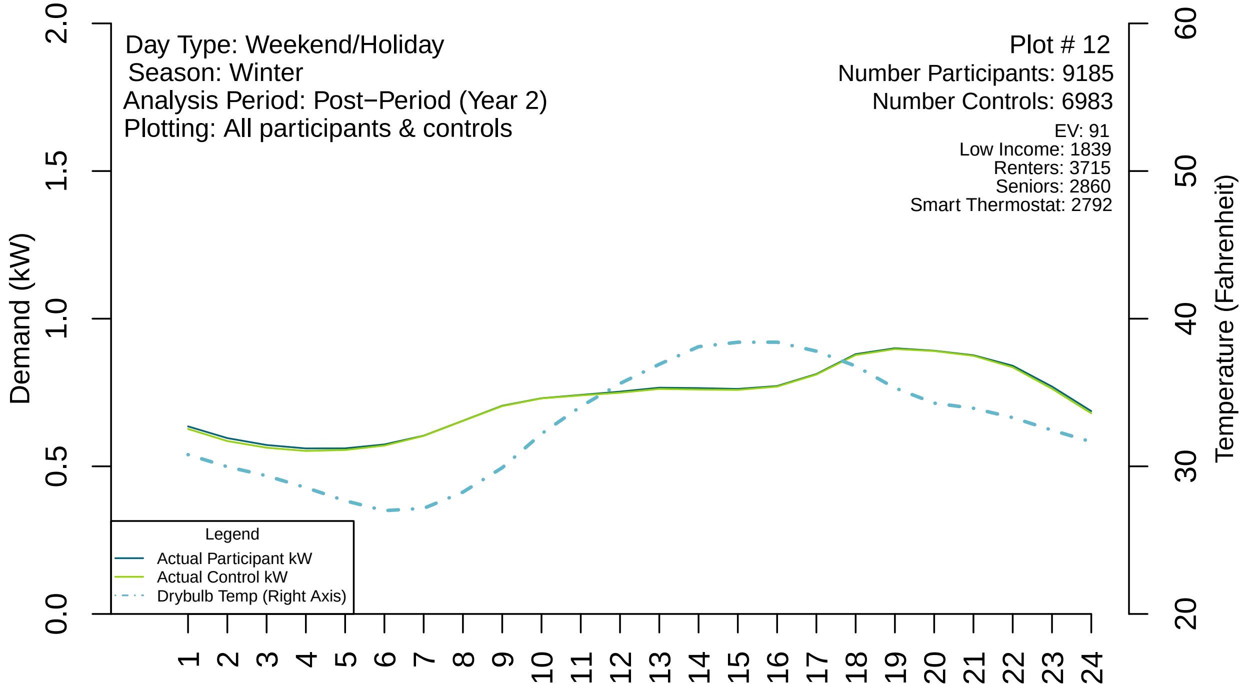
Number Controls: 6983
EV: 91
Low Income: 1839
Renters: 3715
Seniors: 2860
Smart Thermostat: 2792
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)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Plot # 12
Number Participants: 9185
Number Controls: 6983
EV: 91
Low Income: 1839
Renters: 3715
Seniors: 2860
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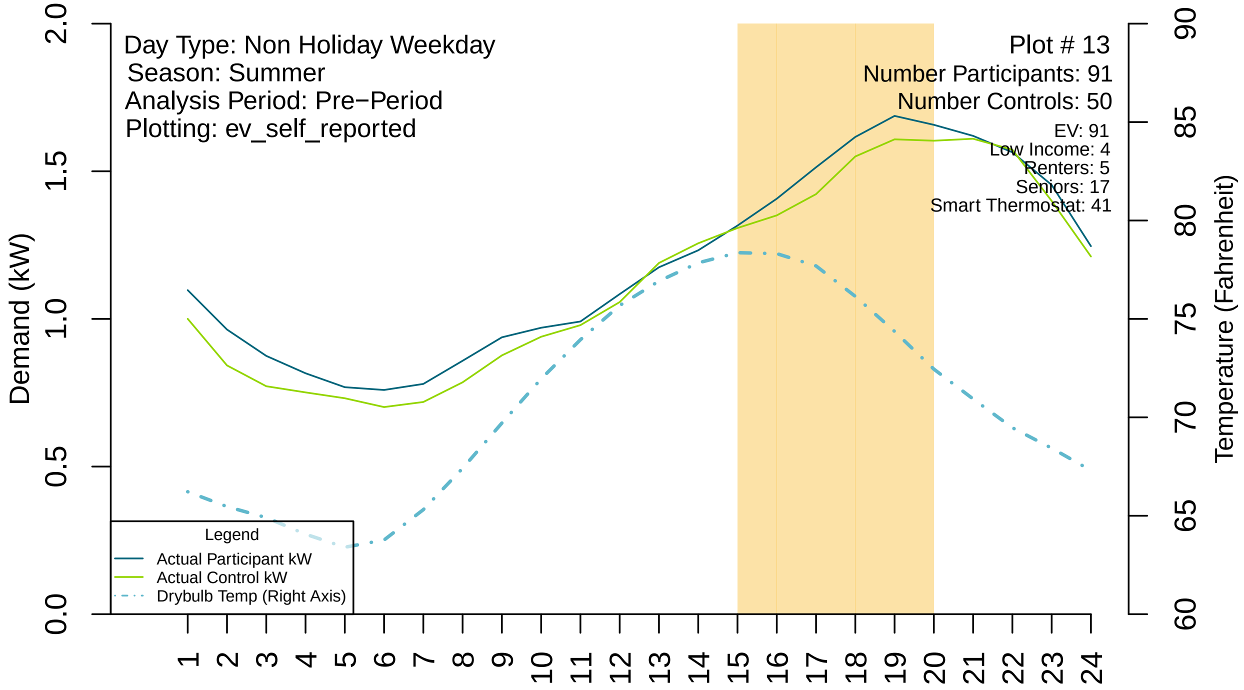
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)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Season: Summer
Analysis Period: Pre−Period
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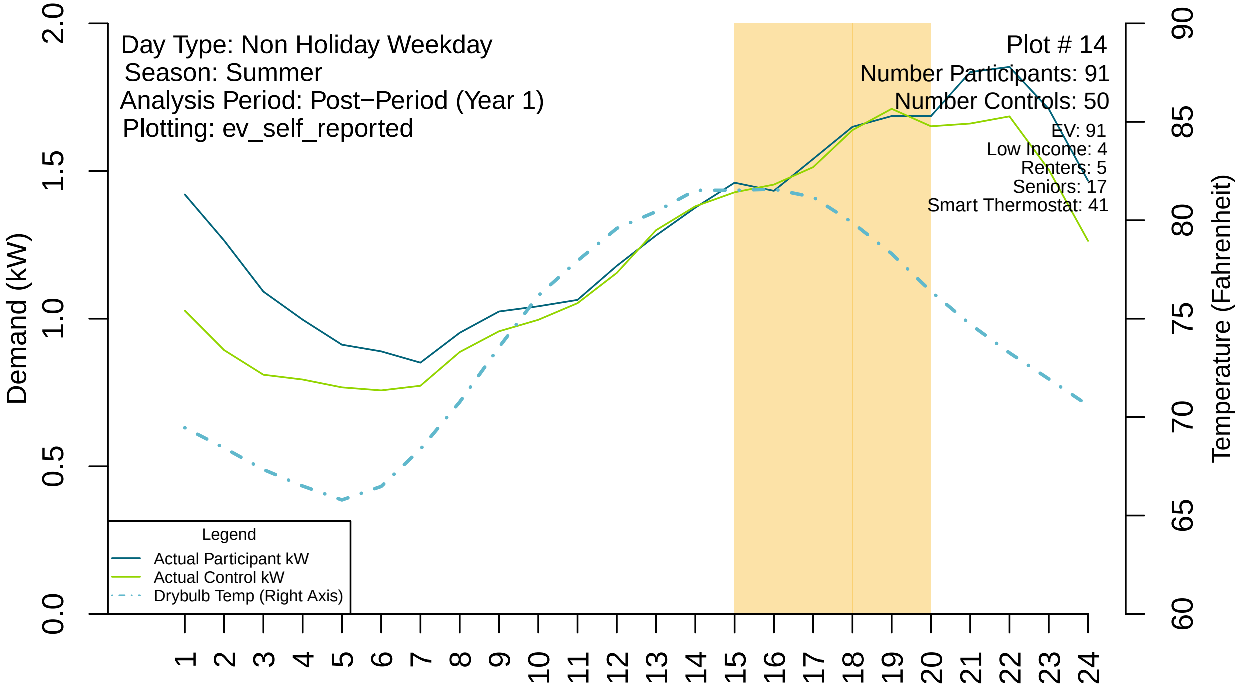
Plot # 13
Number Participants: 91
Number Controls: 50
EV: 91
Low Income: 4
Renters: 5
Seniors: 17
Smart Thermostat: 41
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)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Season: Summer
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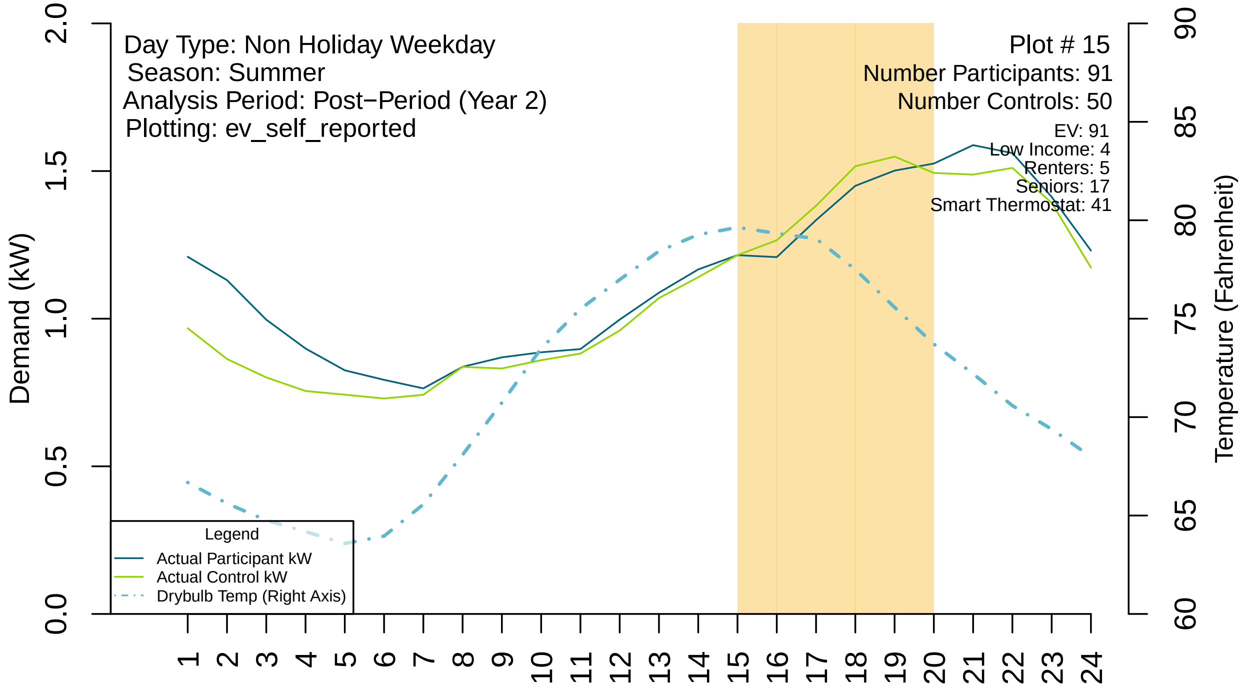
Plot # 14
Number Participants: 91
Number Controls: 50
EV: 91
Low Income: 4
Renters: 5
Seniors: 17
Smart Thermostat: 41
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)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Analysis Period: Post−Period (Year 2)
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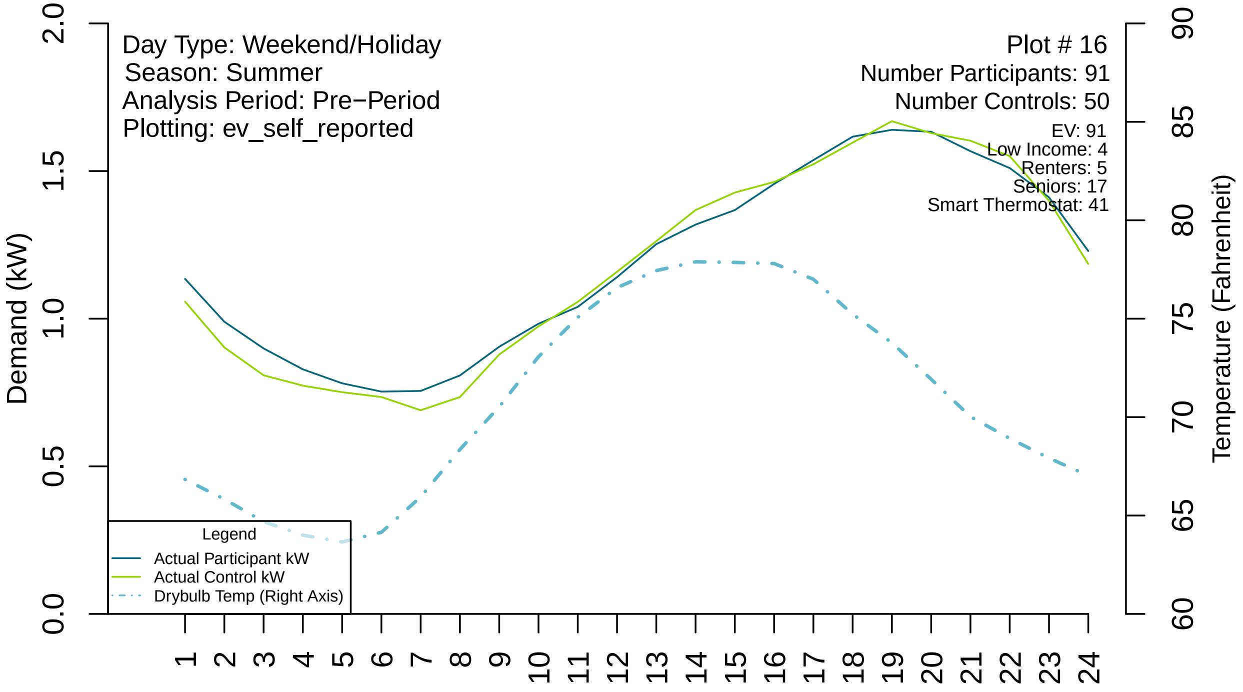
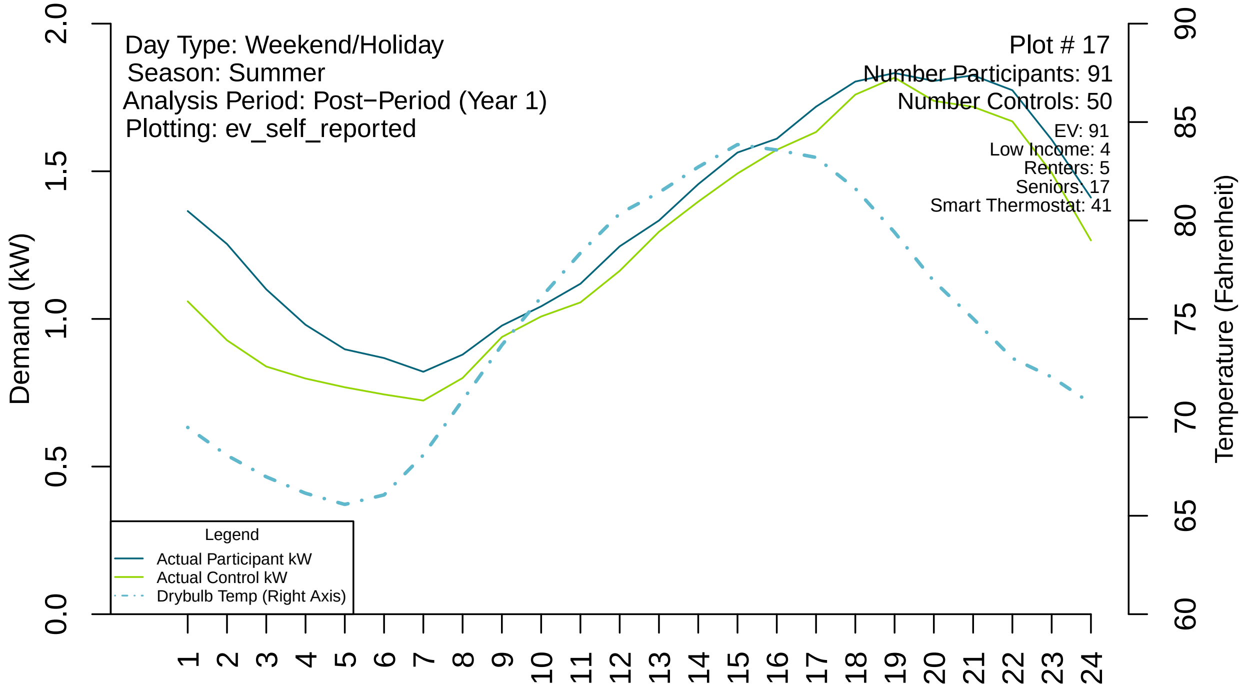
Number Participants: 91
Number Controls: 50
EV: 91
Low Income: 4
Renters: 5
Seniors: 17
Smart Thermostat: 41
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)


Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Pre−Period
Plotting: ev_self_reported
Plot # 16
Number Participants: 91
Number Controls: 50
EV: 91
Low Income: 4
Renters: 5
Seniors: 17
Smart Thermostat: 41
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)


Day Type: Weekend/Holiday
Season: Summer
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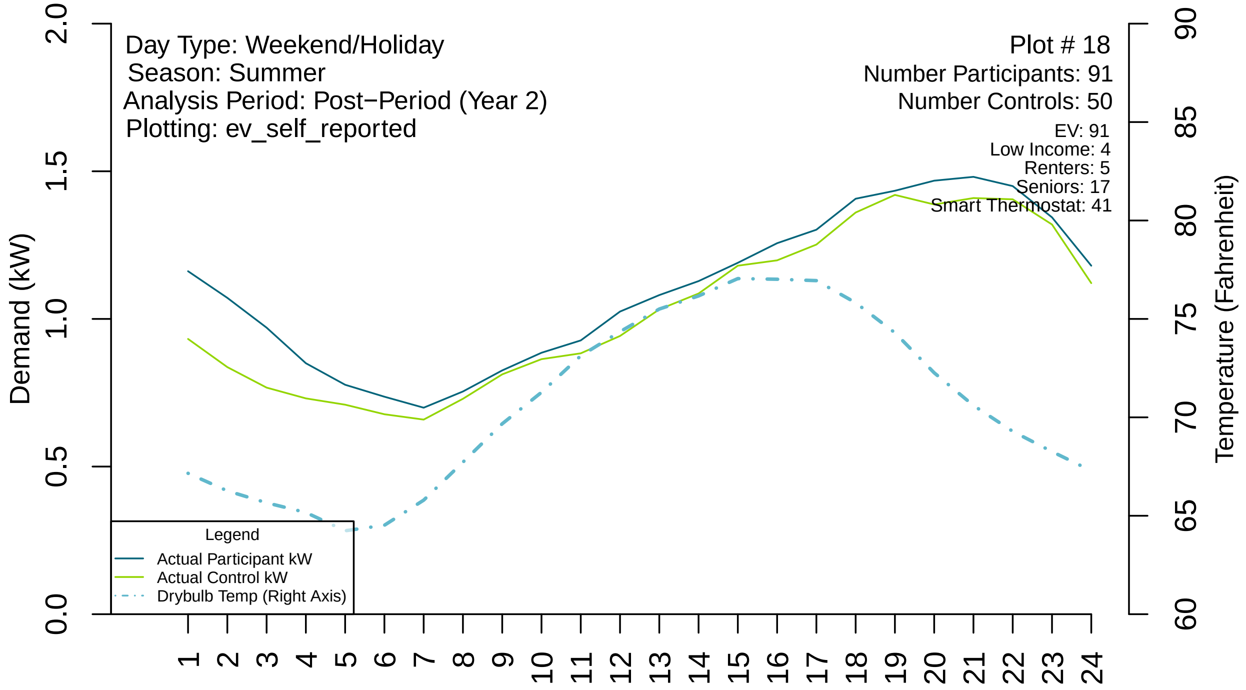
Plot # 17
Number Participants: 91
Number Controls: 50
EV: 91
Low Income: 4
Renters: 5
Seniors: 17
Smart Thermostat: 41
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)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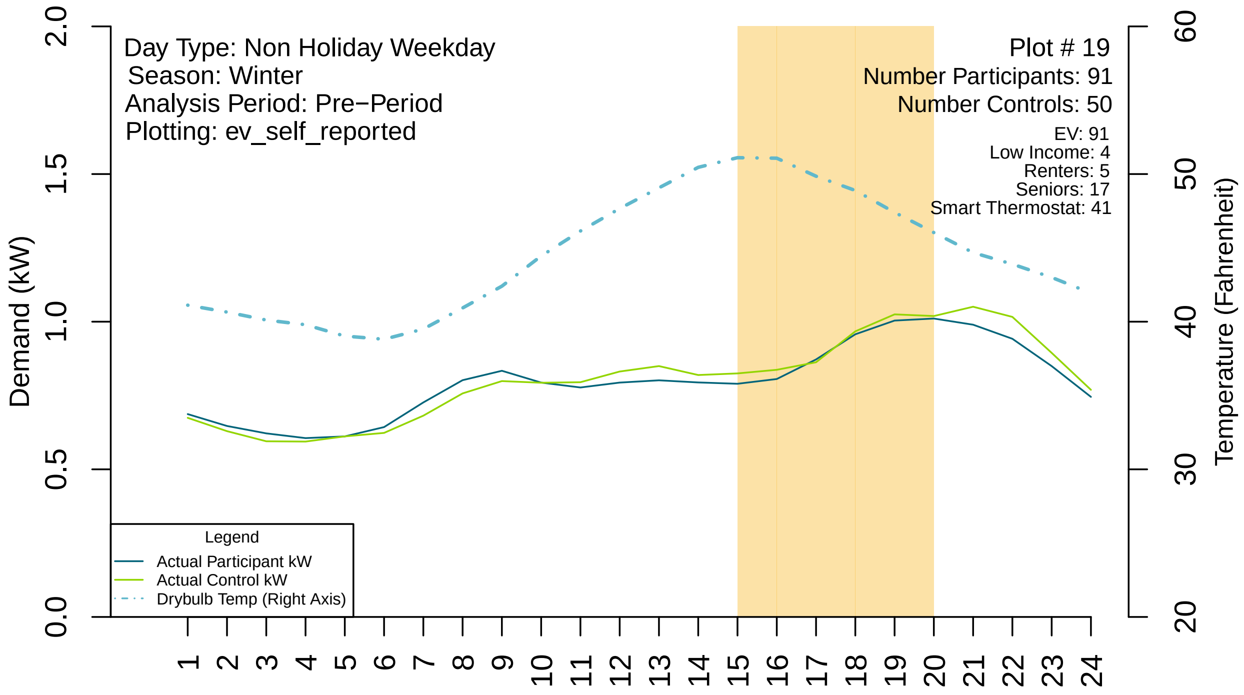
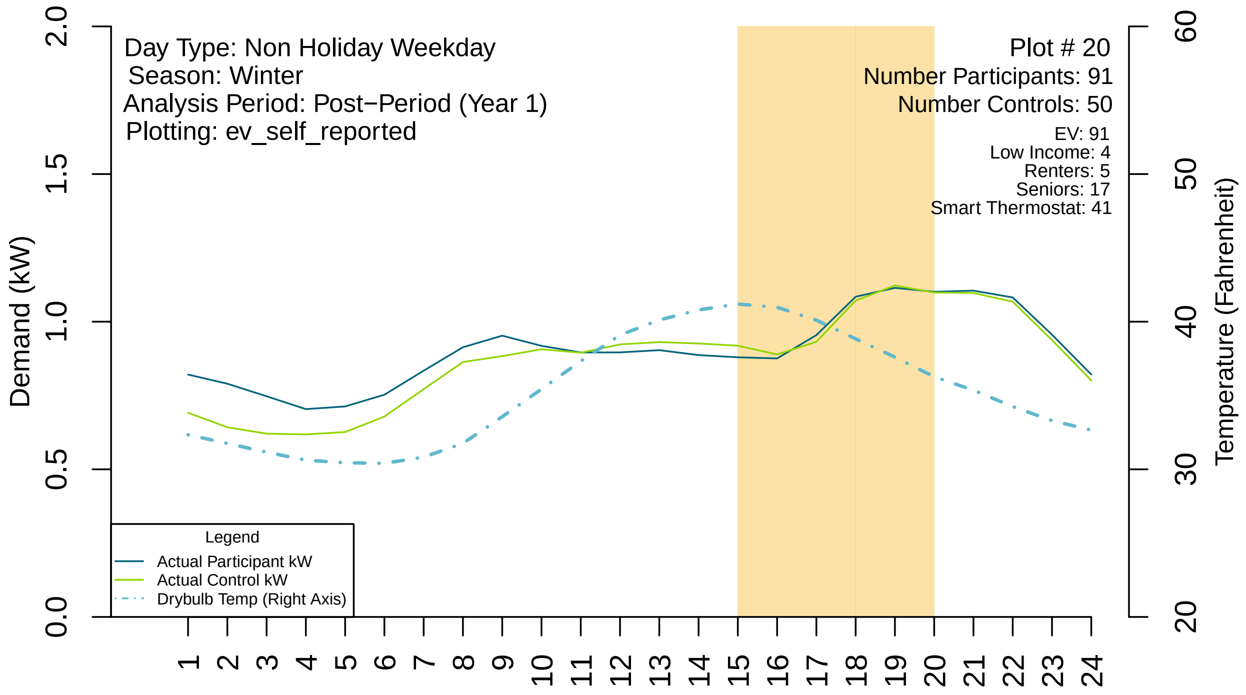
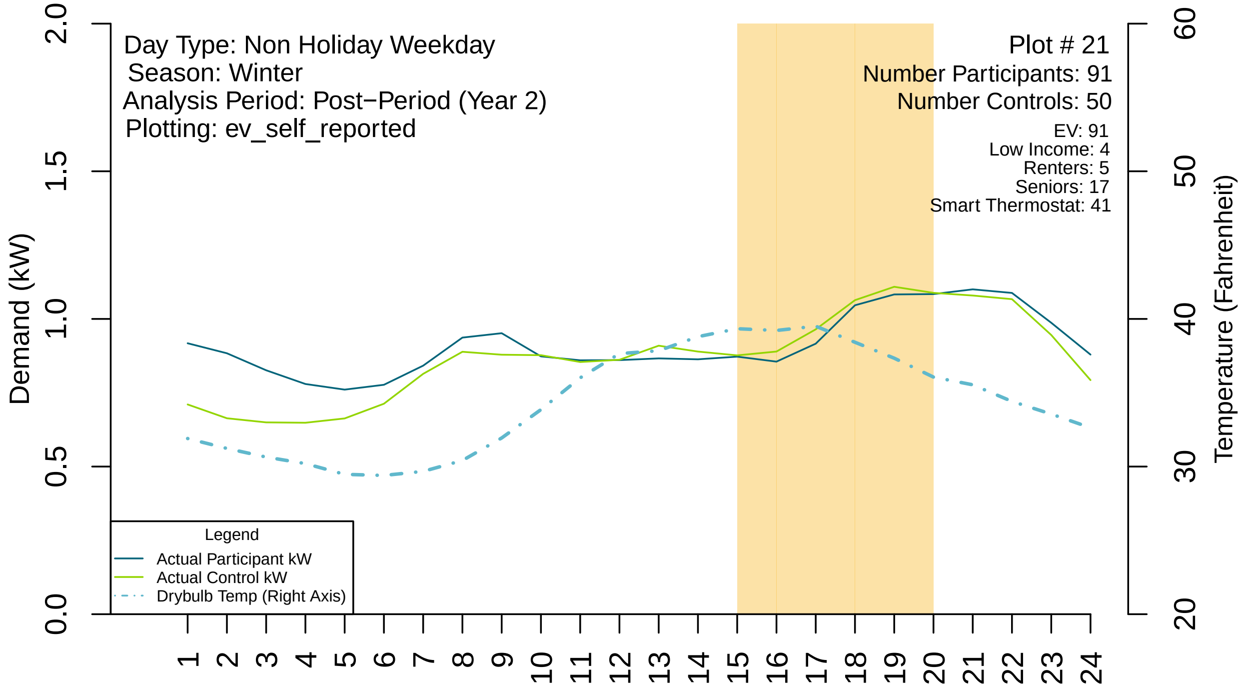
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: ev_self_reported
Plot # 18
Number Participants: 91
Number Controls: 50
EV: 91
Low Income: 4
Renters: 5
Seniors: 17
Smart Thermostat: 41
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)


Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Pre−Period
Plotting: ev_self_reported
Plot # 19
Number Participants: 91
Number Controls: 50
EV: 91
Low Income: 4
Renters: 5
Seniors: 17
Smart Thermostat: 41
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)


Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: ev_self_reported
Plot # 20
Number Participants: 91
Number Controls: 50
EV: 91
Low Income: 4
Renters: 5
Seniors: 17
Smart Thermostat: 41
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)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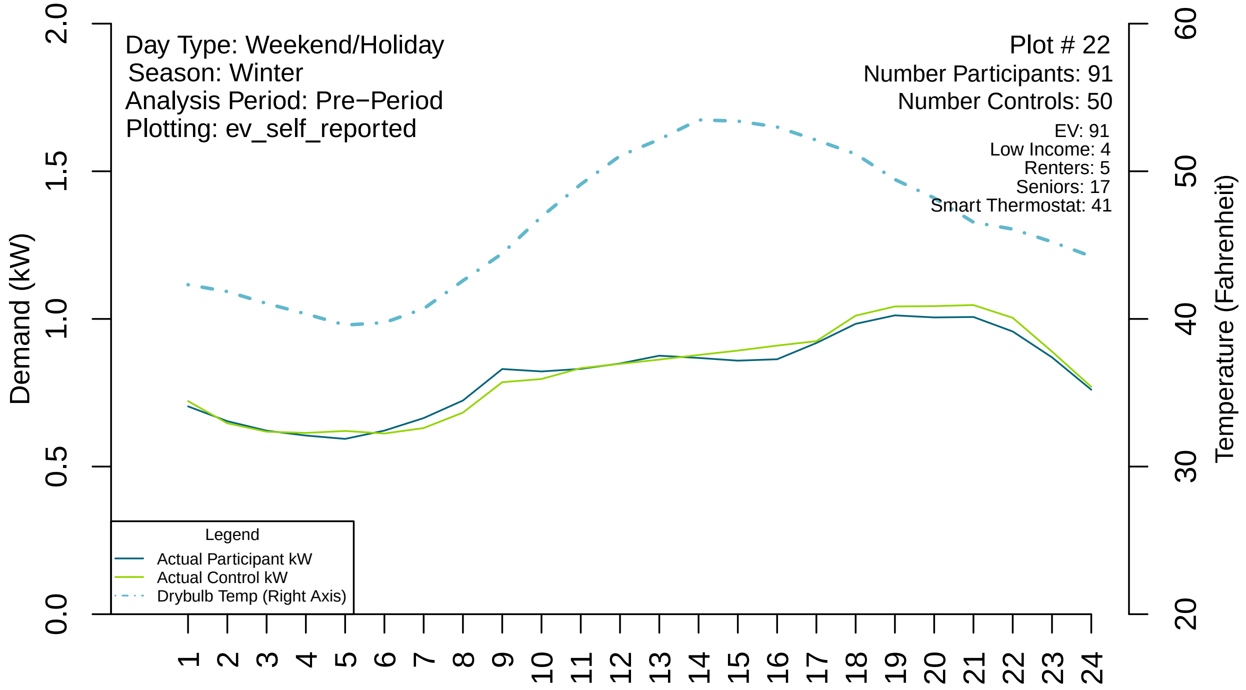
Analysis Period: Post−Period (Year 2)
Plotting: ev_self_reported
Plot # 21
Number Participants: 91
Number Controls: 50
EV: 91
Low Income: 4
Renters: 5
Seniors: 17
Smart Thermostat: 41
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)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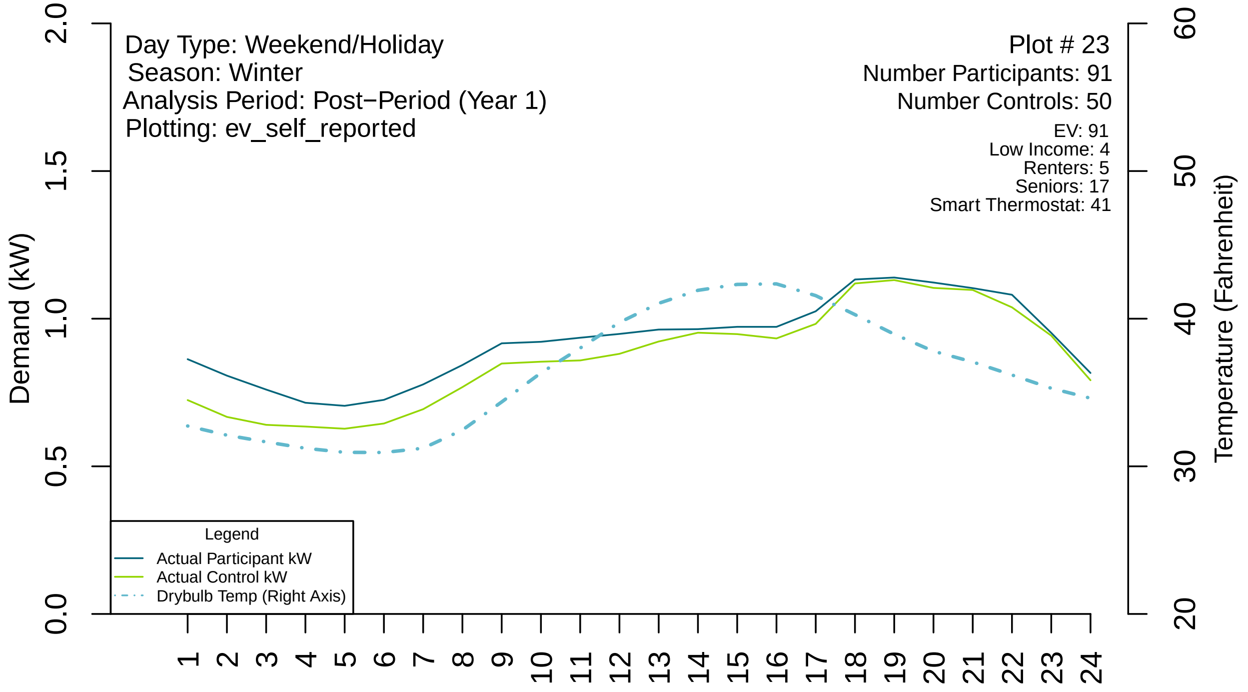
Plot # 22
Number Participants: 91
Number Controls: 50
EV: 91
Low Income: 4
Renters: 5
Seniors: 17
Smart Thermostat: 41
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)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Plotting: ev_self_reported
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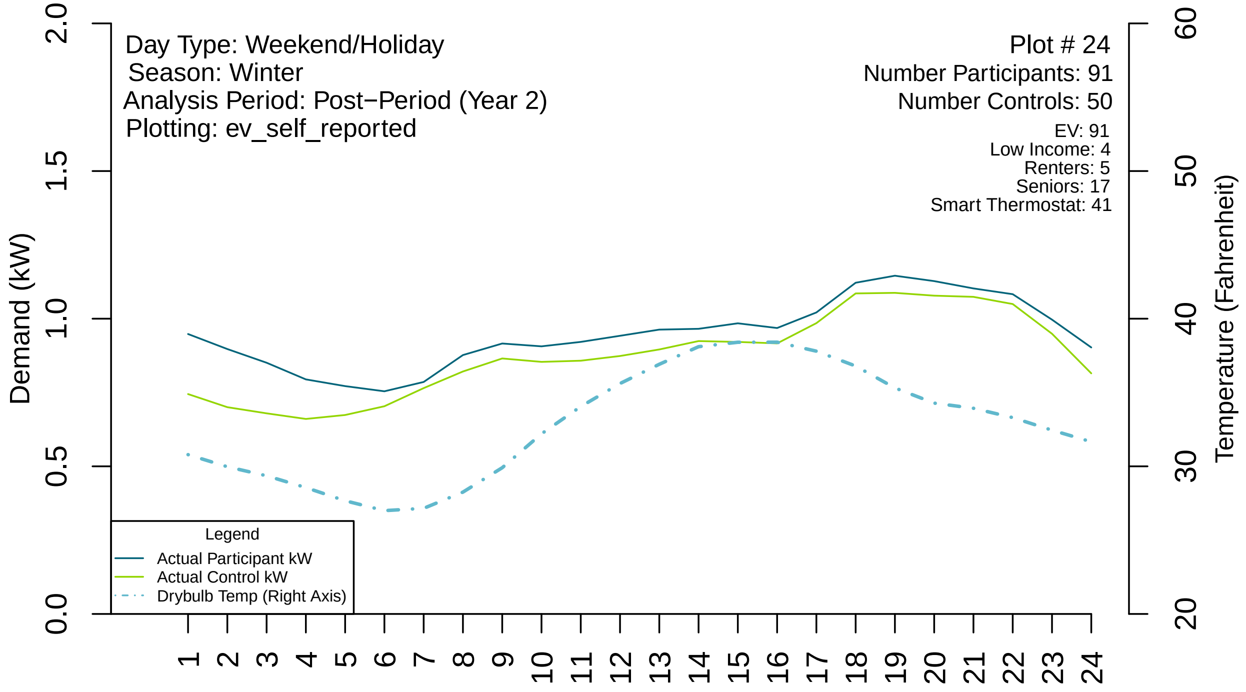
Number Controls: 50
EV: 91
Low Income: 4
Renters: 5
Seniors: 17
Smart Thermostat: 41
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)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Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: ev_self_reported
Plot # 24
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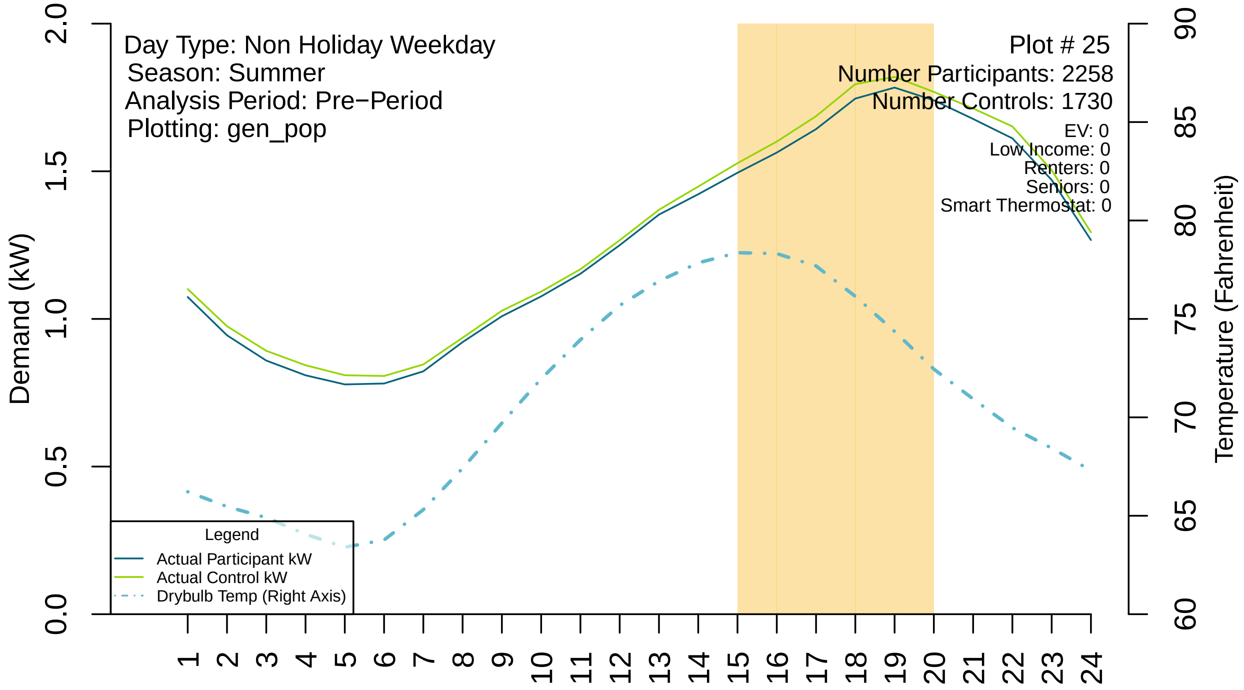
Number Controls: 50
EV: 91
Low Income: 4
Renters: 5
Seniors: 17
Smart Thermostat: 41
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)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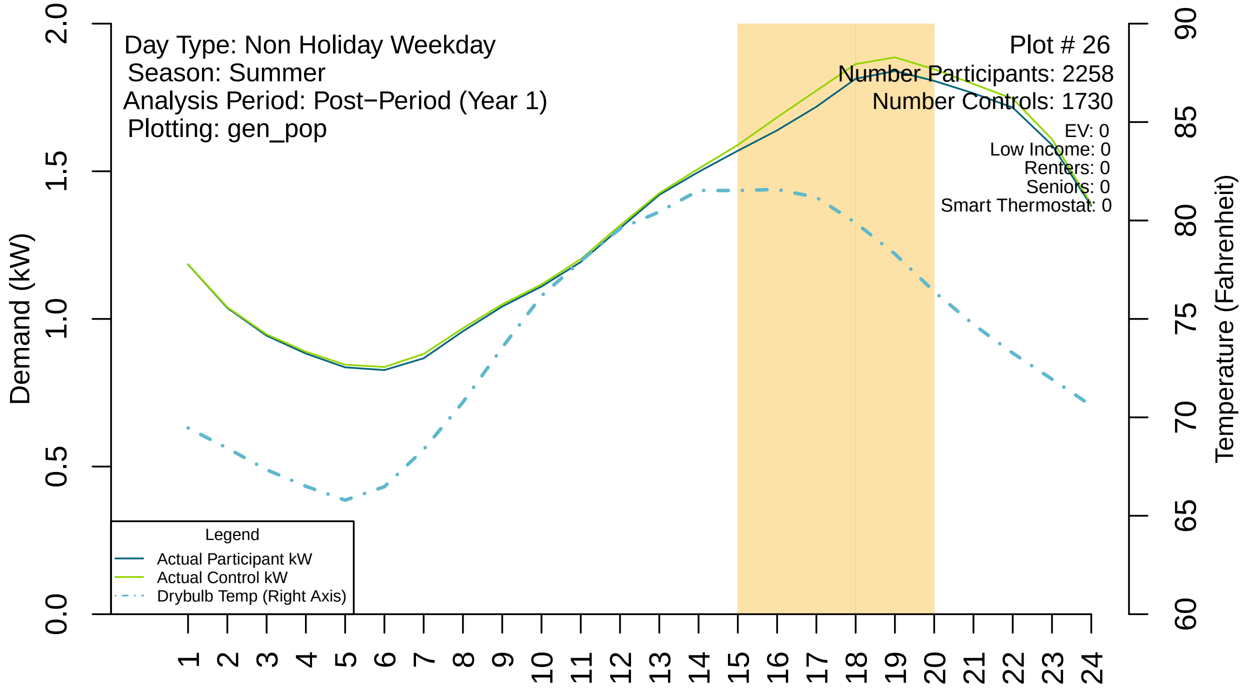
Season: Summer
Analysis Period: Pre−Period
Plotting: gen_pop
Plot # 25
Number Participants: 2258
Number Controls: 1730
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)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Analysis Period: Post−Period (Year 1)
Plotting: gen_pop
Plot # 26
Number Participants: 2258
Number Controls: 1730
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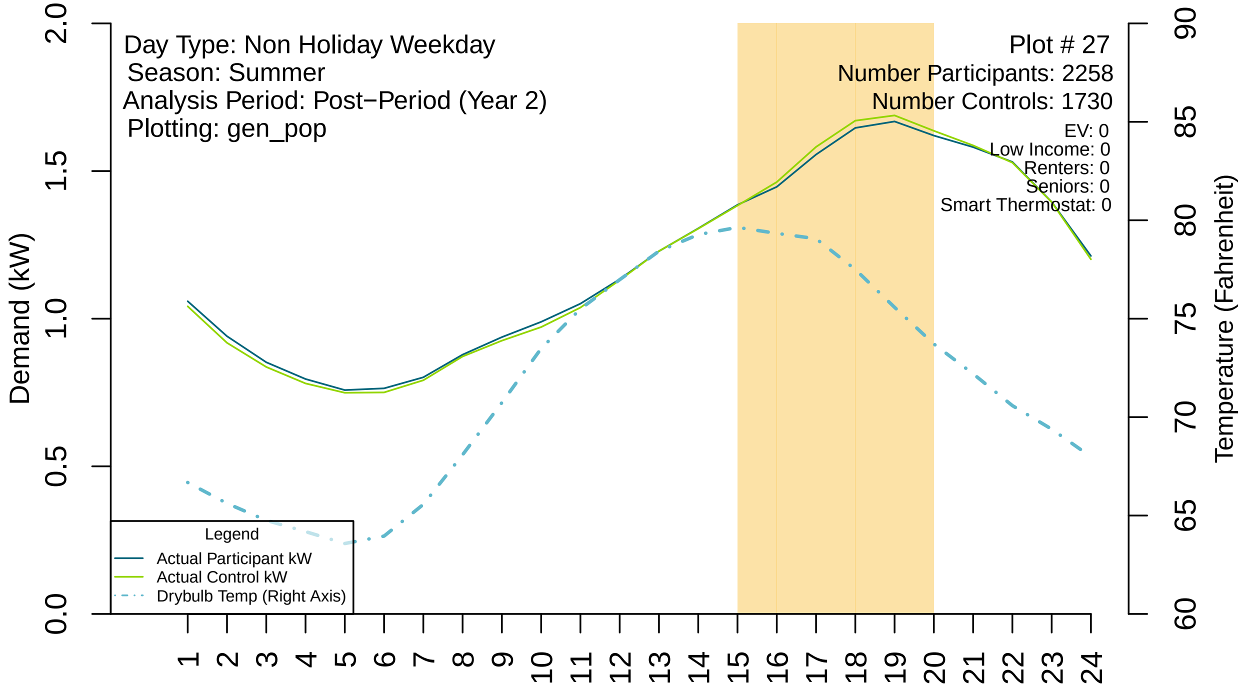
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)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Plot # 27
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Number Controls: 1730
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Low Income: 0
Renters: 0
Seniors: 0
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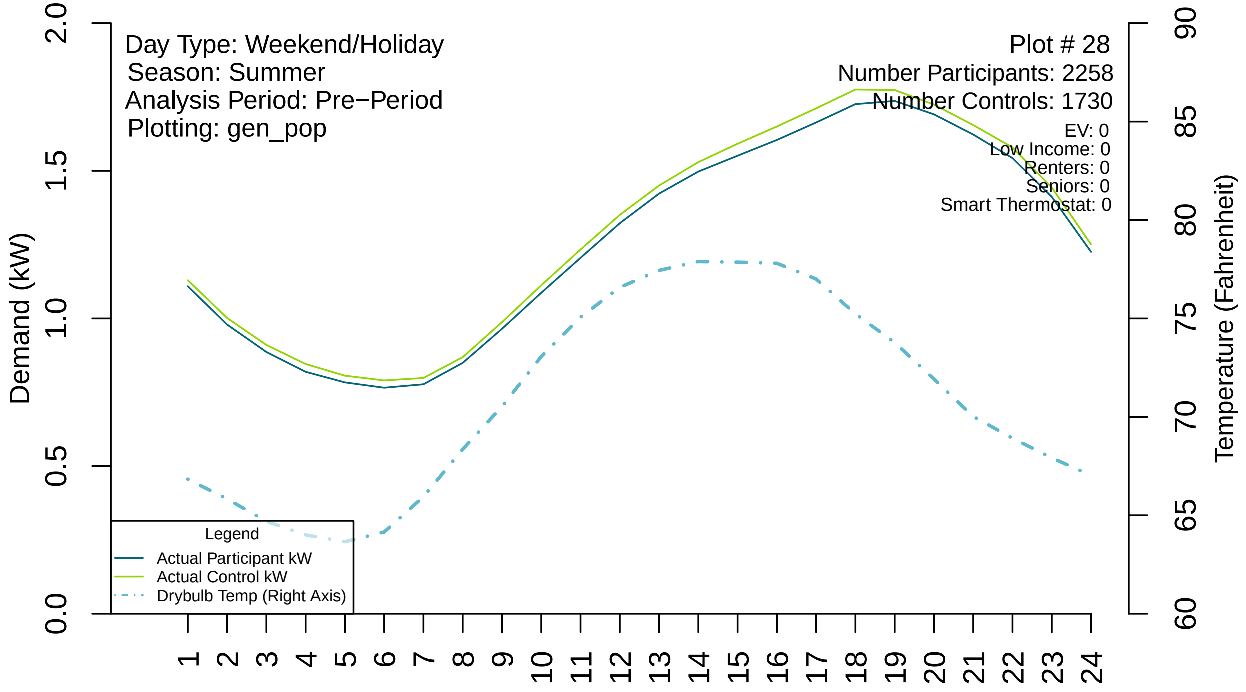
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)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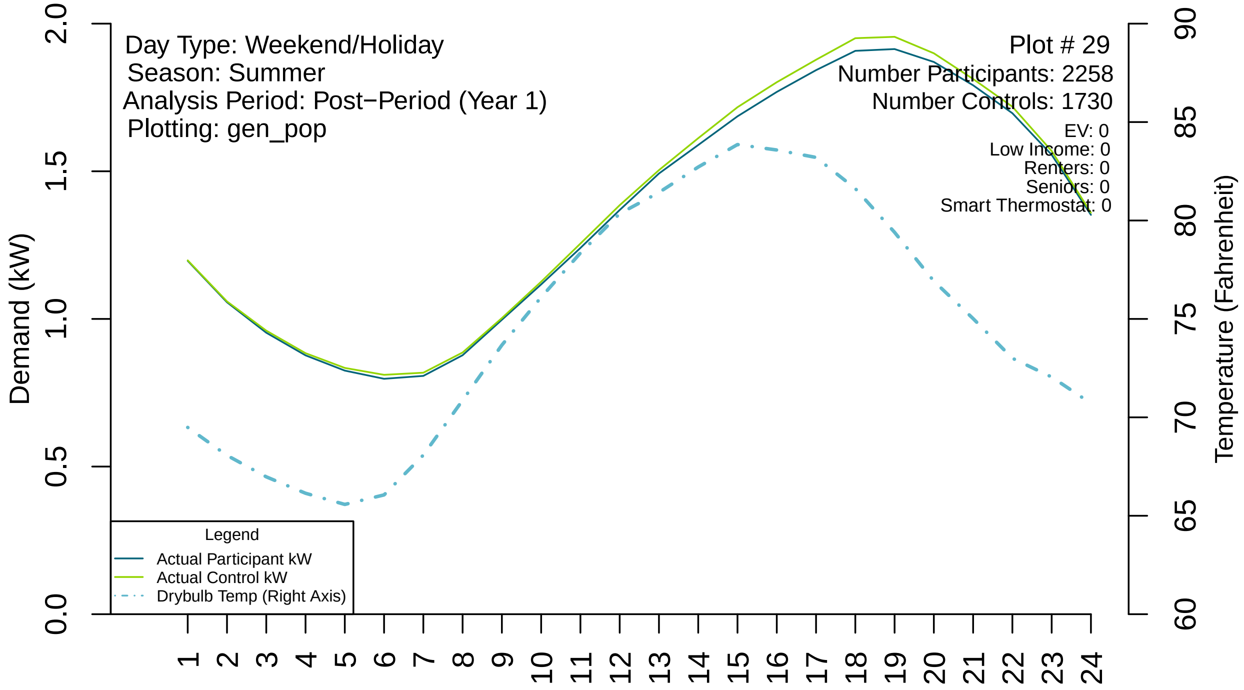
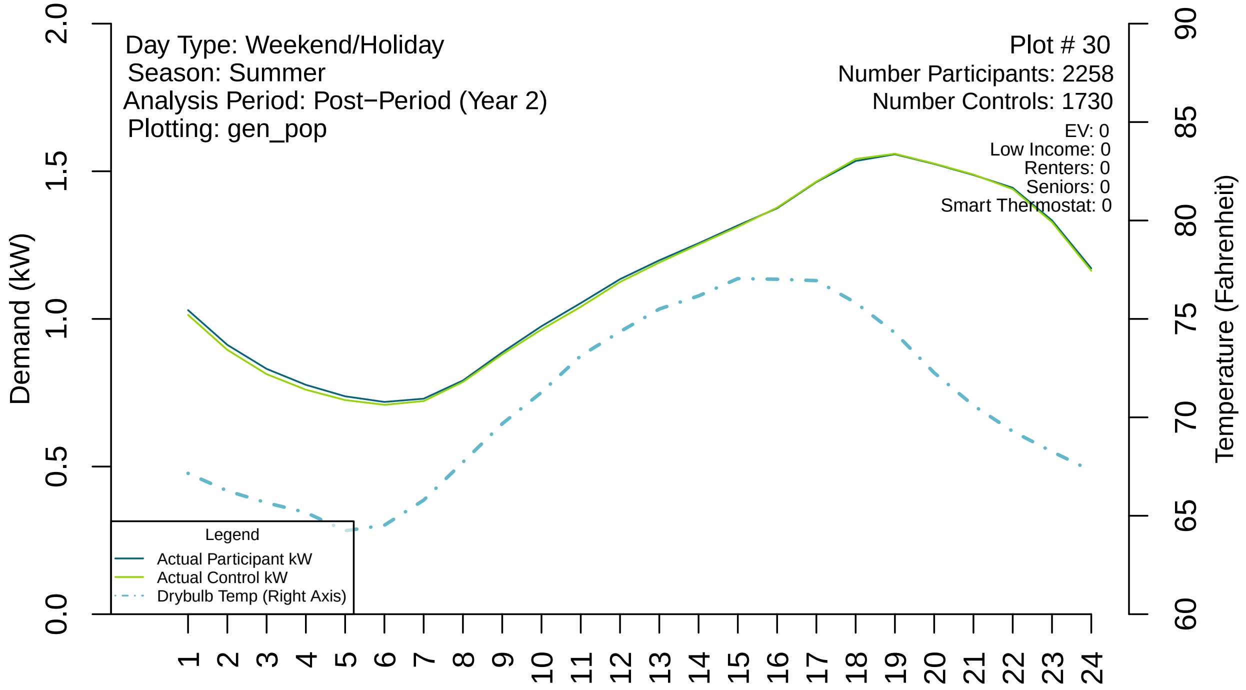
Season: Summer
Analysis Period: Pre−Period
Plotting: gen_pop
Plot # 28
Number Participants: 2258
Number Controls: 1730
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)


Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: gen_pop
Plot # 29
Number Participants: 2258
Number Controls: 1730
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)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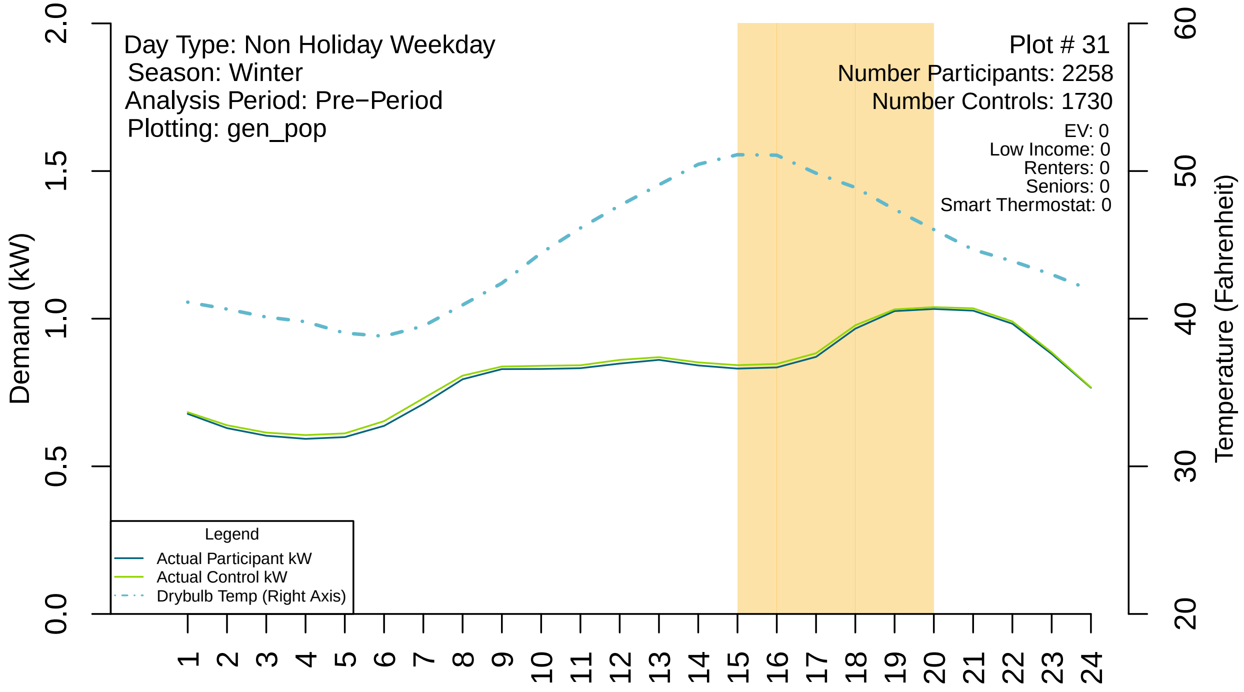
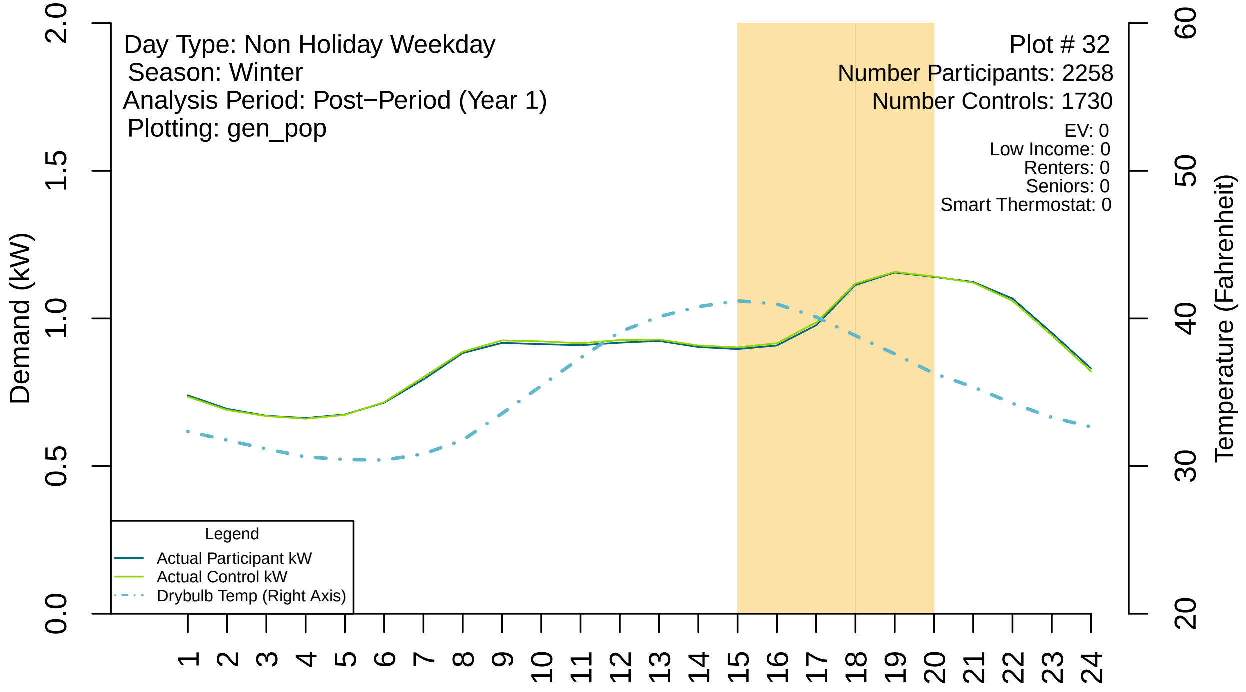
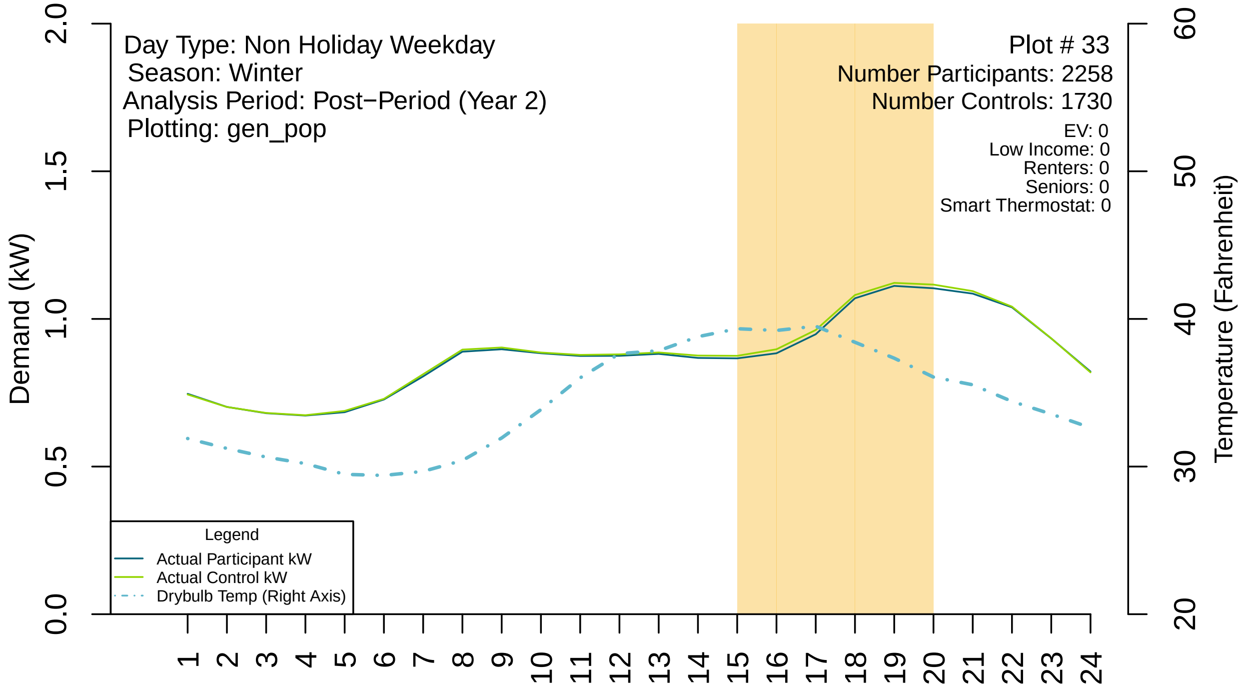
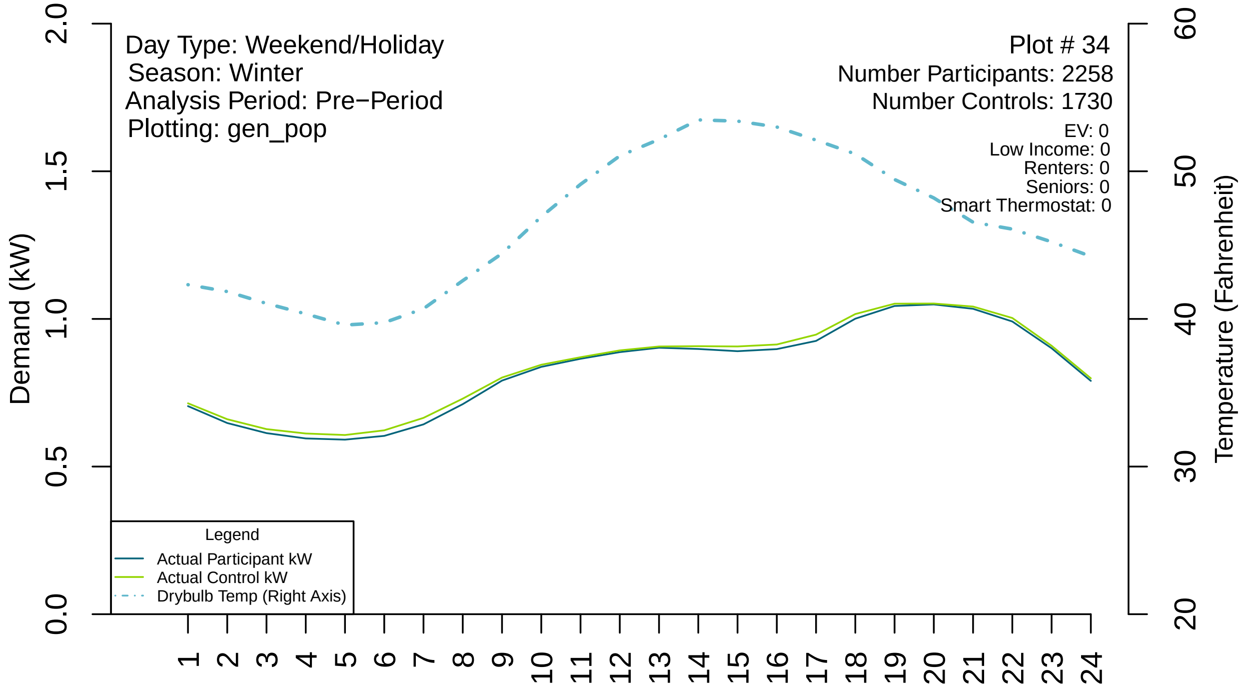
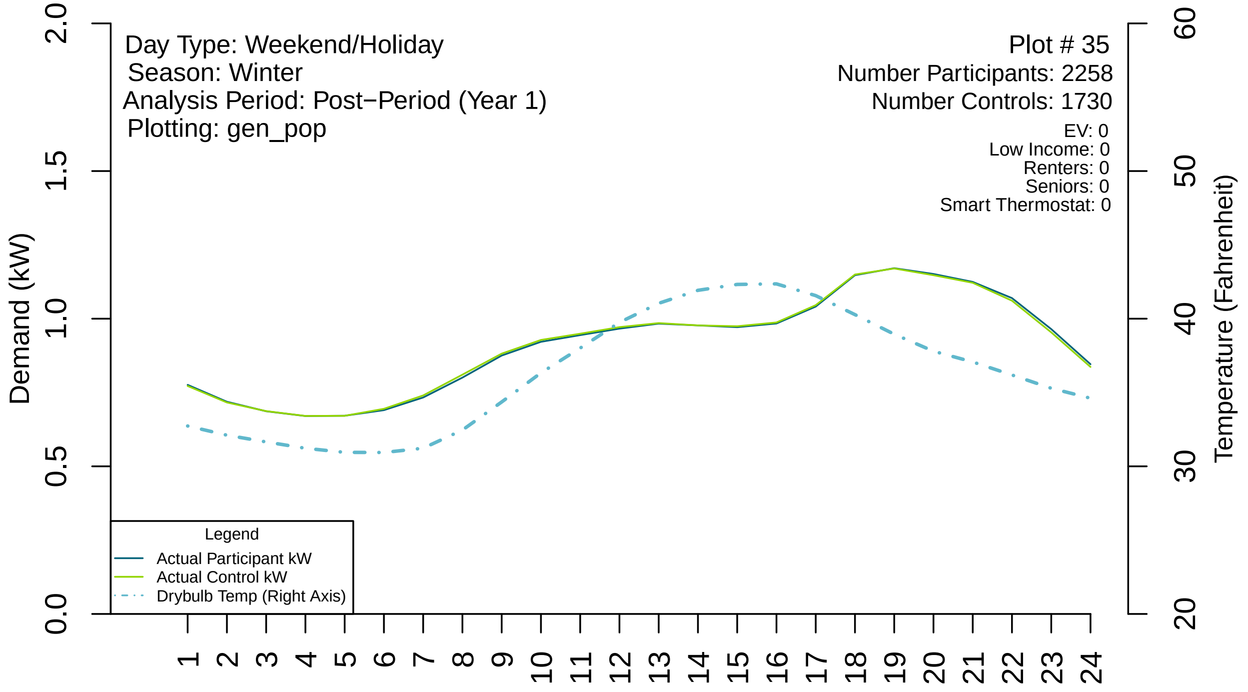
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: gen_pop
Plot # 30
Number Participants: 2258
Number Controls: 1730
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

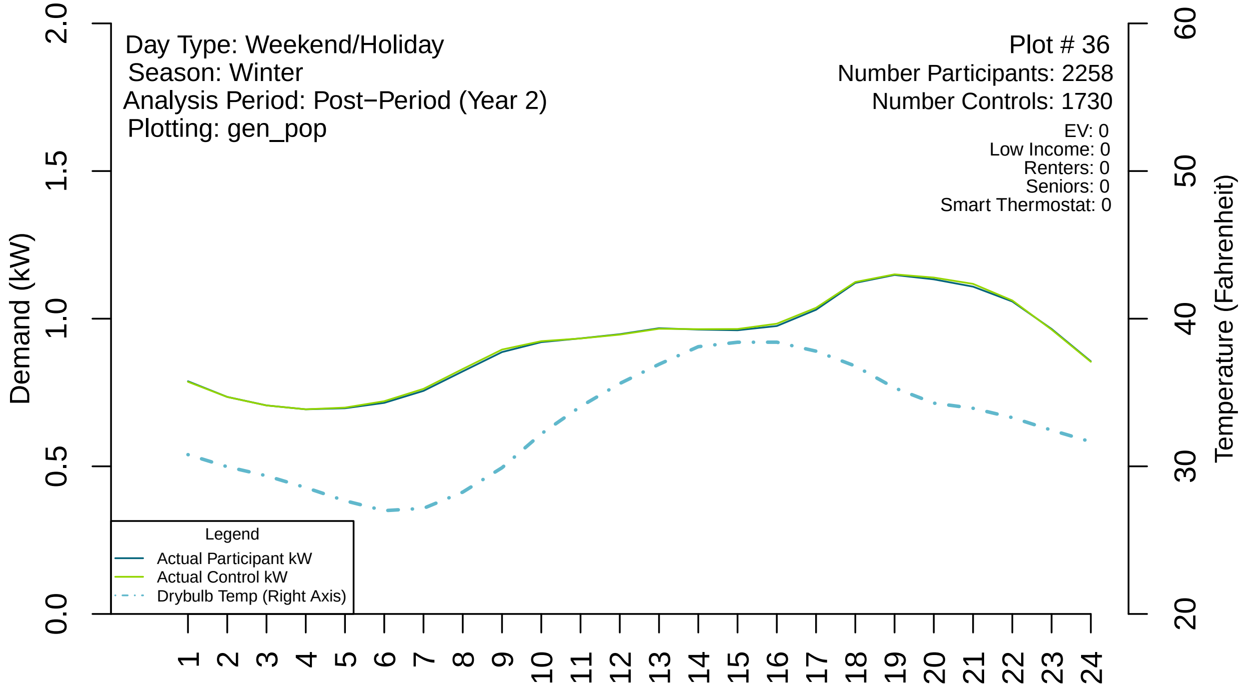

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Pre−Period
Plotting: gen_pop
Plot # 31
Number Participants: 2258
Number Controls: 1730
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

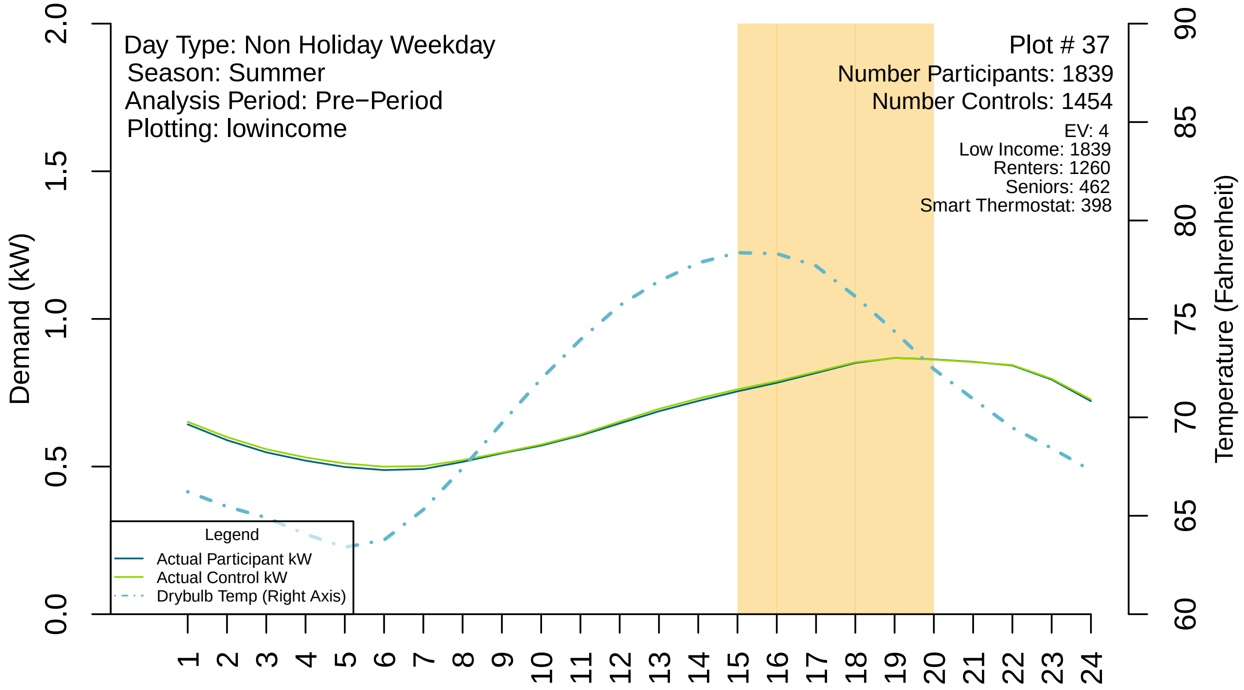

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: gen_pop
Plot # 32
Number Participants: 2258
Number Controls: 1730
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

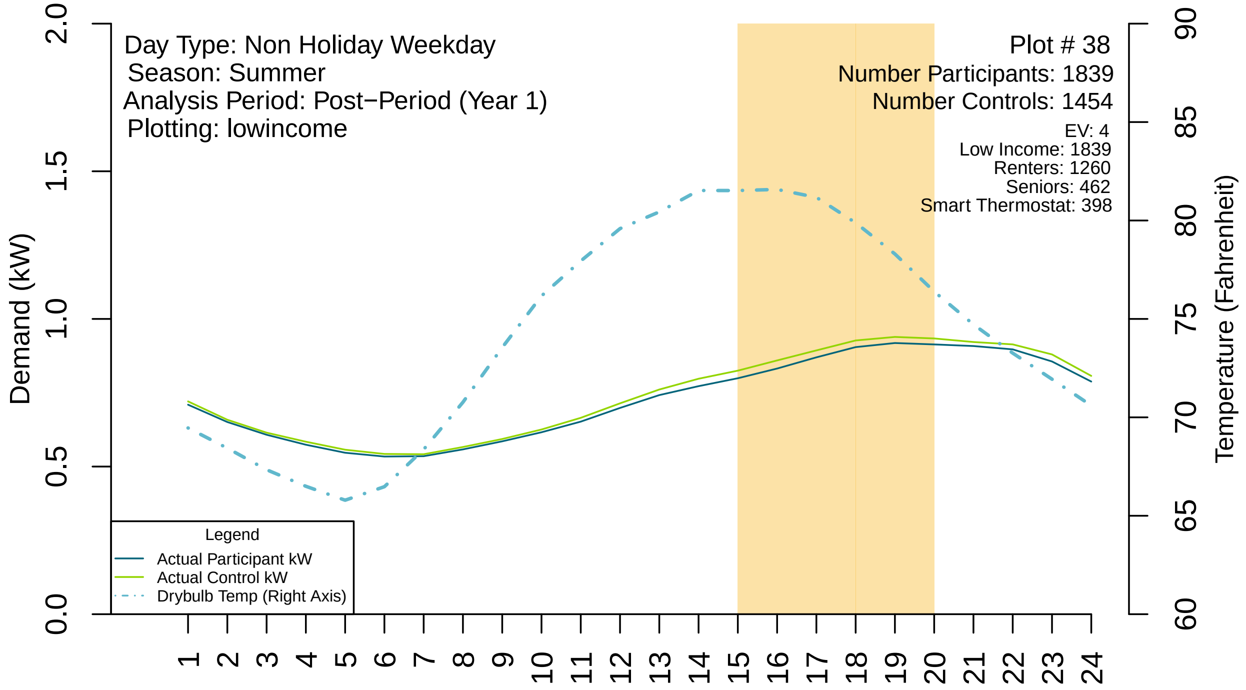

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: gen_pop
Plot # 33
Number Participants: 2258
Number Controls: 1730
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

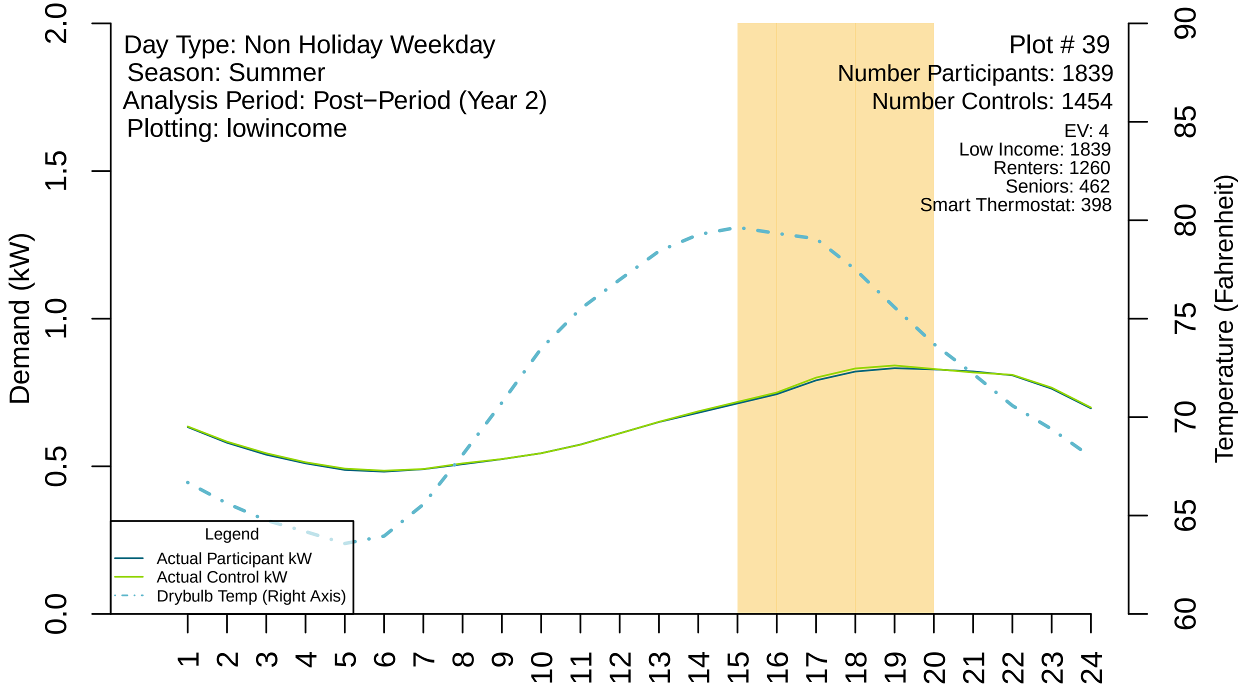

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Pre−Period
Plotting: gen_pop
Plot # 34
Number Participants: 2258
Number Controls: 1730
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

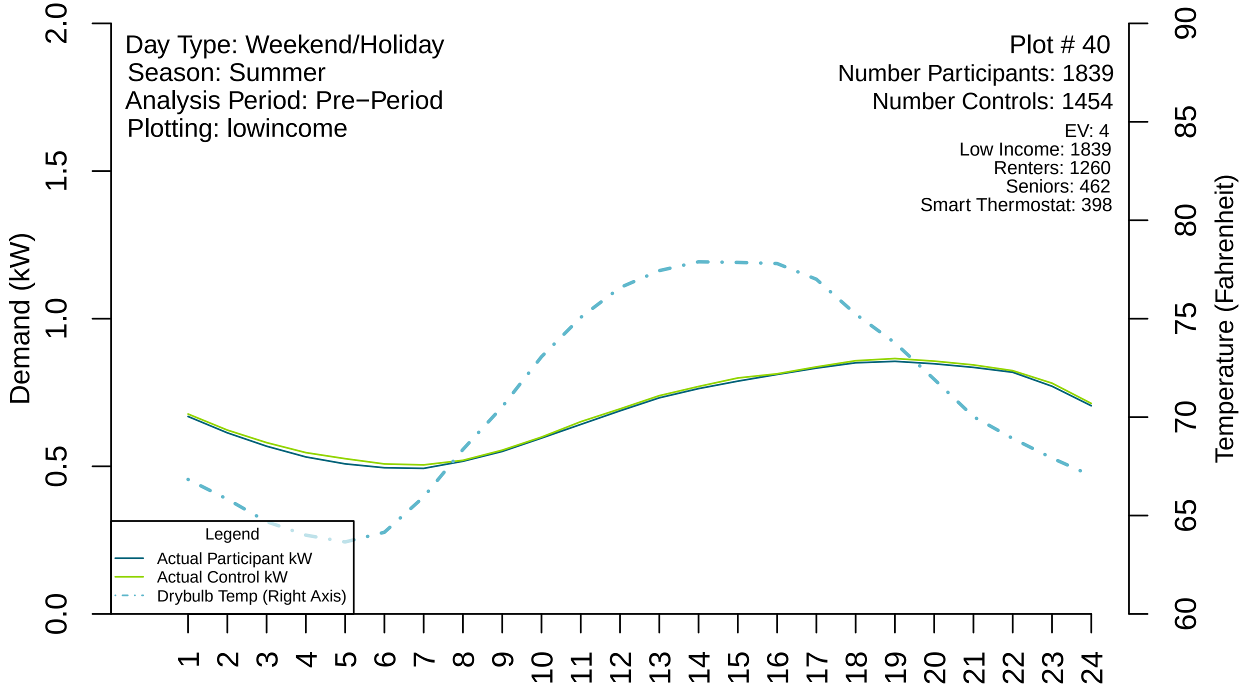

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: gen_pop
Plot # 35
Number Participants: 2258
Number Controls: 1730
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

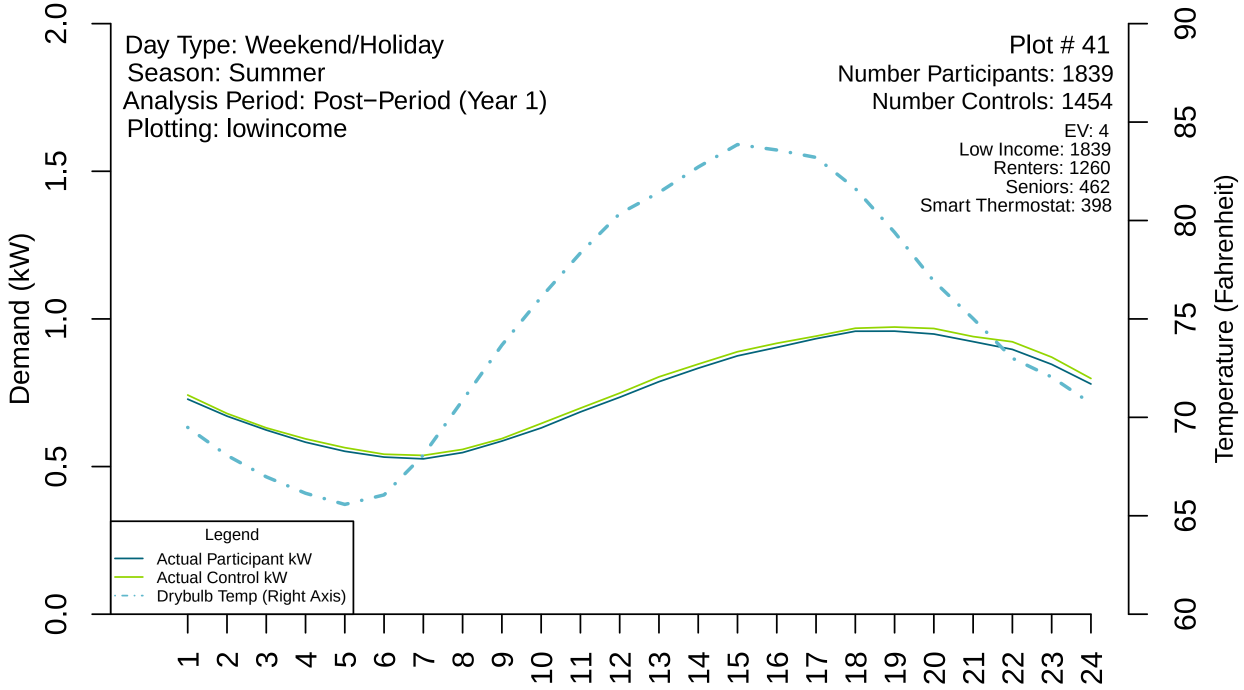

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: gen_pop
Plot # 36
Number Participants: 2258
Number Controls: 1730
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

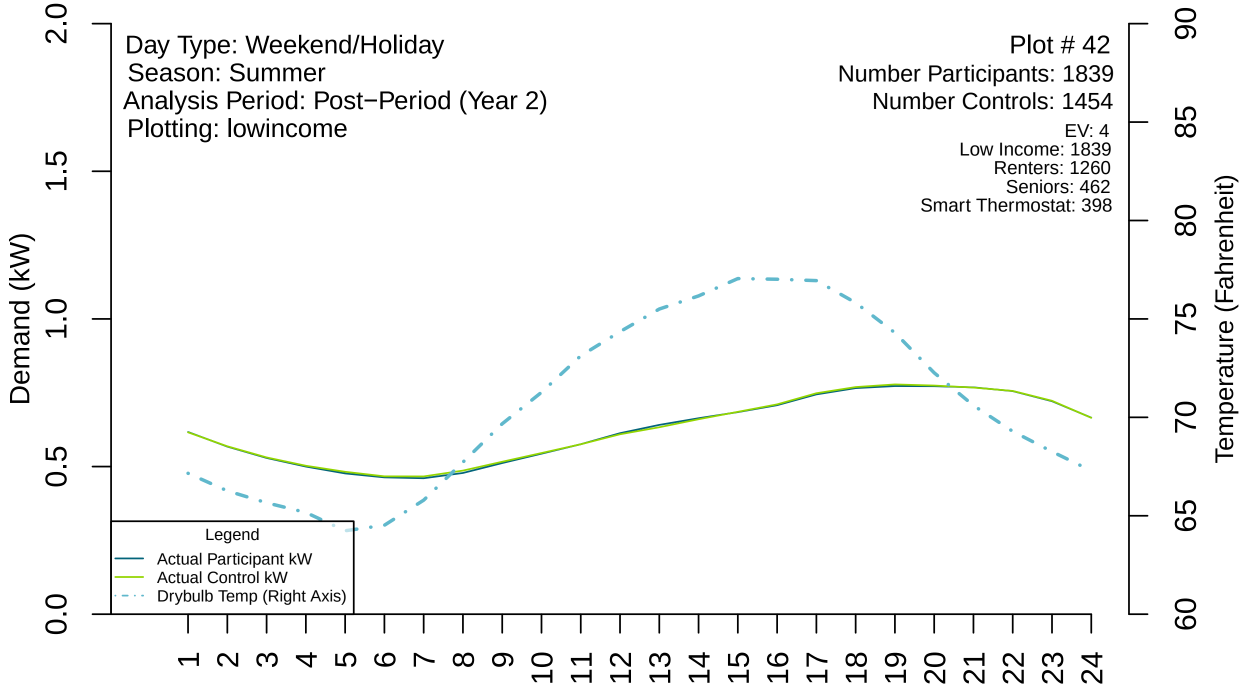

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Pre−Period
Plotting: lowincome
Plot # 37
Number Participants: 1839
Number Controls: 1454
EV: 4
Low Income: 1839
Renters: 1260
Seniors: 462
Smart Thermostat: 398
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

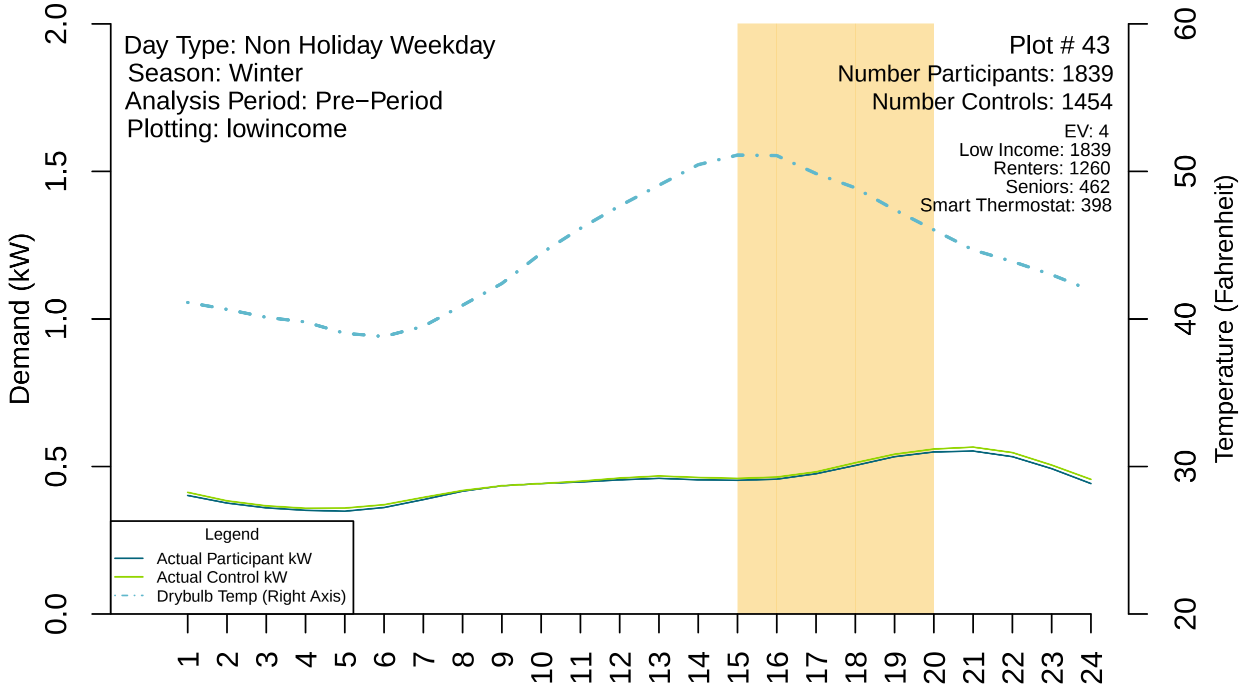

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: lowincome
Plot # 38
Number Participants: 1839
Number Controls: 1454
EV: 4
Low Income: 1839
Renters: 1260
Seniors: 462
Smart Thermostat: 398
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

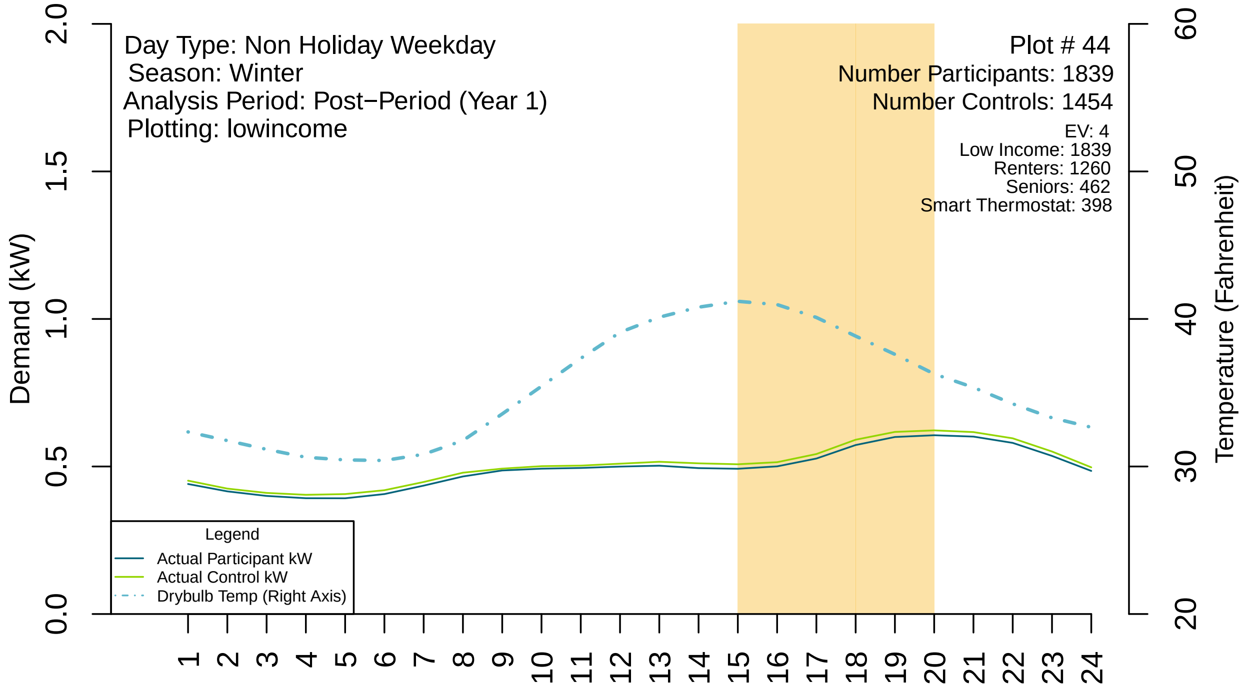

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: lowincome
Plot # 39
Number Participants: 1839
Number Controls: 1454
EV: 4
Low Income: 1839
Renters: 1260
Seniors: 462
Smart Thermostat: 398
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

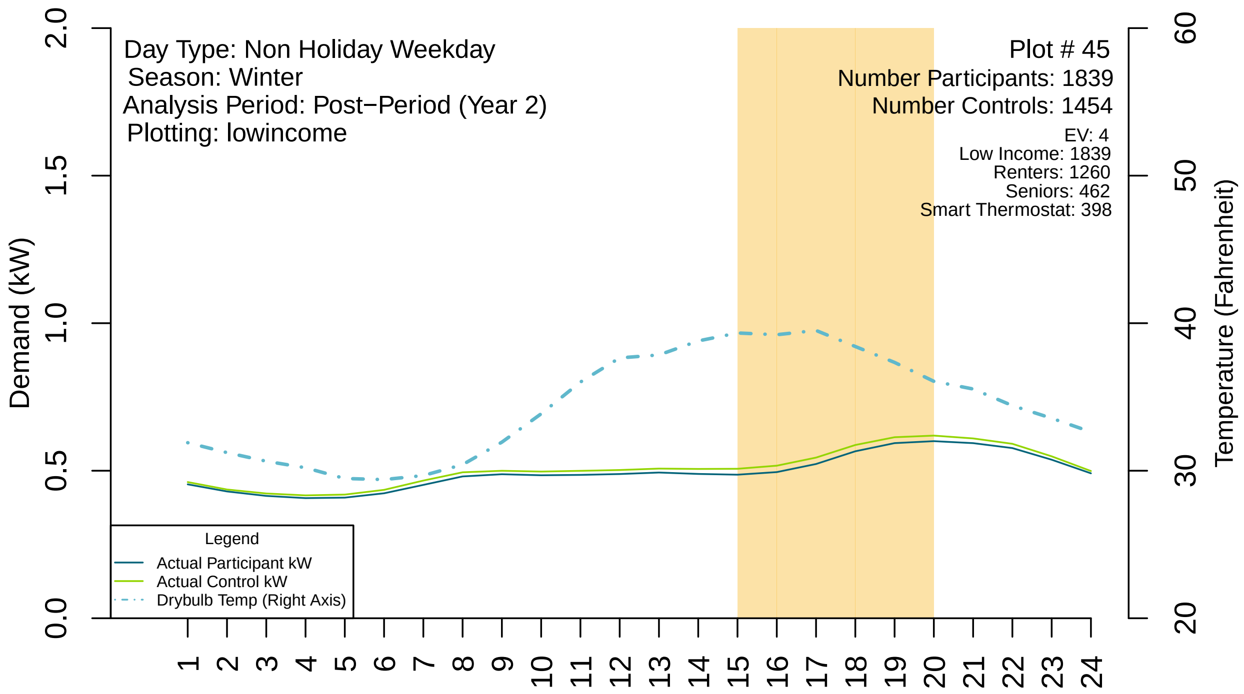

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Pre−Period
Plotting: lowincome
Plot # 40
Number Participants: 1839
Number Controls: 1454
EV: 4
Low Income: 1839
Renters: 1260
Seniors: 462
Smart Thermostat: 398
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

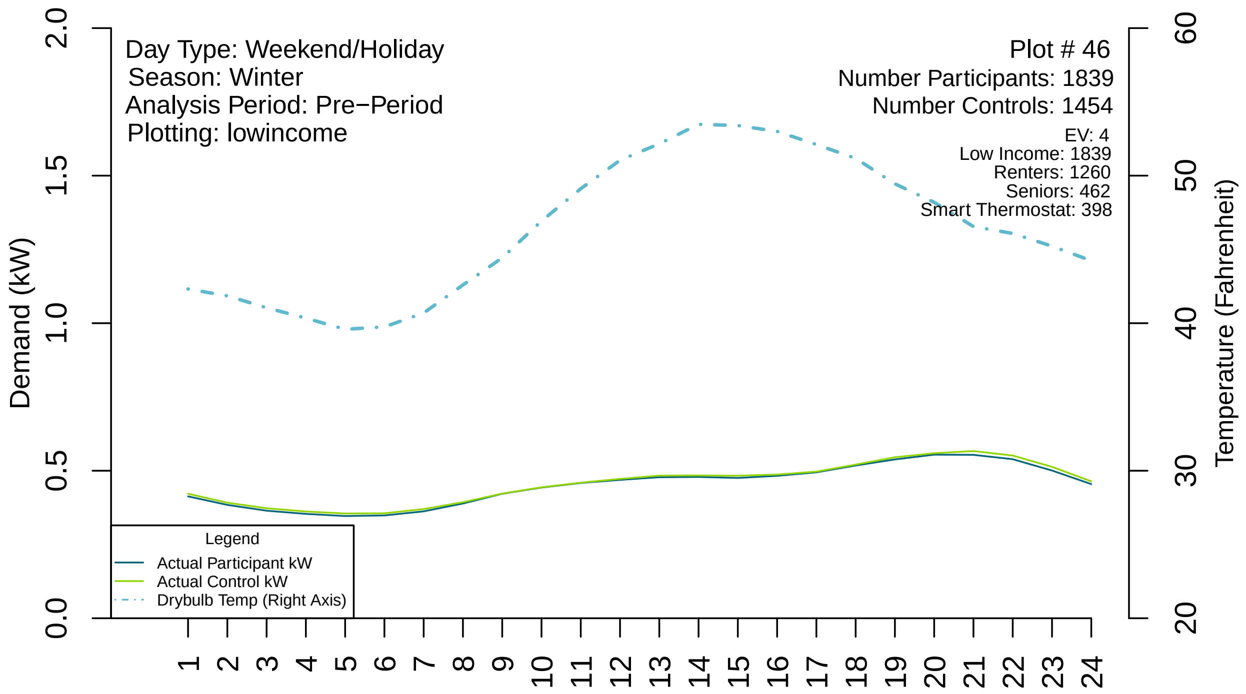

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: lowincome
Plot # 41
Number Participants: 1839
Number Controls: 1454
EV: 4
Low Income: 1839
Renters: 1260
Seniors: 462
Smart Thermostat: 398
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

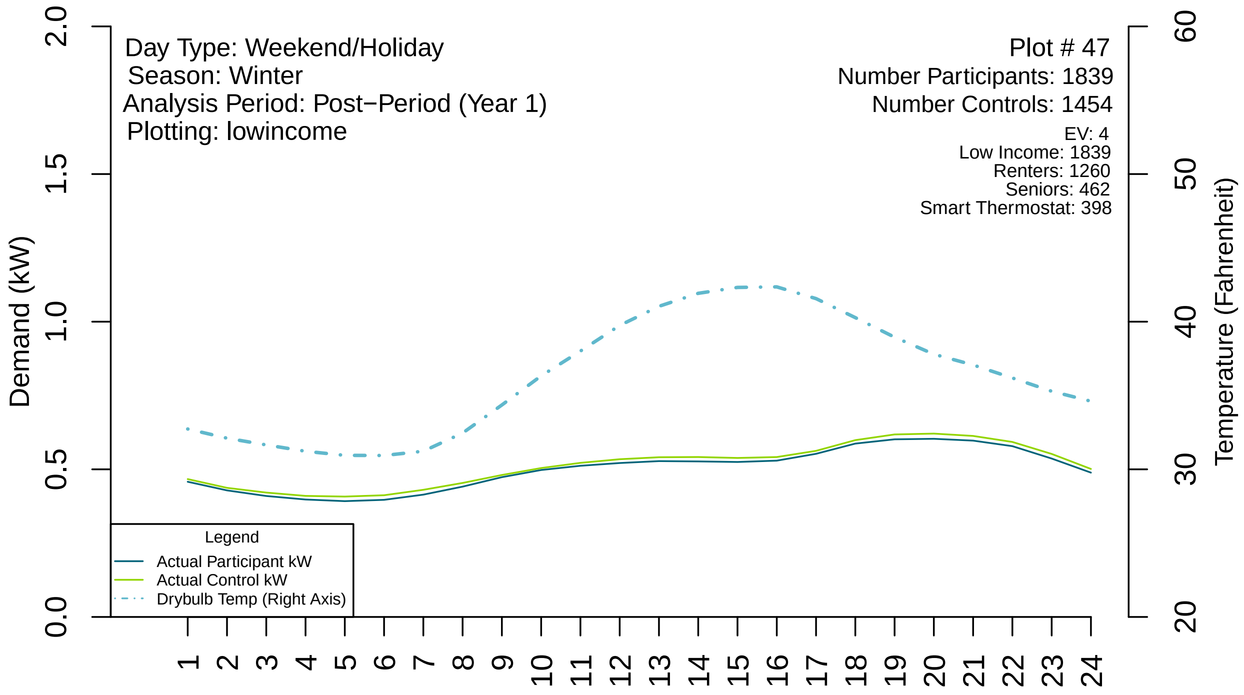

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: lowincome
Plot # 42
Number Participants: 1839
Number Controls: 1454
EV: 4
Low Income: 1839
Renters: 1260
Seniors: 462
Smart Thermostat: 398
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

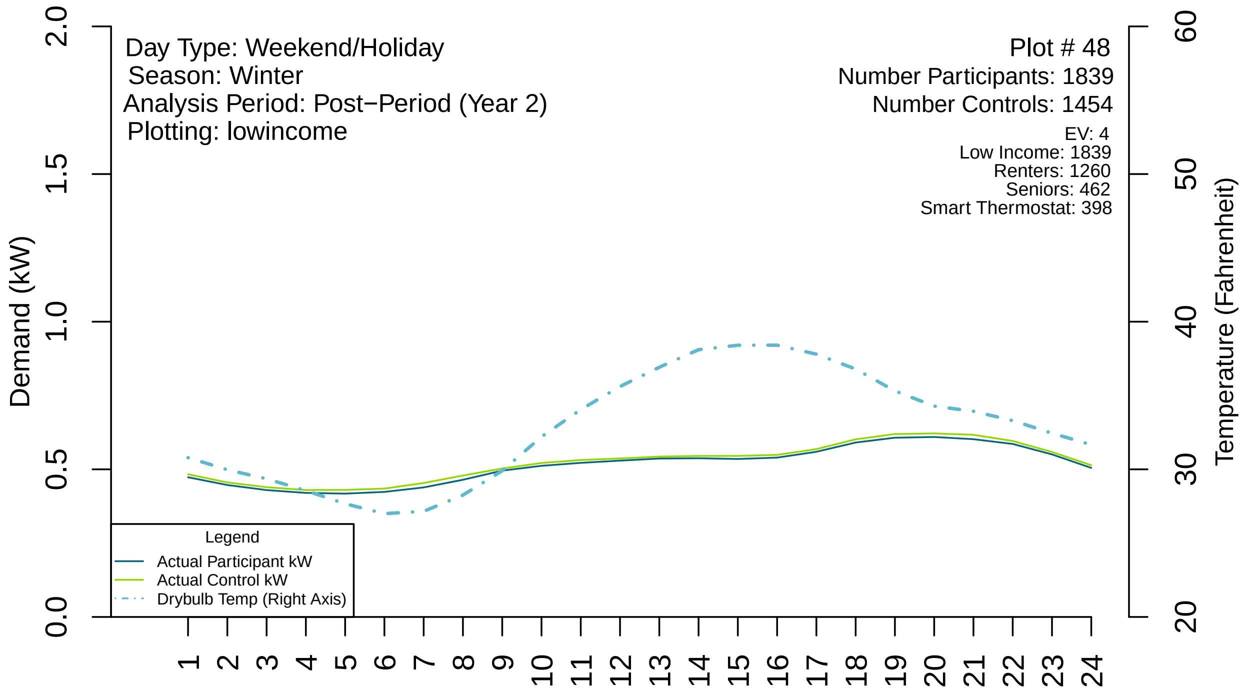

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Pre−Period
Plotting: lowincome
Plot # 43
Number Participants: 1839
Number Controls: 1454
EV: 4
Low Income: 1839
Renters: 1260
Seniors: 462
Smart Thermostat: 398
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

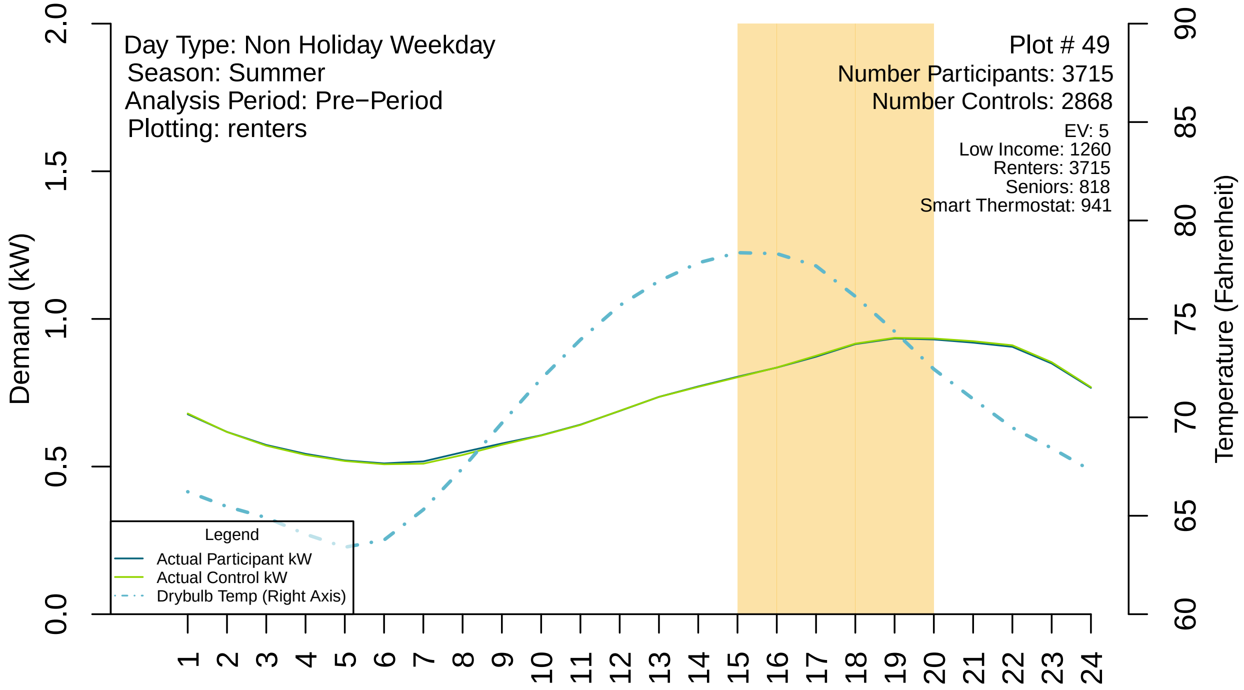

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: lowincome
Plot # 44
Number Participants: 1839
Number Controls: 1454
EV: 4
Low Income: 1839
Renters: 1260
Seniors: 462
Smart Thermostat: 398
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

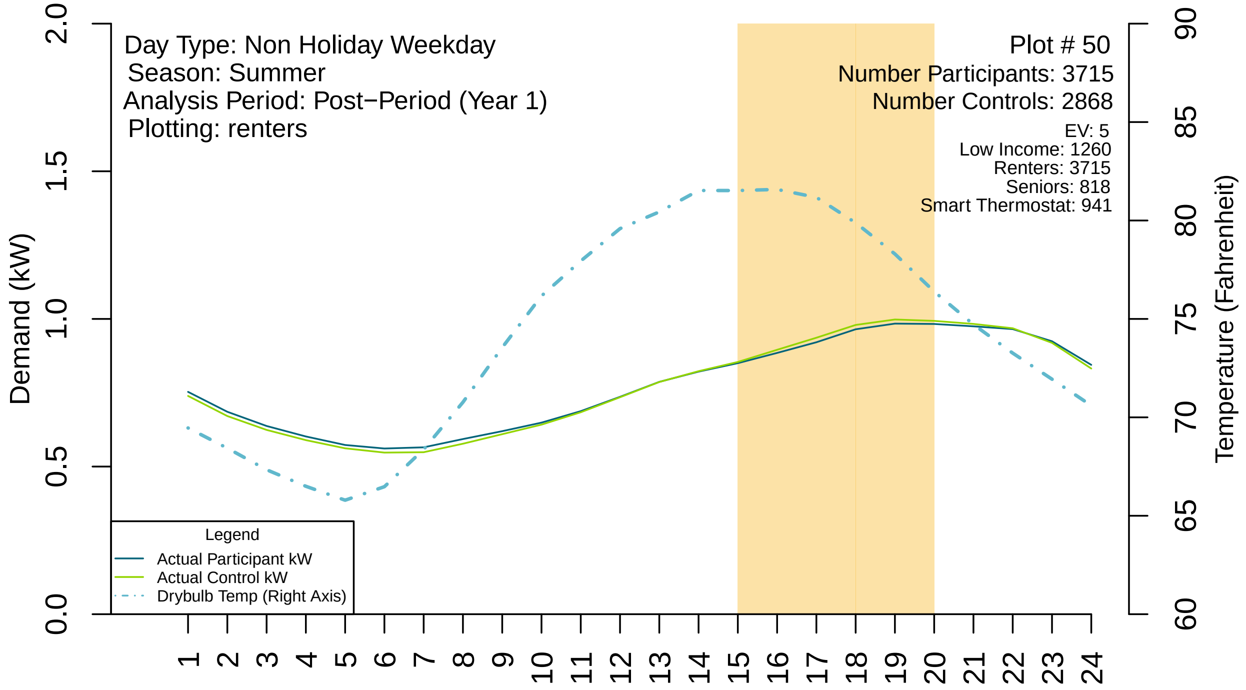

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: lowincome
Plot # 45
Number Participants: 1839
Number Controls: 1454
EV: 4
Low Income: 1839
Renters: 1260
Seniors: 462
Smart Thermostat: 398
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

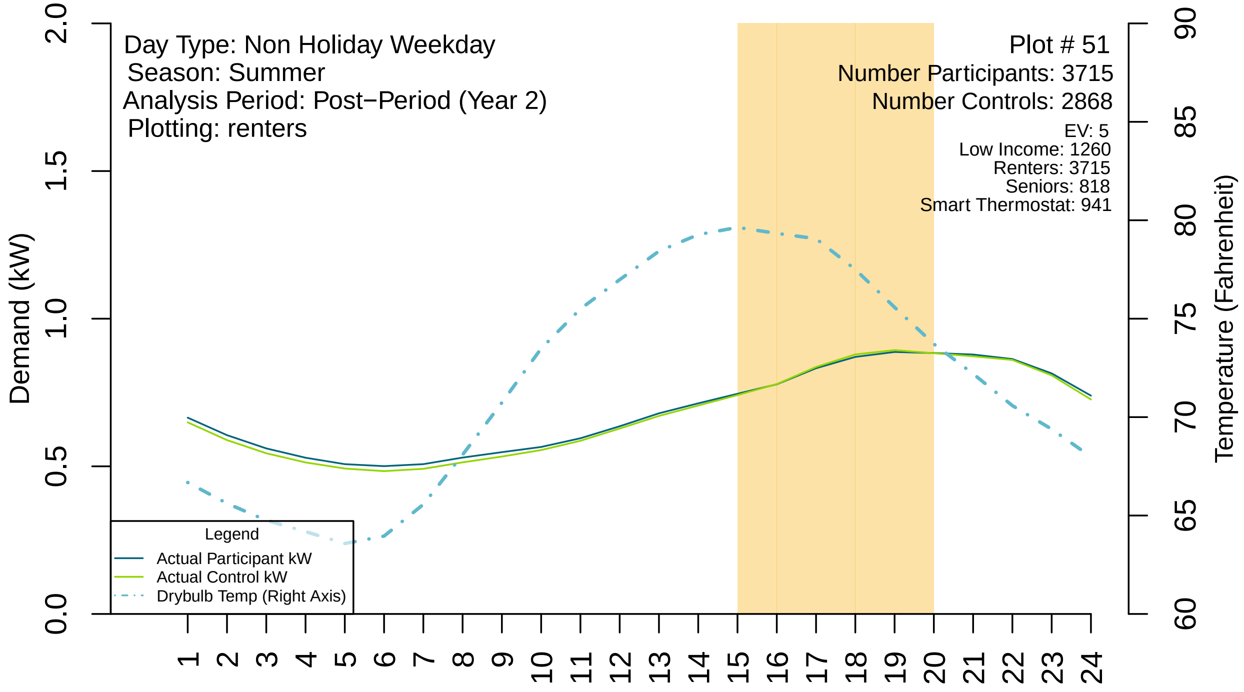

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Pre−Period
Plotting: lowincome
Plot # 46
Number Participants: 1839
Number Controls: 1454
EV: 4
Low Income: 1839
Renters: 1260
Seniors: 462
Smart Thermostat: 398
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

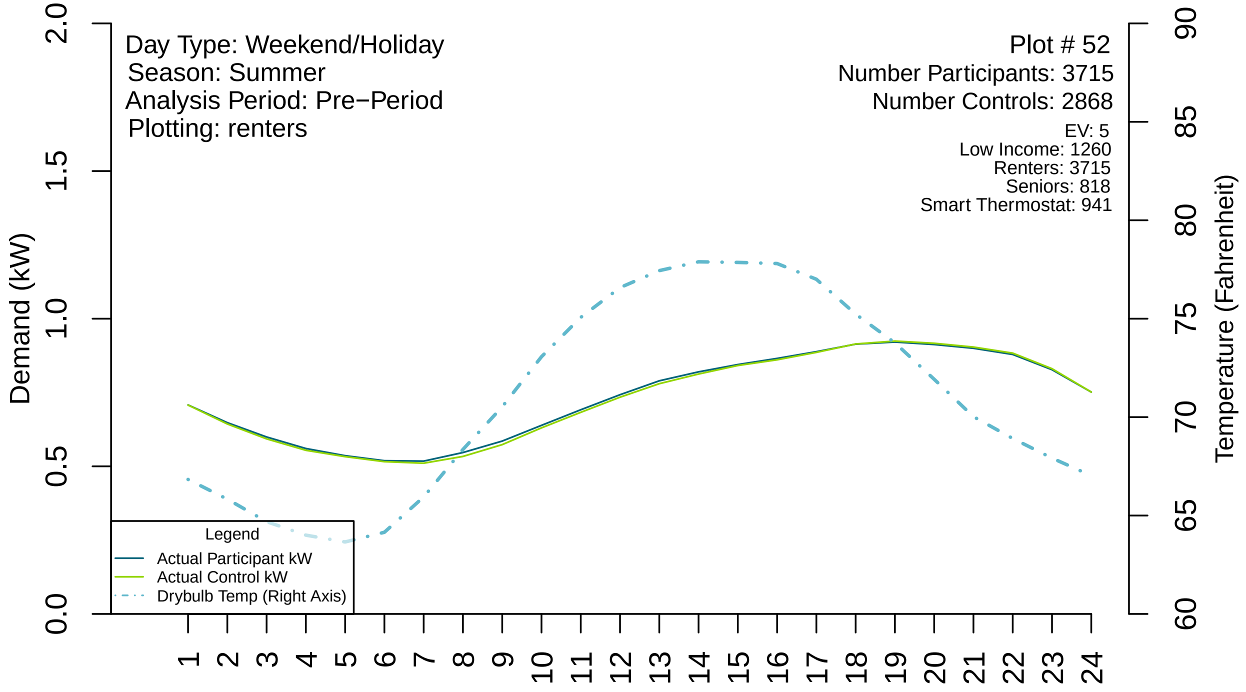

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: lowincome
Plot # 47
Number Participants: 1839
Number Controls: 1454
EV: 4
Low Income: 1839
Renters: 1260
Seniors: 462
Smart Thermostat: 398
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

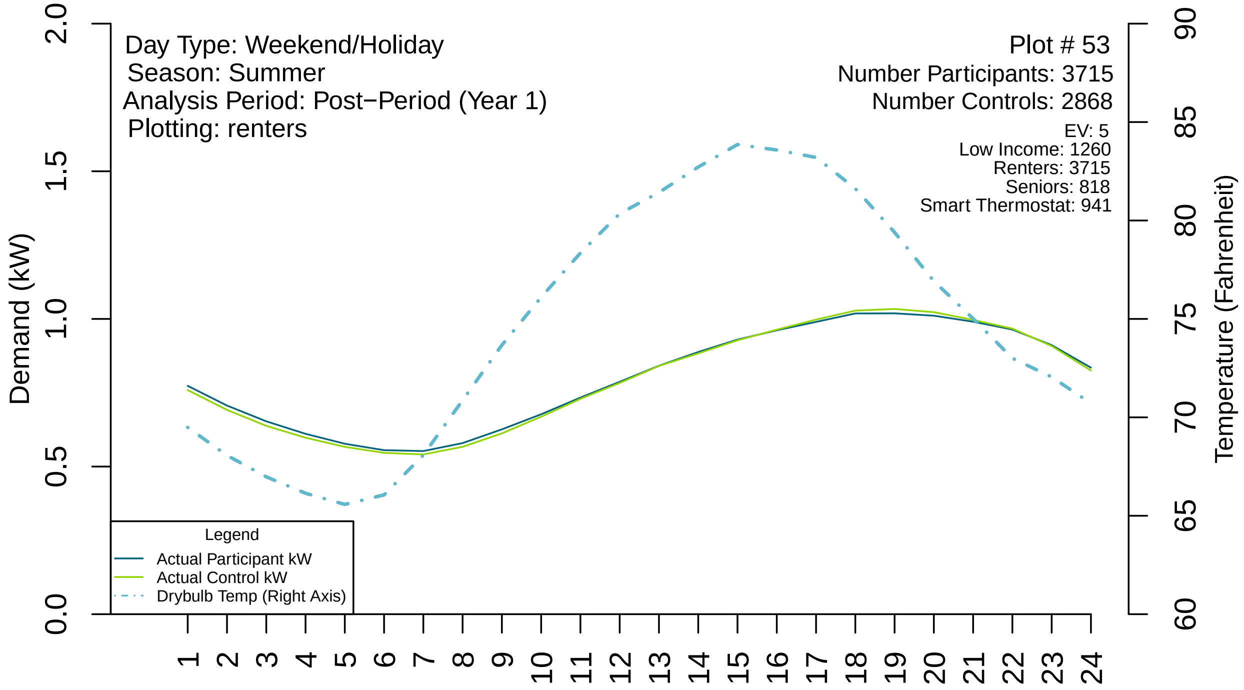

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: lowincome
Plot # 48
Number Participants: 1839
Number Controls: 1454
EV: 4
Low Income: 1839
Renters: 1260
Seniors: 462
Smart Thermostat: 398
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

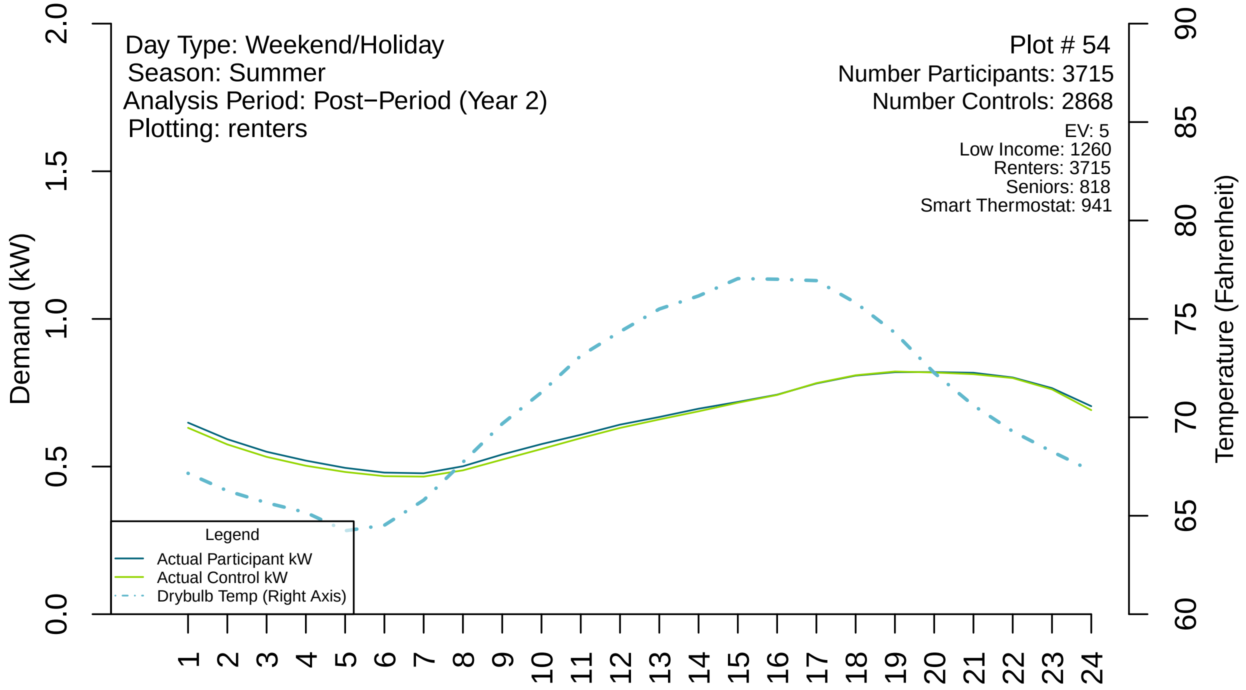

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Pre−Period
Plotting: renters
Plot # 49
Number Participants: 3715
Number Controls: 2868
EV: 5
Low Income: 1260
Renters: 3715
Seniors: 818
Smart Thermostat: 941
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

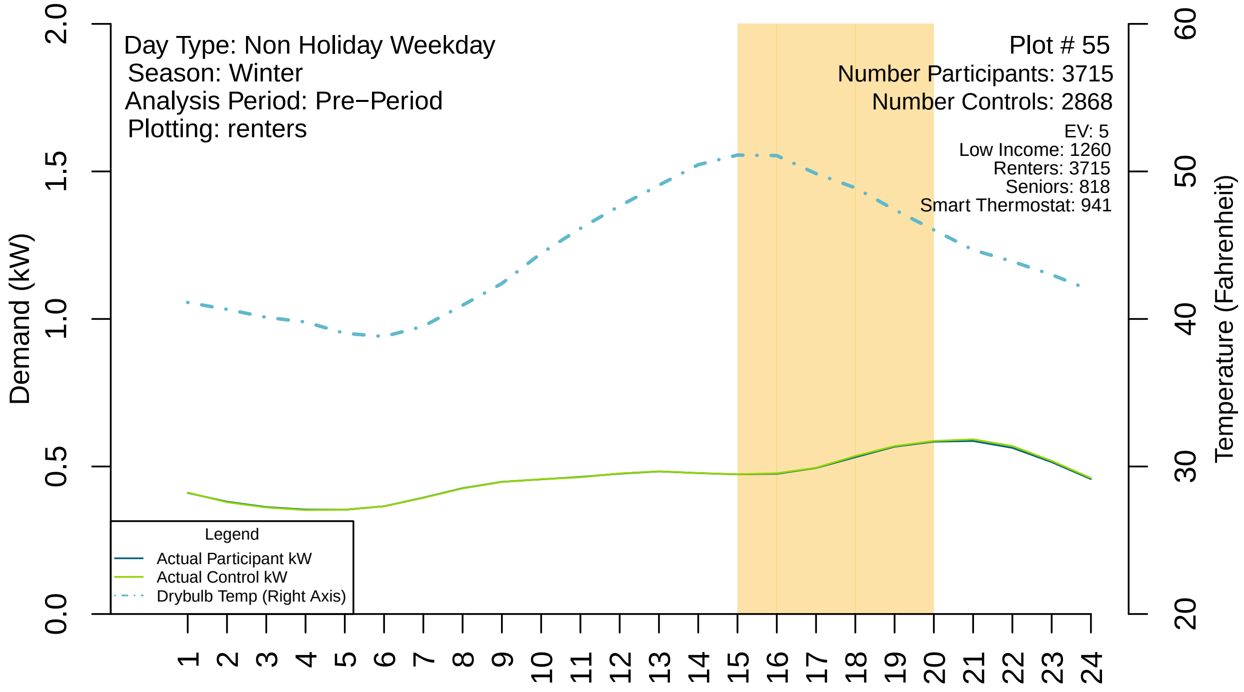

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: renters
Plot # 50
Number Participants: 3715
Number Controls: 2868
EV: 5
Low Income: 1260
Renters: 3715
Seniors: 818
Smart Thermostat: 941
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

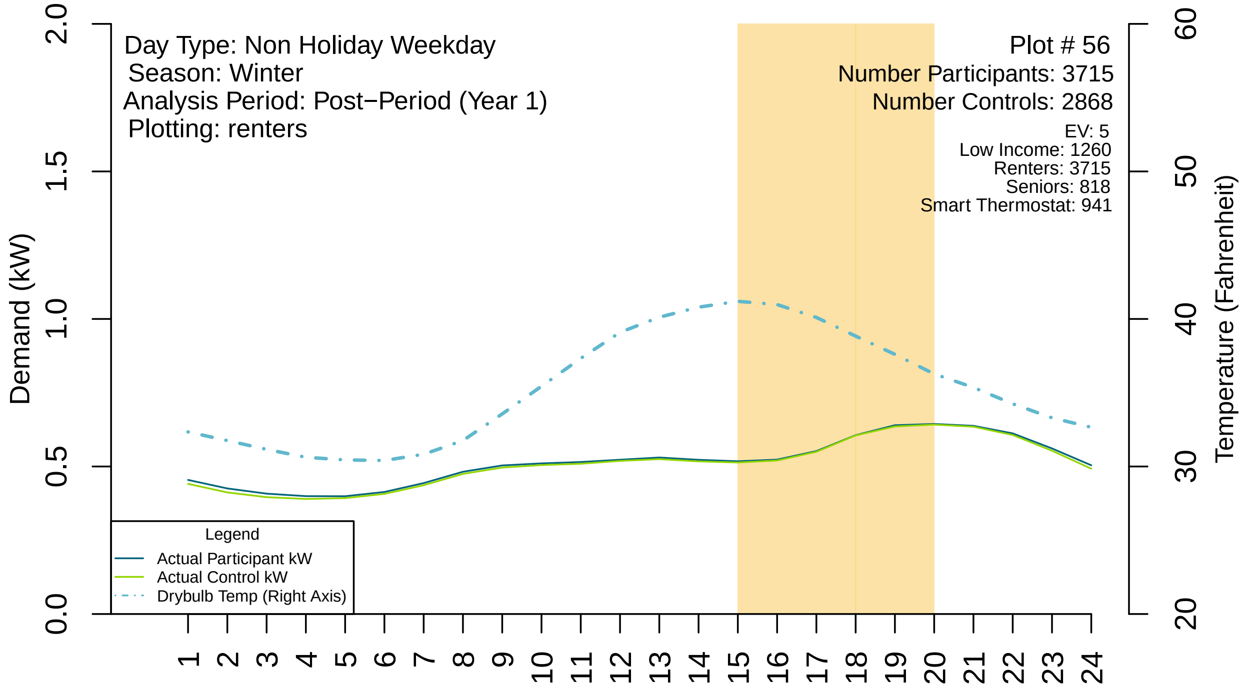

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: renters
Plot # 51
Number Participants: 3715
Number Controls: 2868
EV: 5
Low Income: 1260
Renters: 3715
Seniors: 818
Smart Thermostat: 941
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

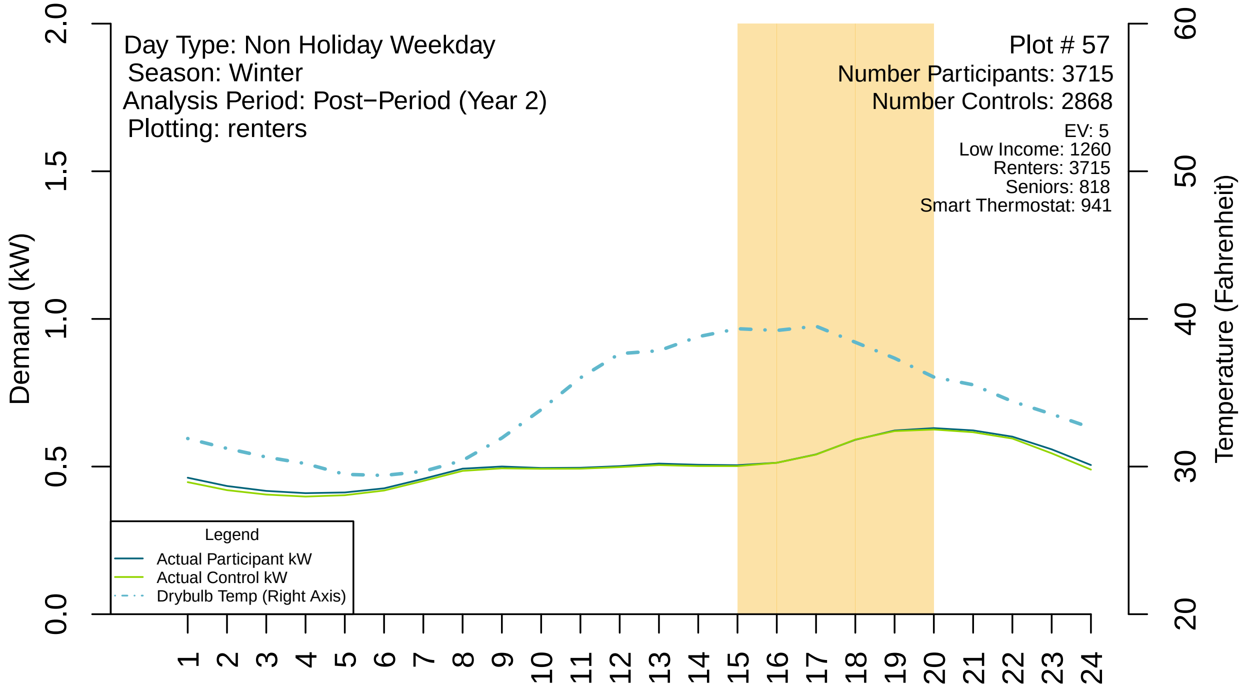

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Pre−Period
Plotting: renters
Plot # 52
Number Participants: 3715
Number Controls: 2868
EV: 5
Low Income: 1260
Renters: 3715
Seniors: 818
Smart Thermostat: 941
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

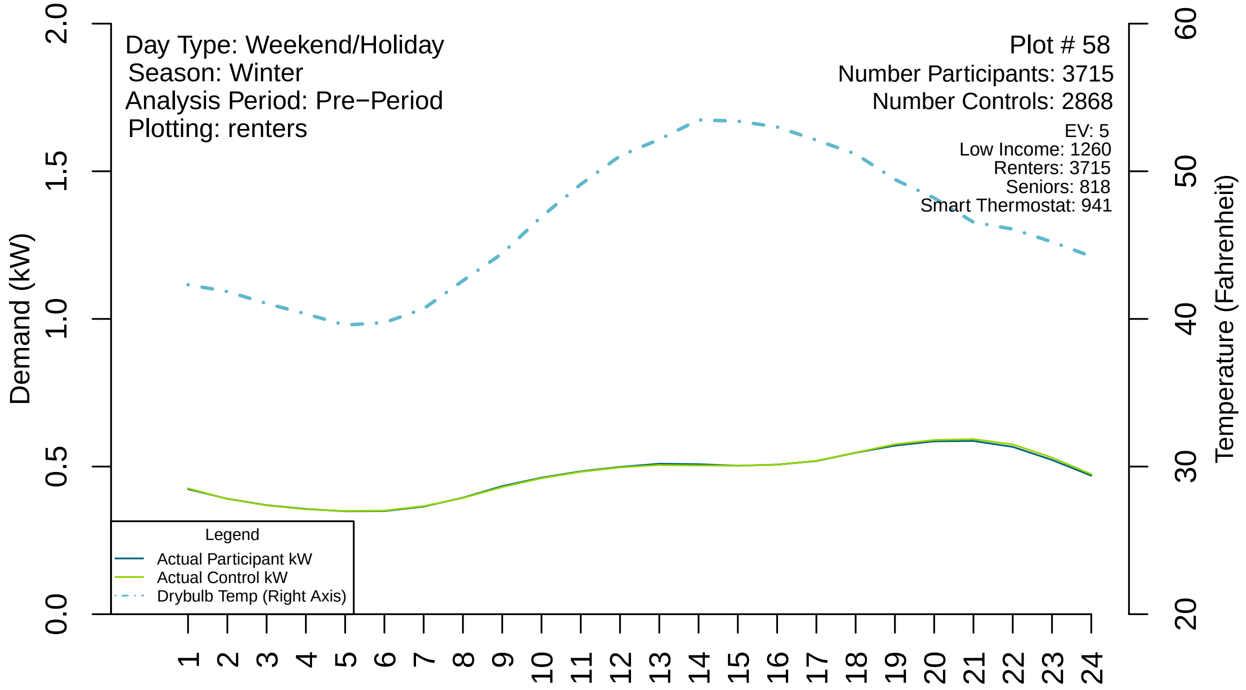

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: renters
Plot # 53
Number Participants: 3715
Number Controls: 2868
EV: 5
Low Income: 1260
Renters: 3715
Seniors: 818
Smart Thermostat: 941
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

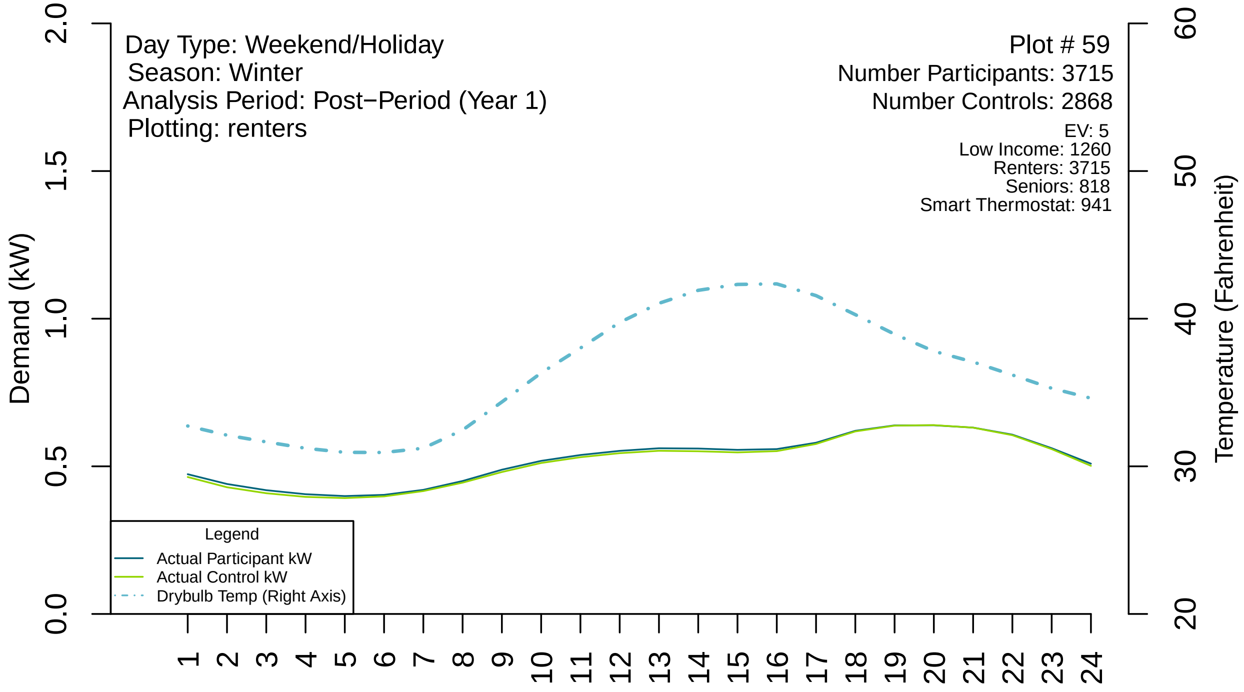

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: renters
Plot # 54
Number Participants: 3715
Number Controls: 2868
EV: 5
Low Income: 1260
Renters: 3715
Seniors: 818
Smart Thermostat: 941
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

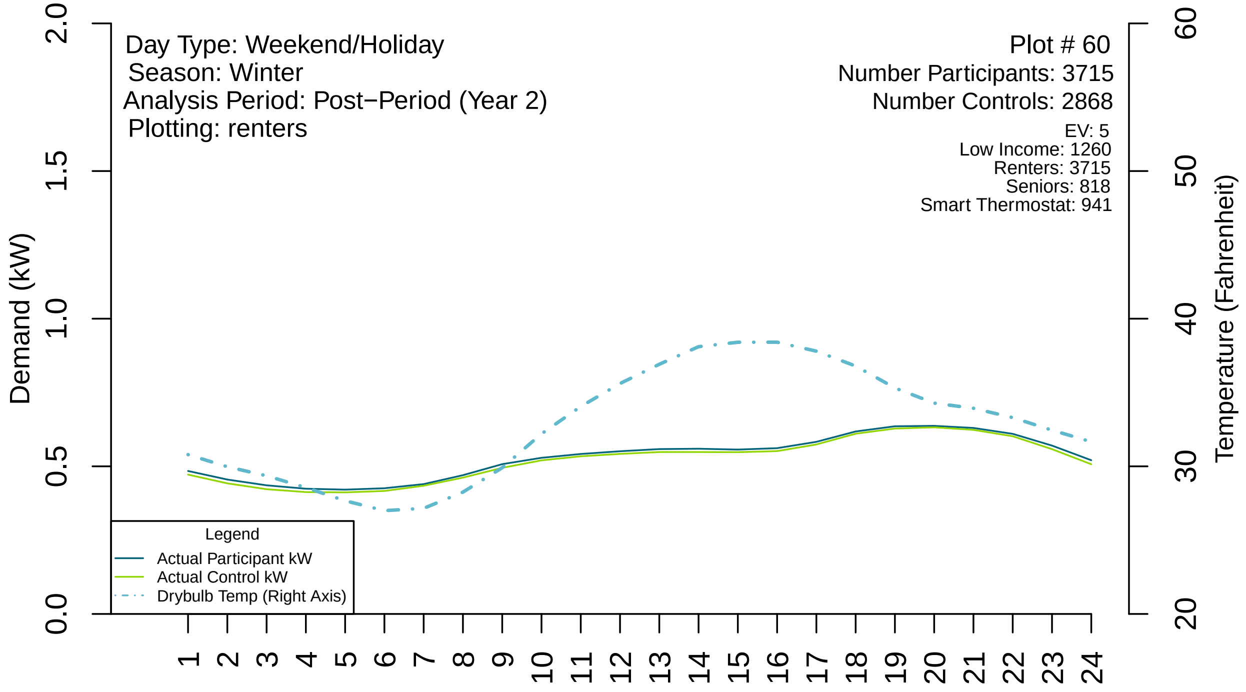

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Pre−Period
Plotting: renters
Plot # 55
Number Participants: 3715
Number Controls: 2868
EV: 5
Low Income: 1260
Renters: 3715
Seniors: 818
Smart Thermostat: 941
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

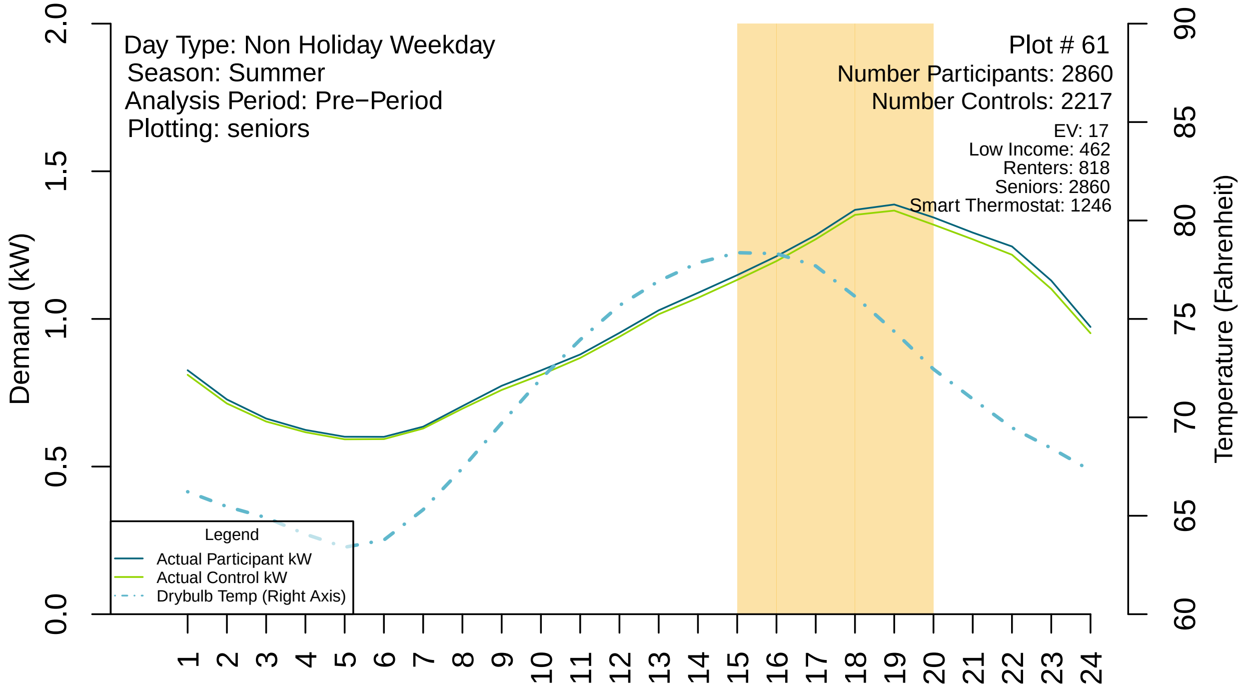

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: renters
Plot # 56
Number Participants: 3715
Number Controls: 2868
EV: 5
Low Income: 1260
Renters: 3715
Seniors: 818
Smart Thermostat: 941
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

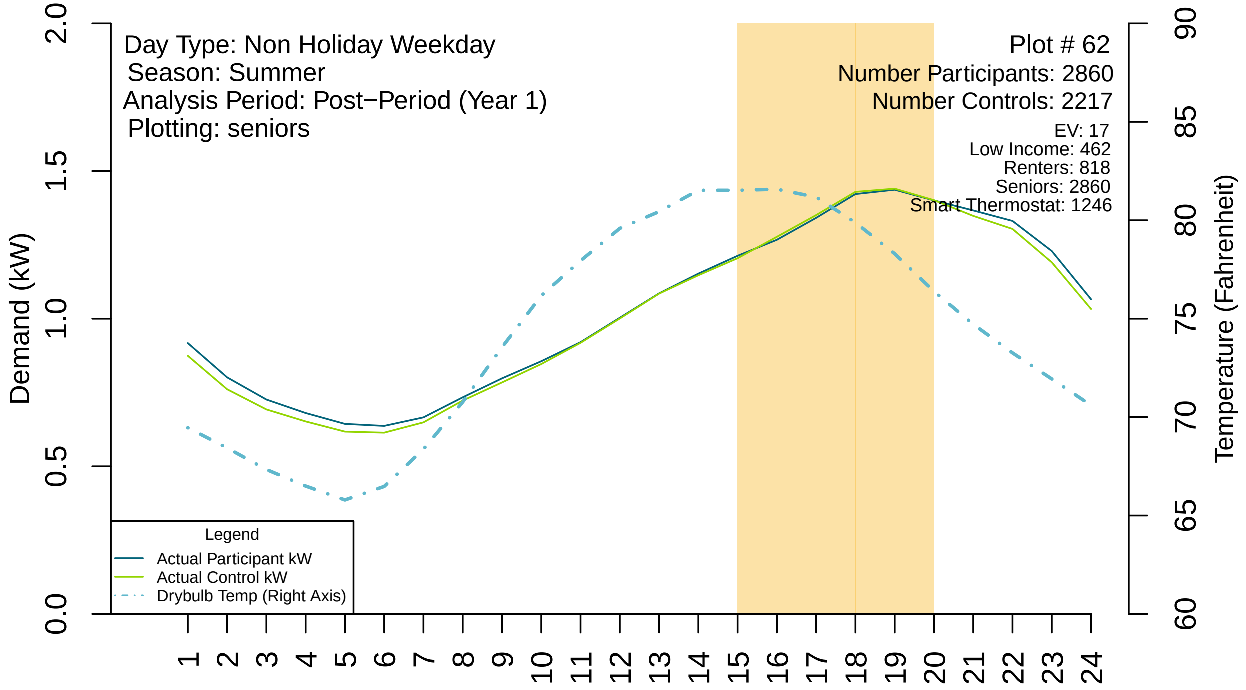

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: renters
Plot # 57
Number Participants: 3715
Number Controls: 2868
EV: 5
Low Income: 1260
Renters: 3715
Seniors: 818
Smart Thermostat: 941
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

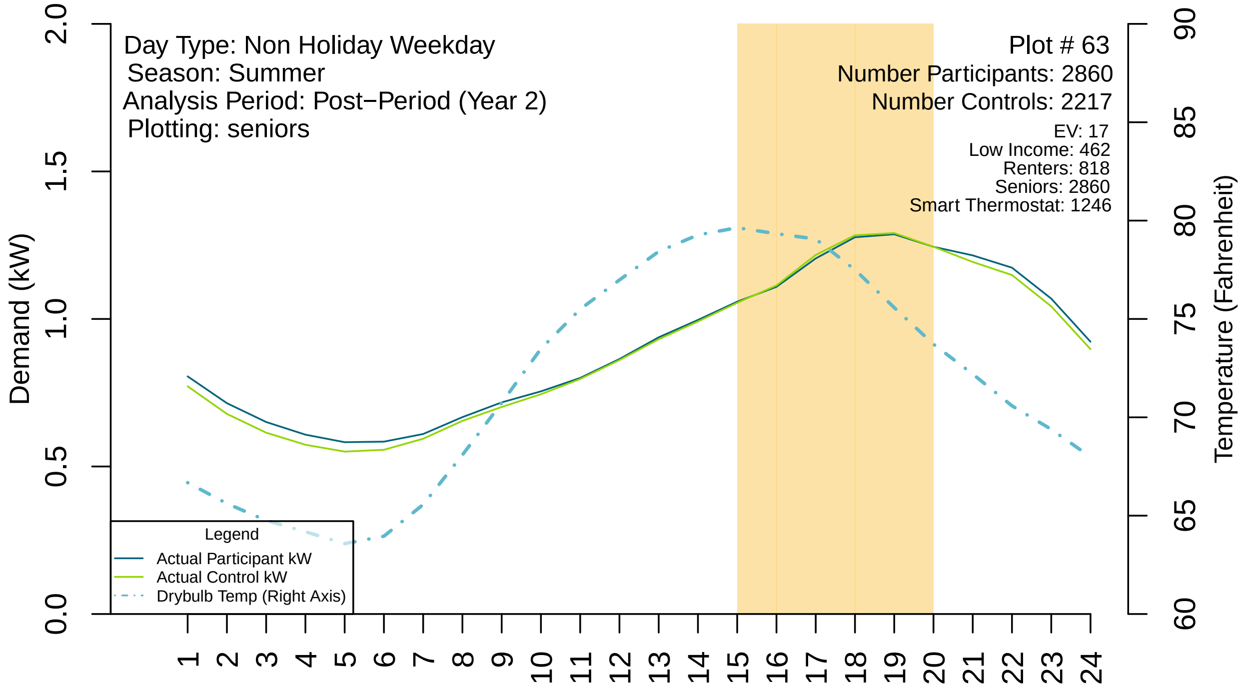

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Pre−Period
Plotting: renters
Plot # 58
Number Participants: 3715
Number Controls: 2868
EV: 5
Low Income: 1260
Renters: 3715
Seniors: 818
Smart Thermostat: 941
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

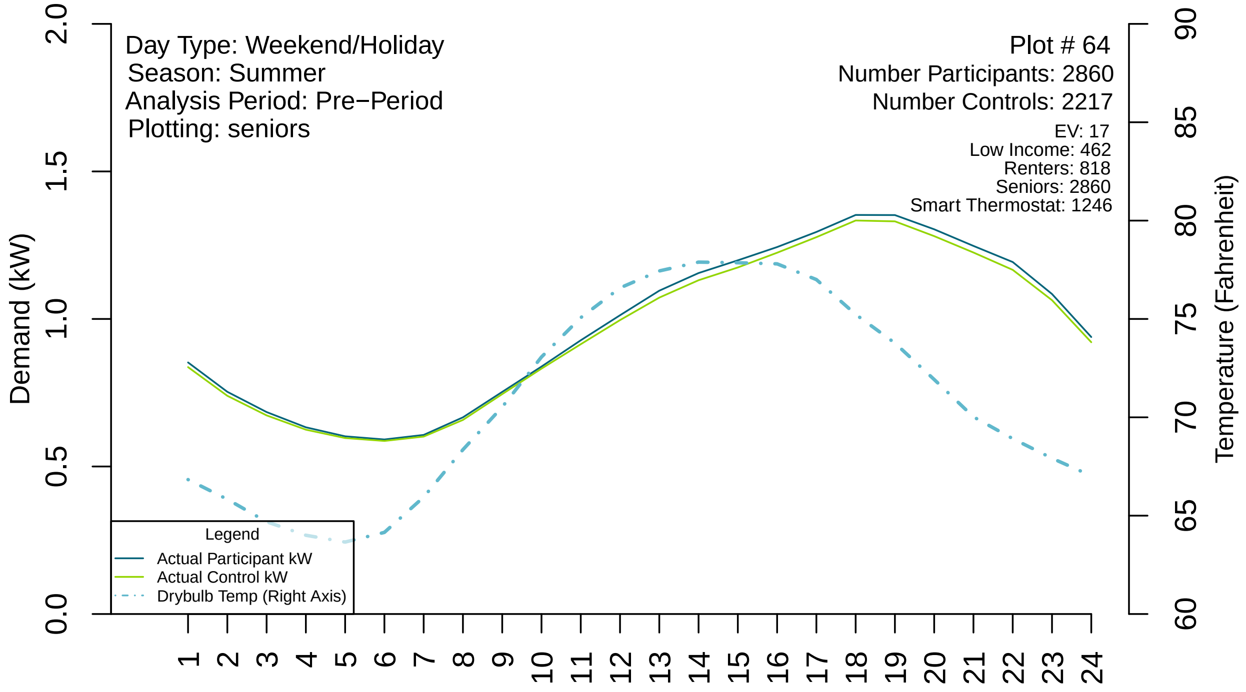

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: renters
Plot # 59
Number Participants: 3715
Number Controls: 2868
EV: 5
Low Income: 1260
Renters: 3715
Seniors: 818
Smart Thermostat: 941
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

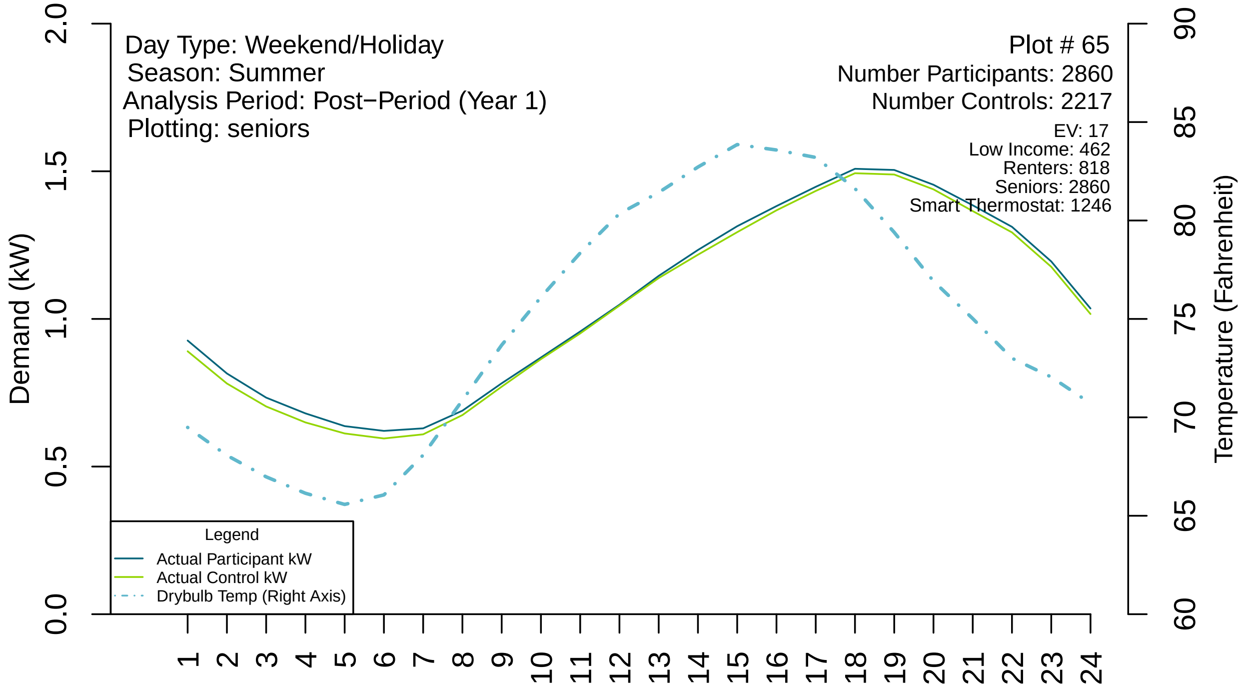

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: renters
Plot # 60
Number Participants: 3715
Number Controls: 2868
EV: 5
Low Income: 1260
Renters: 3715
Seniors: 818
Smart Thermostat: 941
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

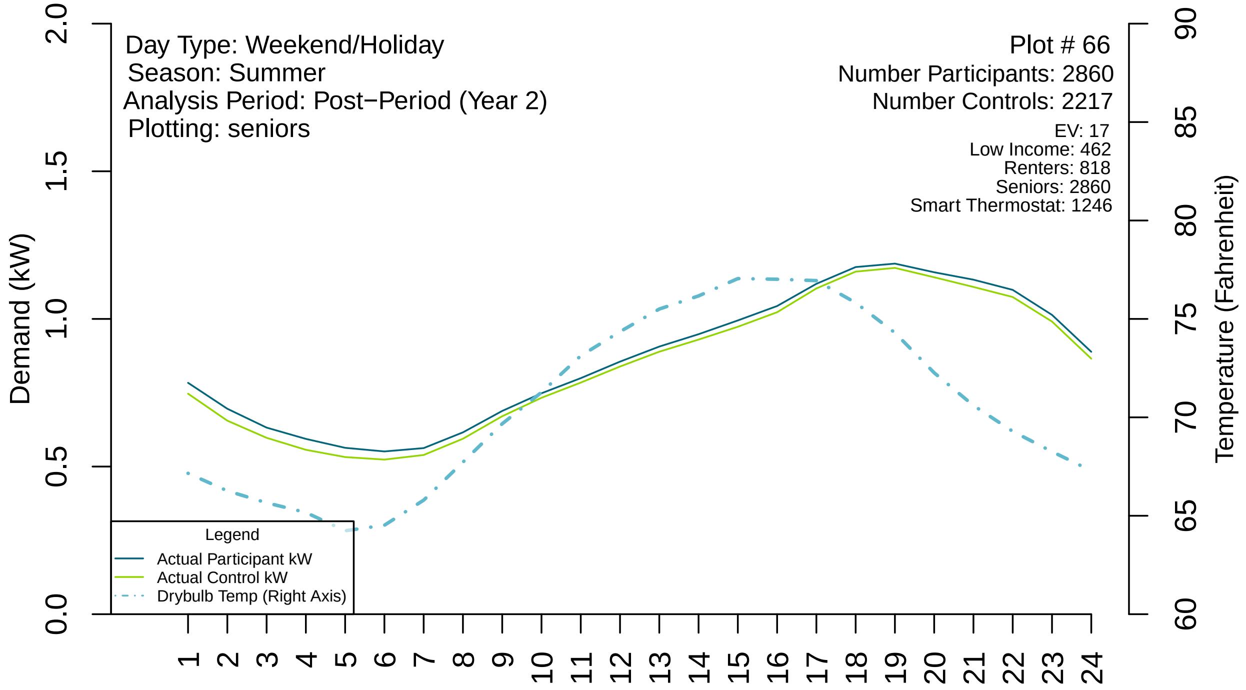

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Pre−Period
Plotting: seniors
Plot # 61
Number Participants: 2860
Number Controls: 2217
EV: 17
Low Income: 462
Renters: 818
Seniors: 2860
Smart Thermostat: 1246
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

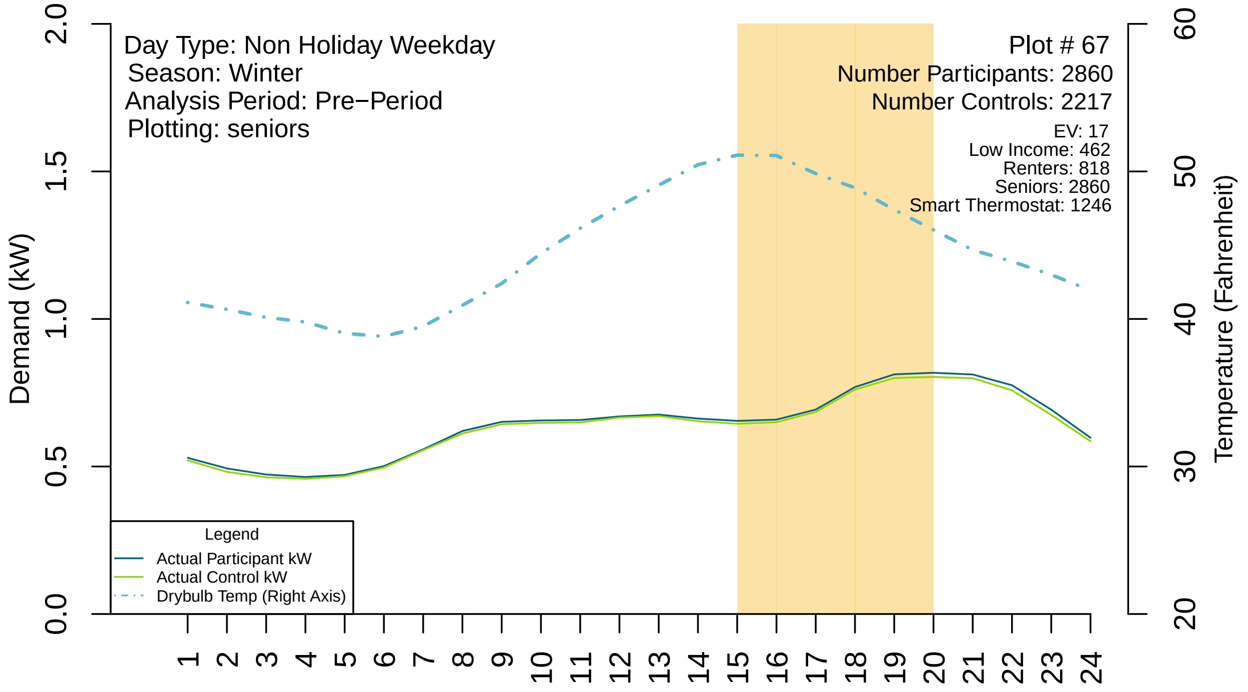

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: seniors
Plot # 62
Number Participants: 2860
Number Controls: 2217
EV: 17
Low Income: 462
Renters: 818
Seniors: 2860
Smart Thermostat: 1246
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

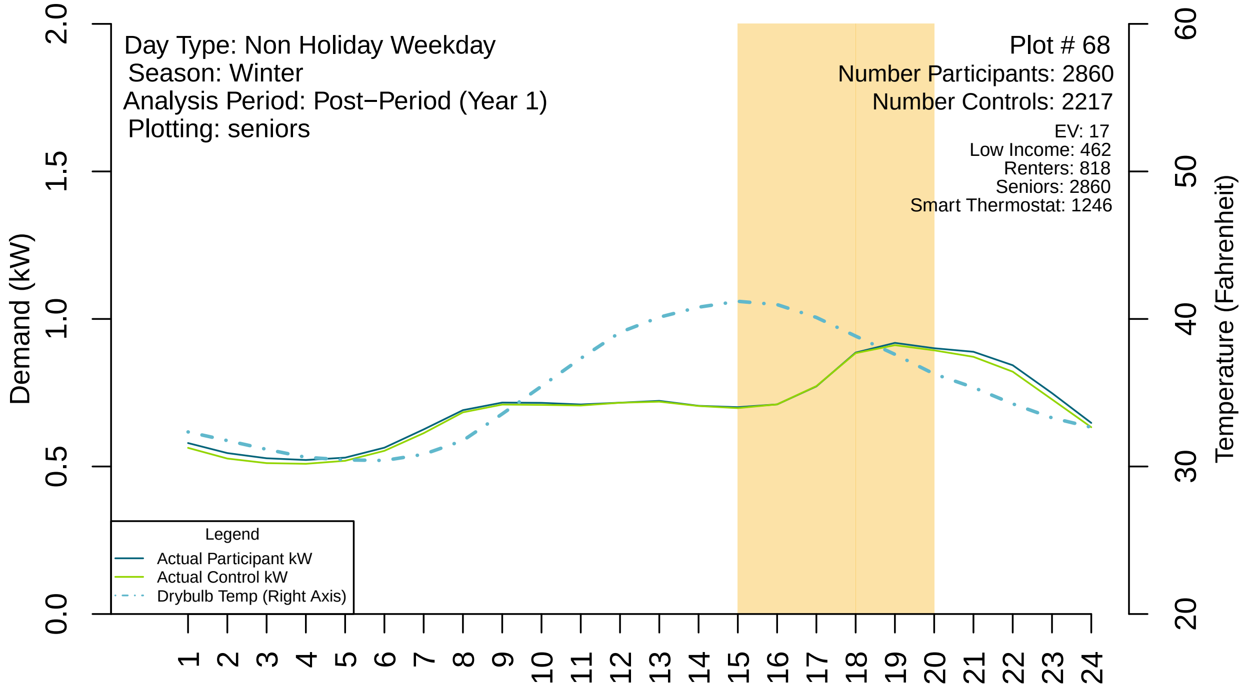

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: seniors
Plot # 63
Number Participants: 2860
Number Controls: 2217
EV: 17
Low Income: 462
Renters: 818
Seniors: 2860
Smart Thermostat: 1246
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

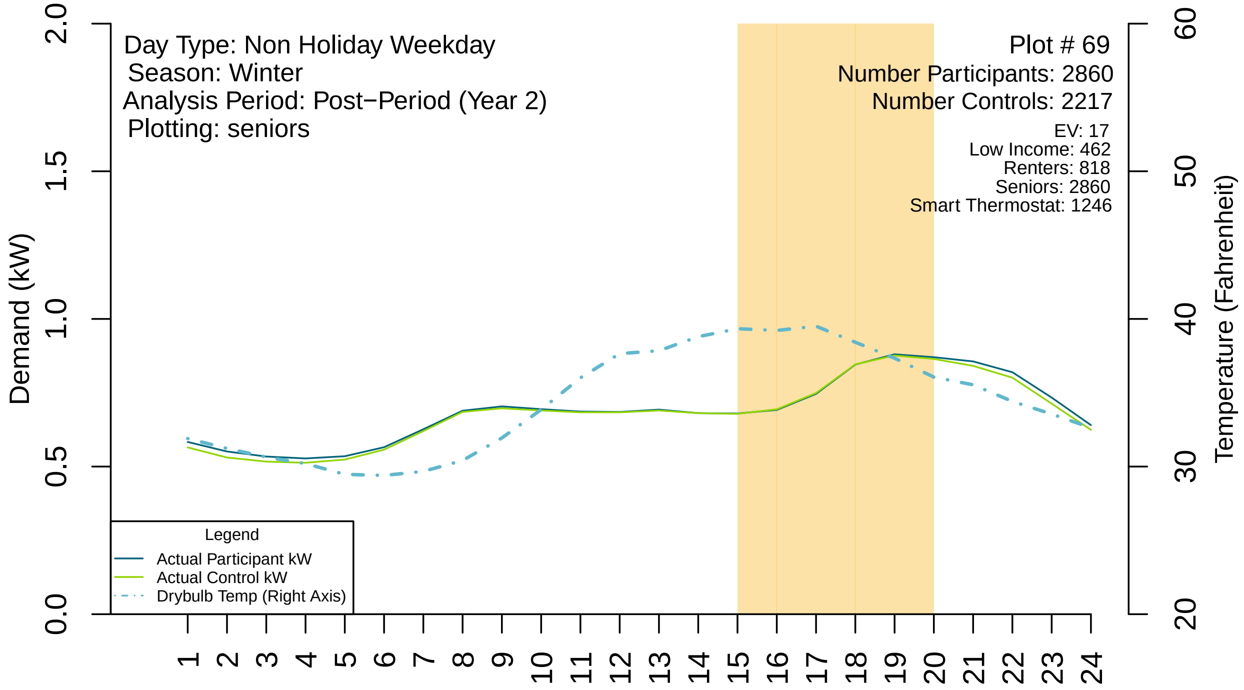

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Pre−Period
Plotting: seniors
Plot # 64
Number Participants: 2860
Number Controls: 2217
EV: 17
Low Income: 462
Renters: 818
Seniors: 2860
Smart Thermostat: 1246
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

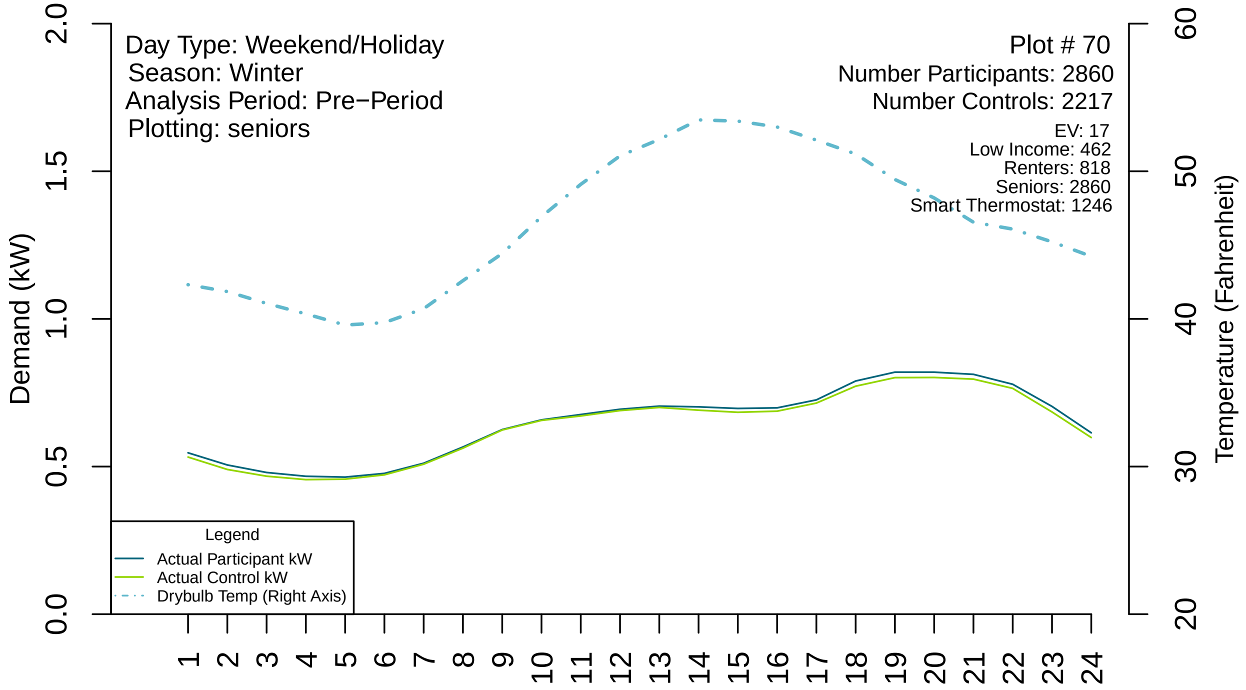

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: seniors
Plot # 65
Number Participants: 2860
Number Controls: 2217
EV: 17
Low Income: 462
Renters: 818
Seniors: 2860
Smart Thermostat: 1246
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

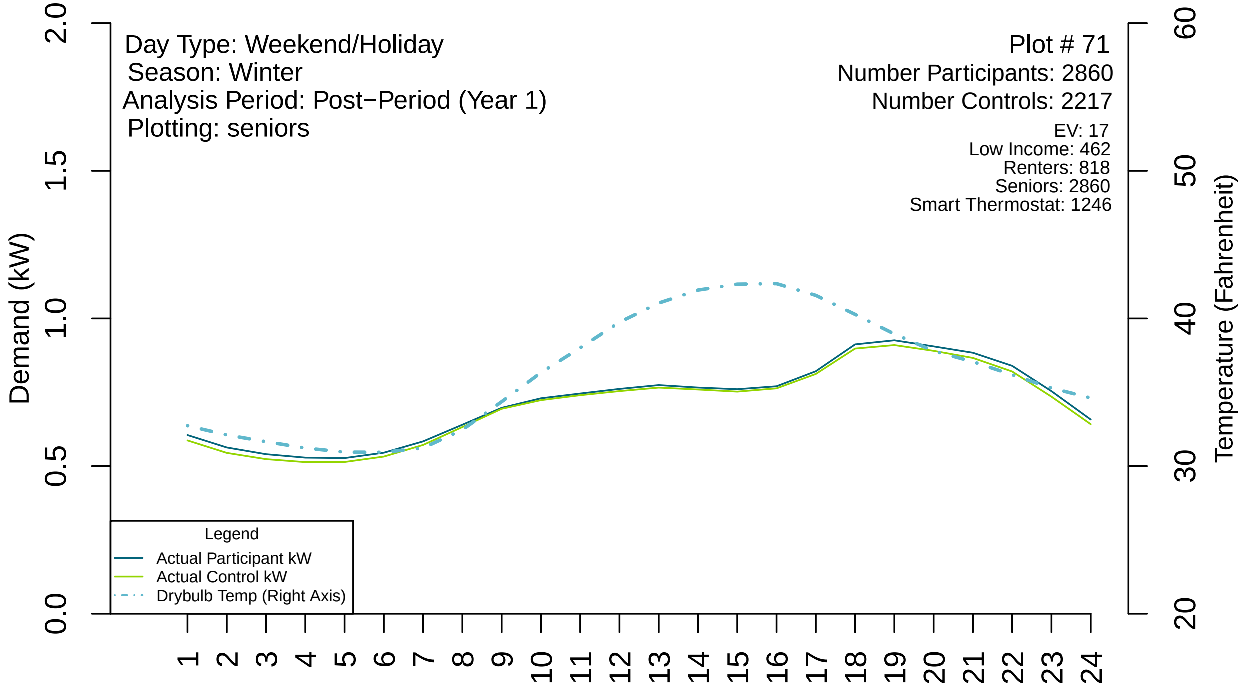

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: seniors
Plot # 66
Number Participants: 2860
Number Controls: 2217
EV: 17
Low Income: 462
Renters: 818
Seniors: 2860
Smart Thermostat: 1246
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

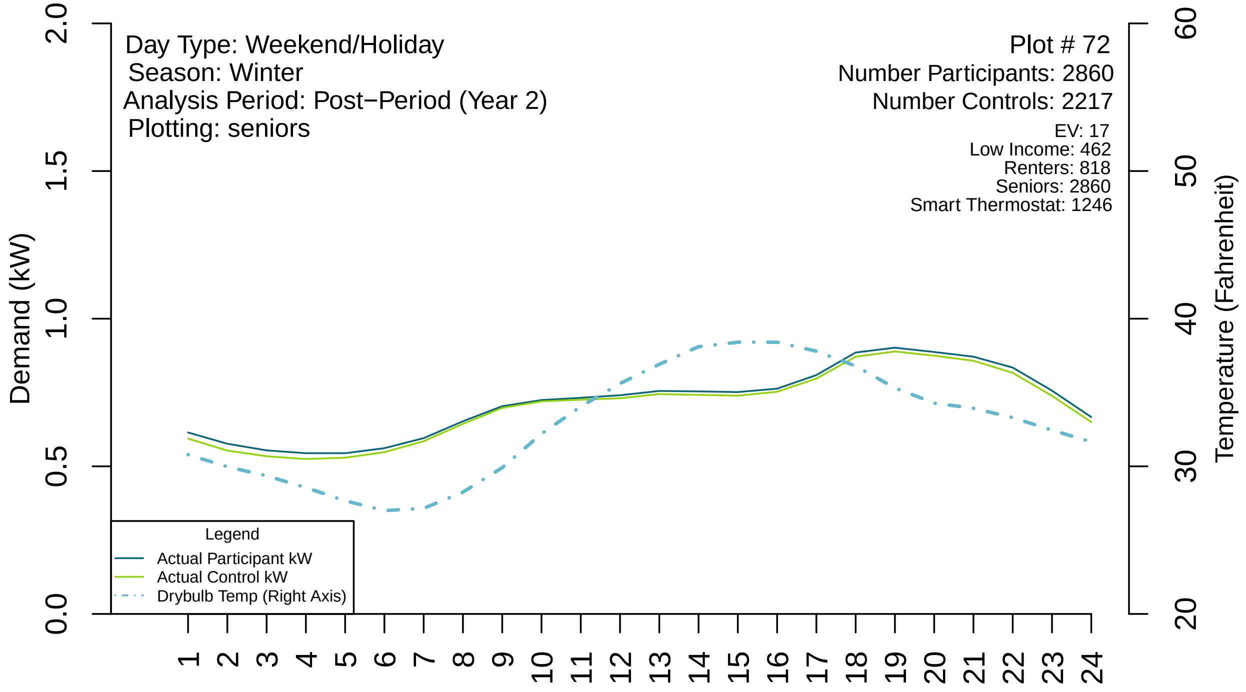

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Pre−Period
Plotting: seniors
Plot # 67
Number Participants: 2860
Number Controls: 2217
EV: 17
Low Income: 462
Renters: 818
Seniors: 2860
Smart Thermostat: 1246
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

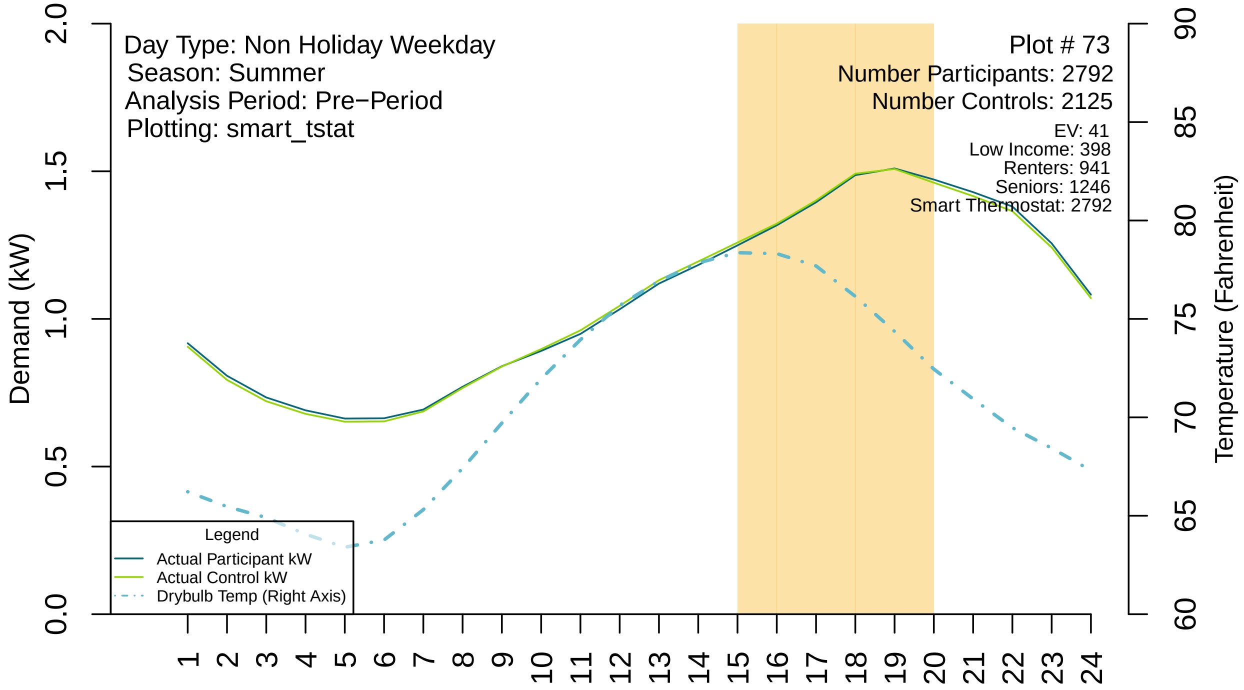

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: seniors
Plot # 68
Number Participants: 2860
Number Controls: 2217
EV: 17
Low Income: 462
Renters: 818
Seniors: 2860
Smart Thermostat: 1246
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

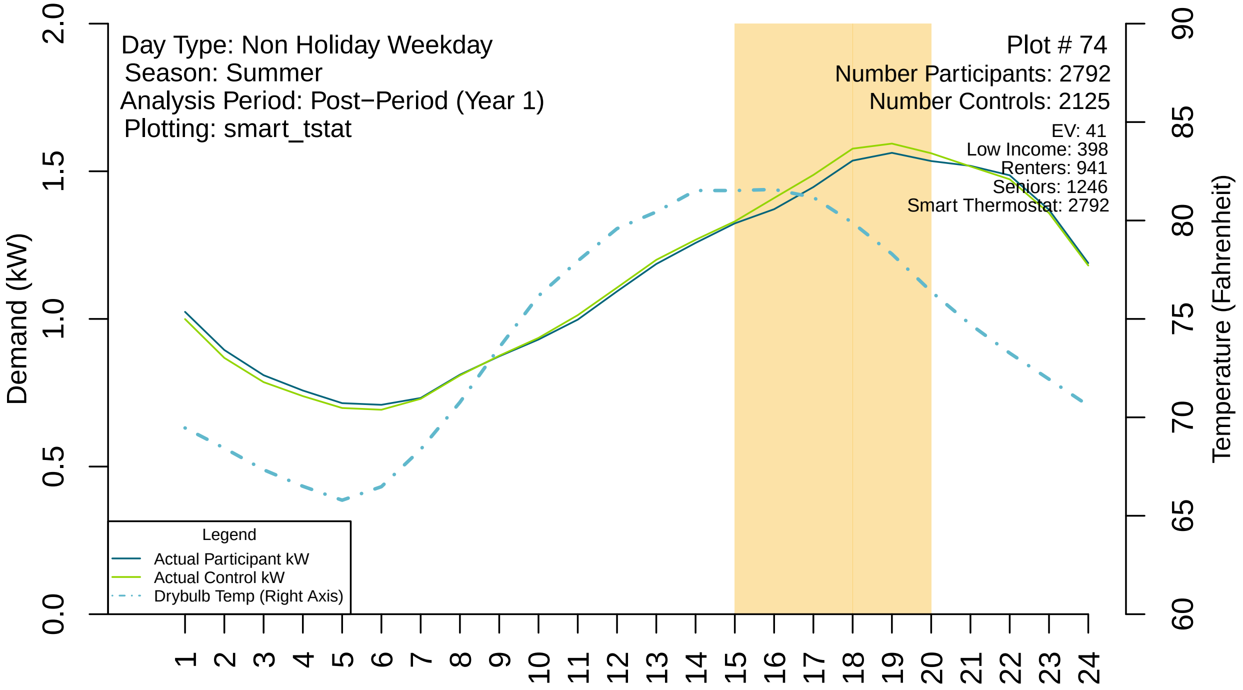

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: seniors
Plot # 69
Number Participants: 2860
Number Controls: 2217
EV: 17
Low Income: 462
Renters: 818
Seniors: 2860
Smart Thermostat: 1246
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

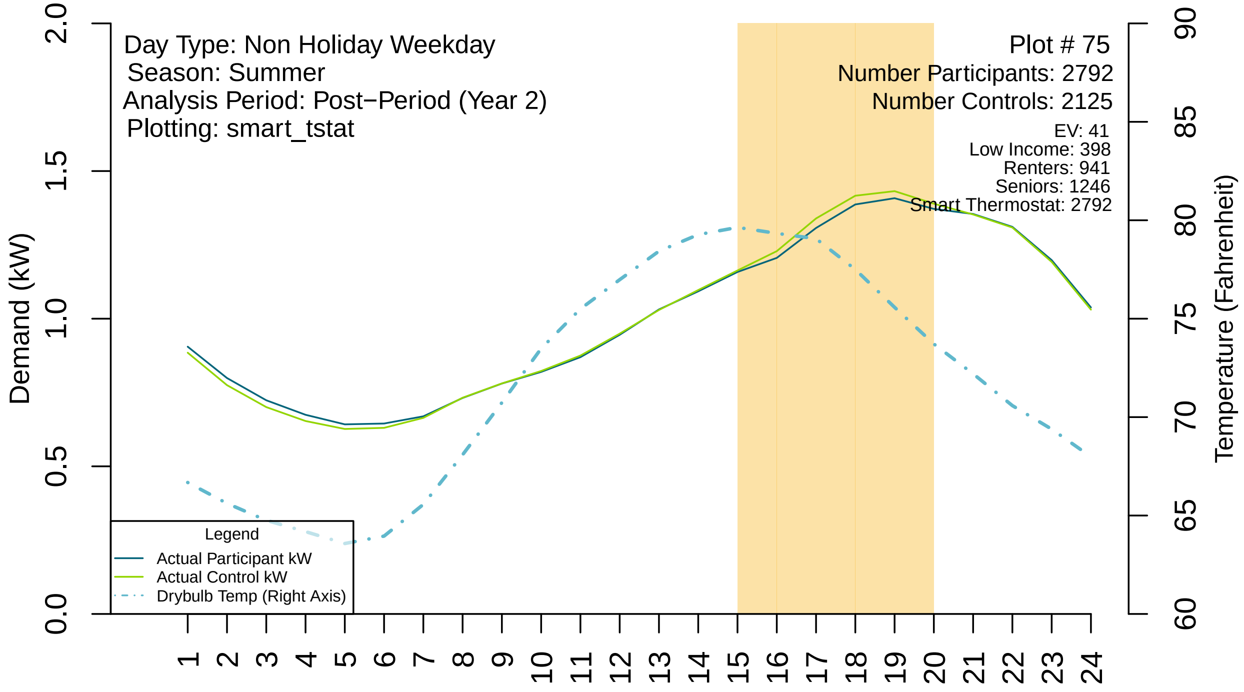

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Pre−Period
Plotting: seniors
Plot # 70
Number Participants: 2860
Number Controls: 2217
EV: 17
Low Income: 462
Renters: 818
Seniors: 2860
Smart Thermostat: 1246
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

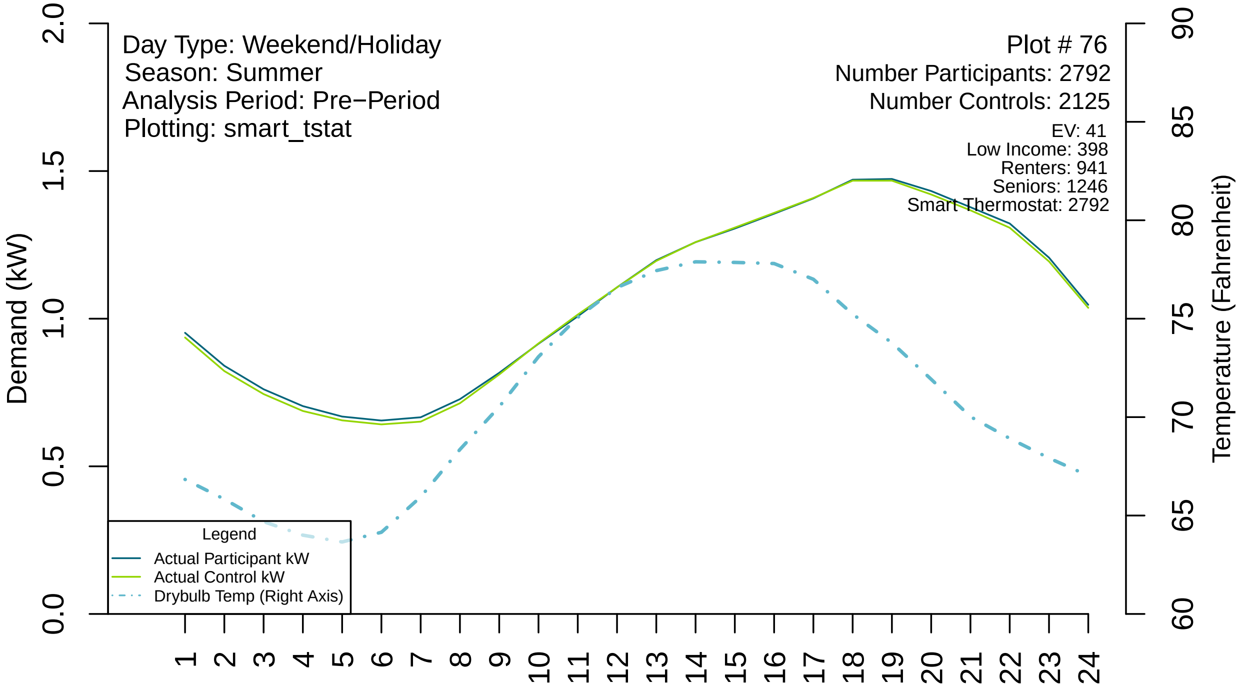

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: seniors
Plot # 71
Number Participants: 2860
Number Controls: 2217
EV: 17
Low Income: 462
Renters: 818
Seniors: 2860
Smart Thermostat: 1246
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

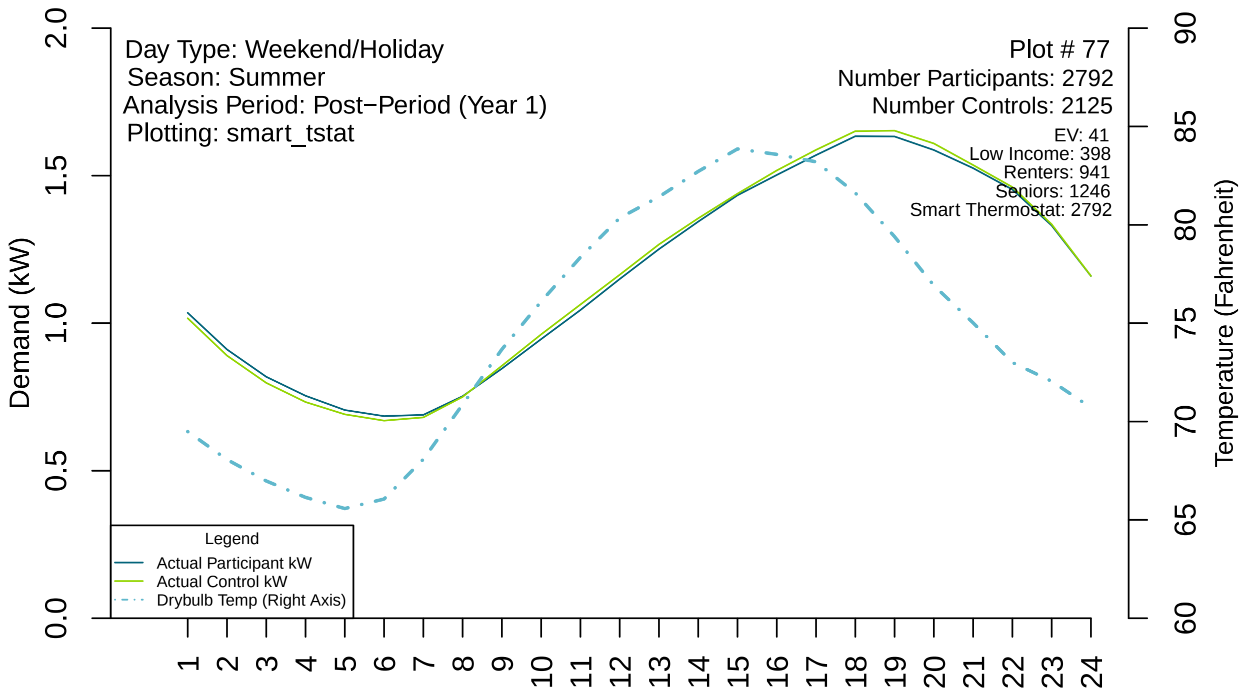

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: seniors
Plot # 72
Number Participants: 2860
Number Controls: 2217
EV: 17
Low Income: 462
Renters: 818
Seniors: 2860
Smart Thermostat: 1246
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

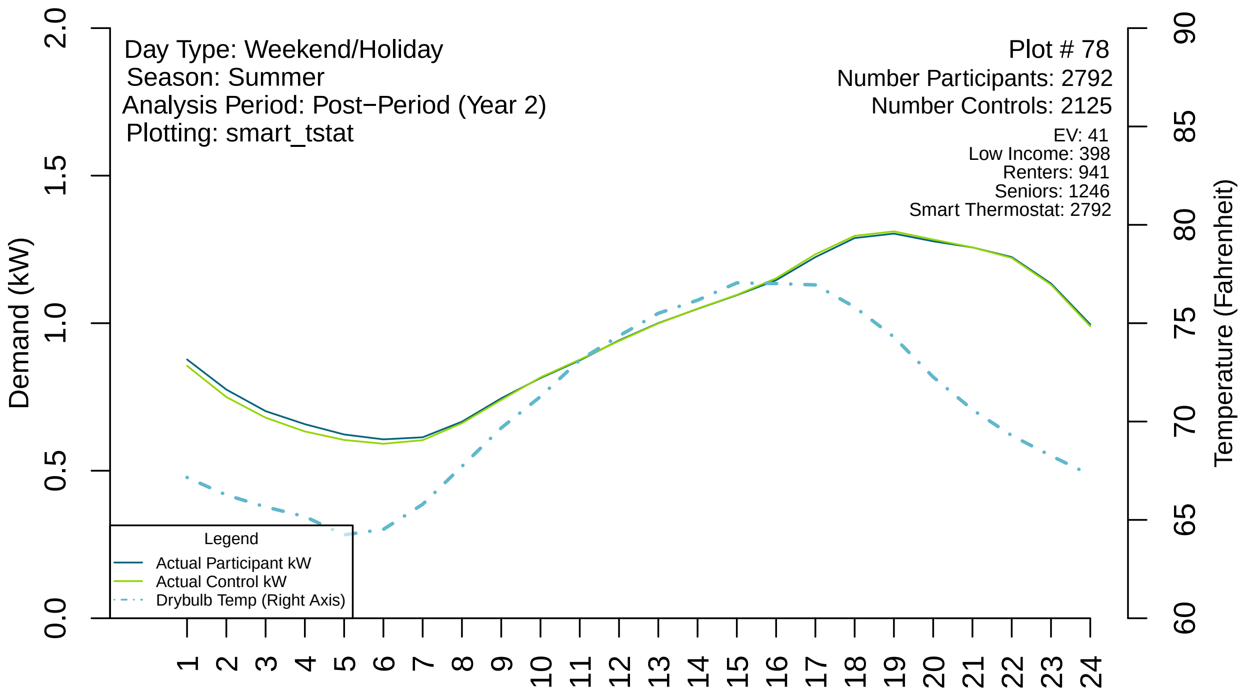

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Pre−Period
Plotting: smart_tstat
Plot # 73
Number Participants: 2792
Number Controls: 2125
EV: 41
Low Income: 398
Renters: 941
Seniors: 1246
Smart Thermostat: 2792
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

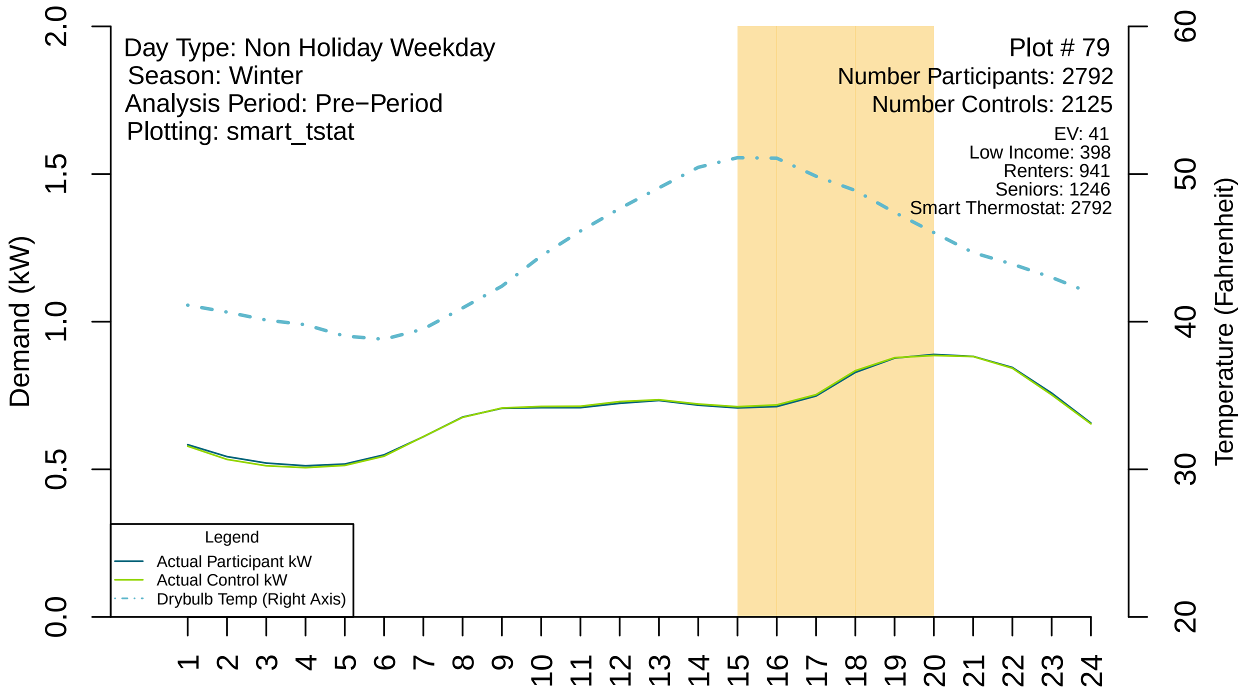

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: smart_tstat
Plot # 74
Number Participants: 2792
Number Controls: 2125
EV: 41
Low Income: 398
Renters: 941
Seniors: 1246
Smart Thermostat: 2792
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

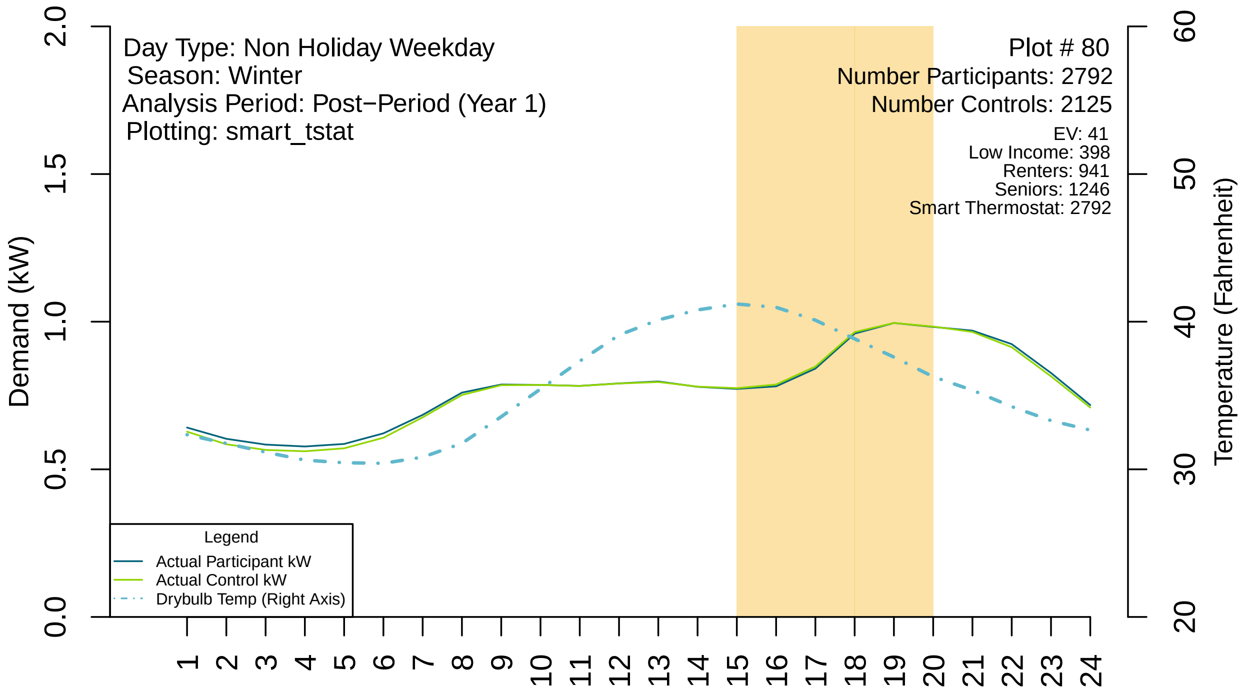

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: smart_tstat
Plot # 75
Number Participants: 2792
Number Controls: 2125
EV: 41
Low Income: 398
Renters: 941
Seniors: 1246
Smart Thermostat: 2792
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

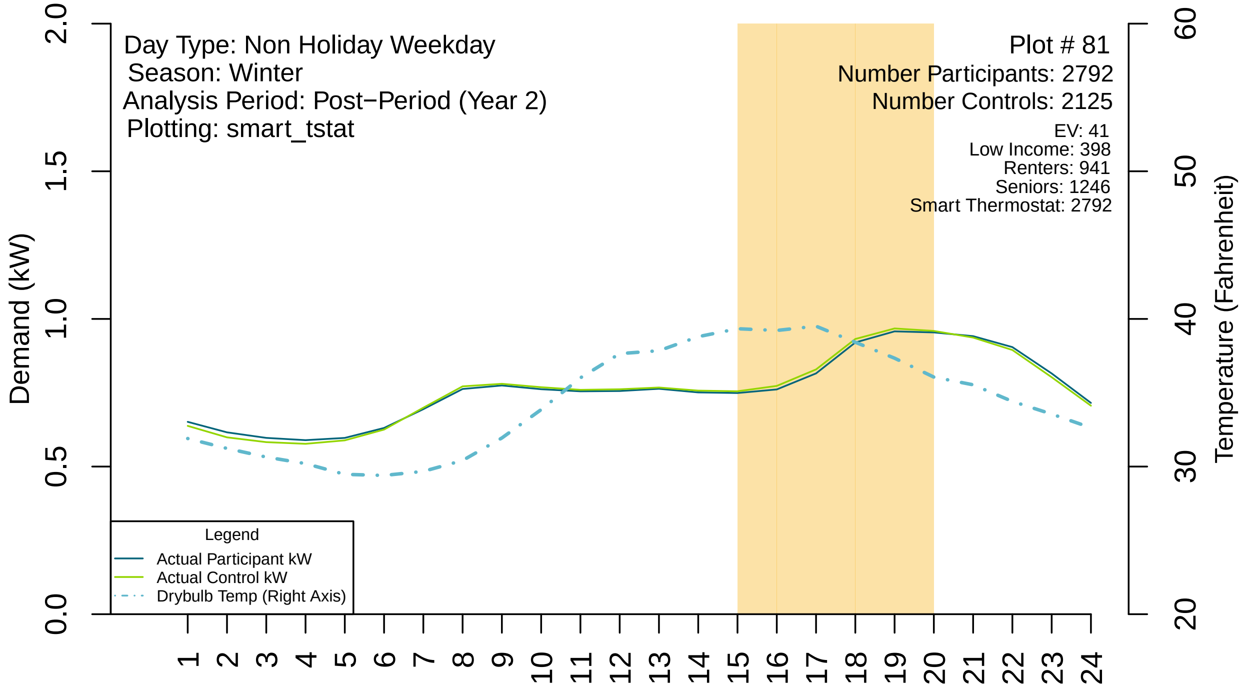

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Pre−Period
Plotting: smart_tstat
Plot # 76
Number Participants: 2792
Number Controls: 2125
EV: 41
Low Income: 398
Renters: 941
Seniors: 1246
Smart Thermostat: 2792
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

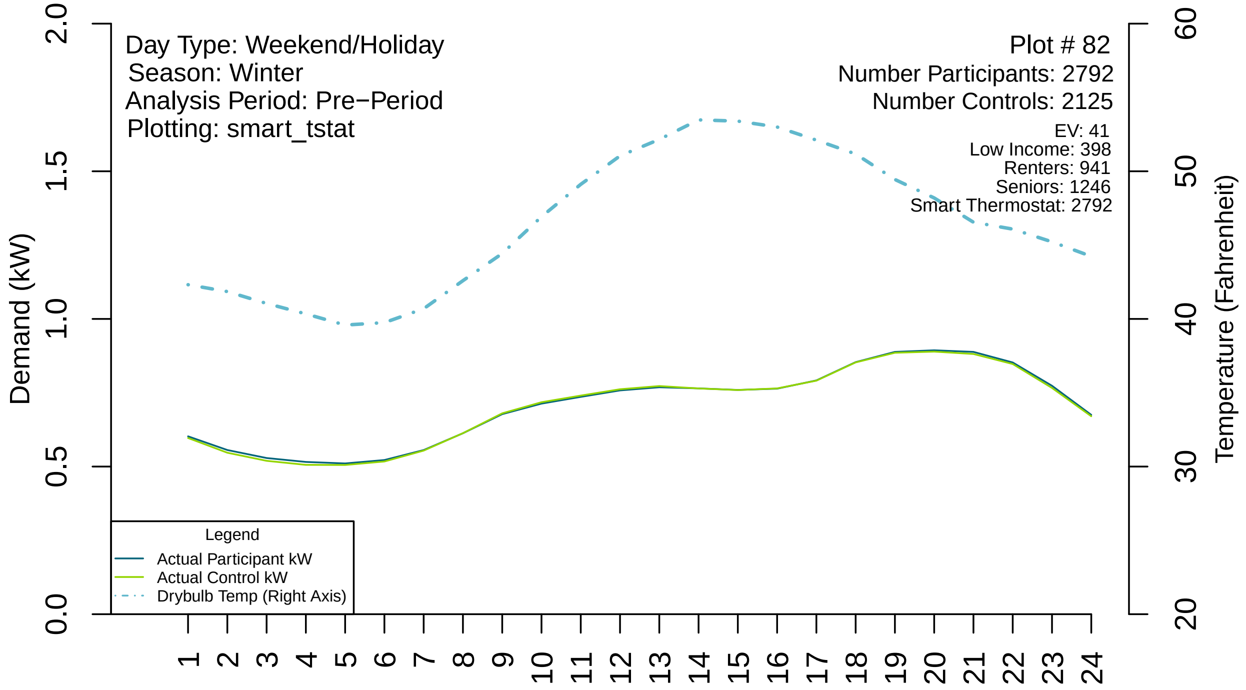

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: smart_tstat
Plot # 77
Number Participants: 2792
Number Controls: 2125
EV: 41
Low Income: 398
Renters: 941
Seniors: 1246
Smart Thermostat: 2792
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

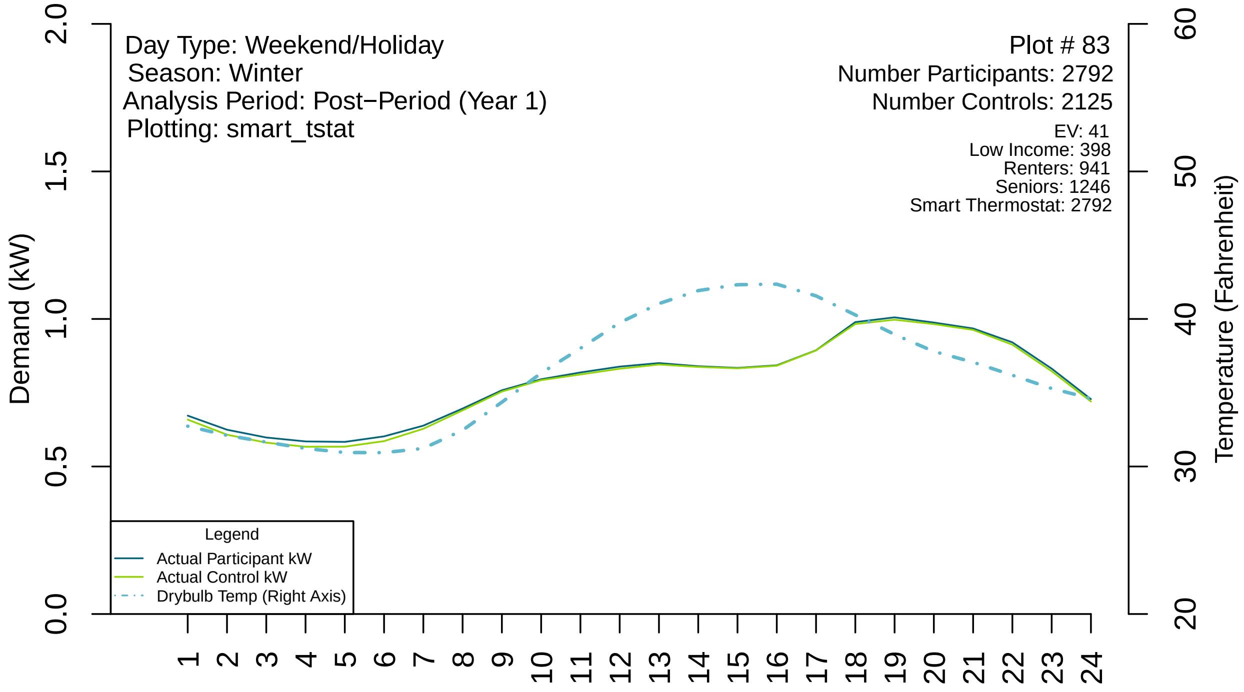

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: smart_tstat
Plot # 78
Number Participants: 2792
Number Controls: 2125
EV: 41
Low Income: 398
Renters: 941
Seniors: 1246
Smart Thermostat: 2792
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

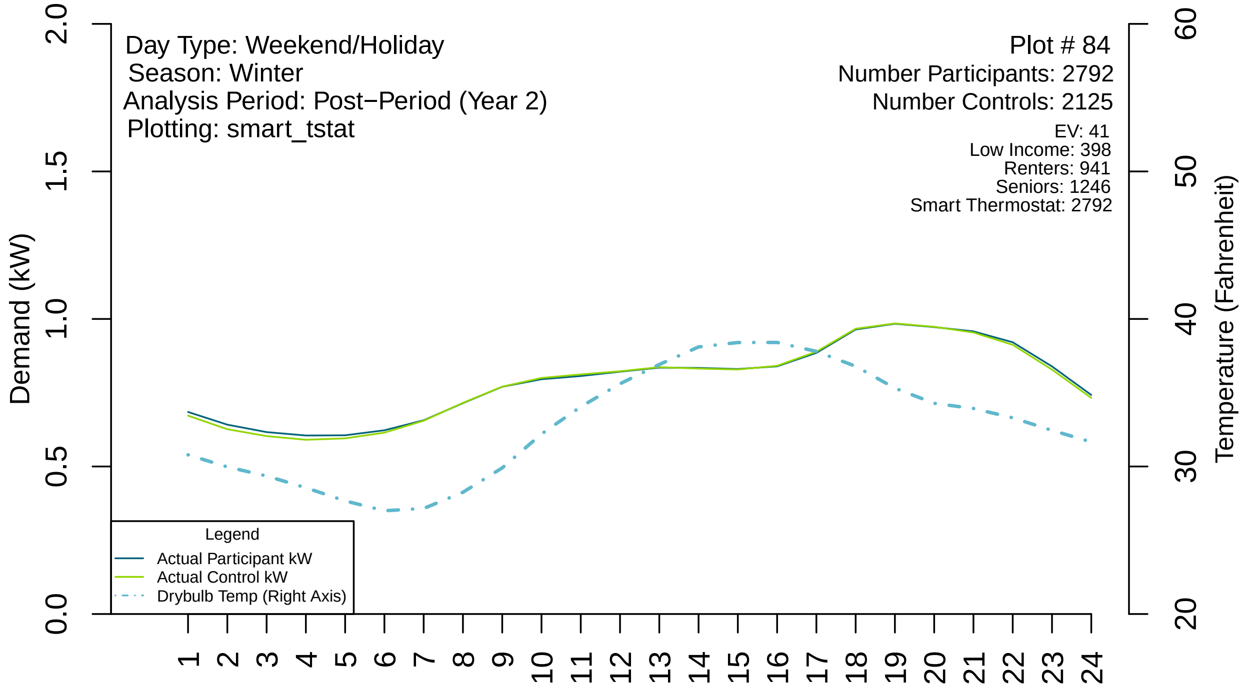

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Pre−Period
Plotting: smart_tstat
Plot # 79
Number Participants: 2792
Number Controls: 2125
EV: 41
Low Income: 398
Renters: 941
Seniors: 1246
Smart Thermostat: 2792
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

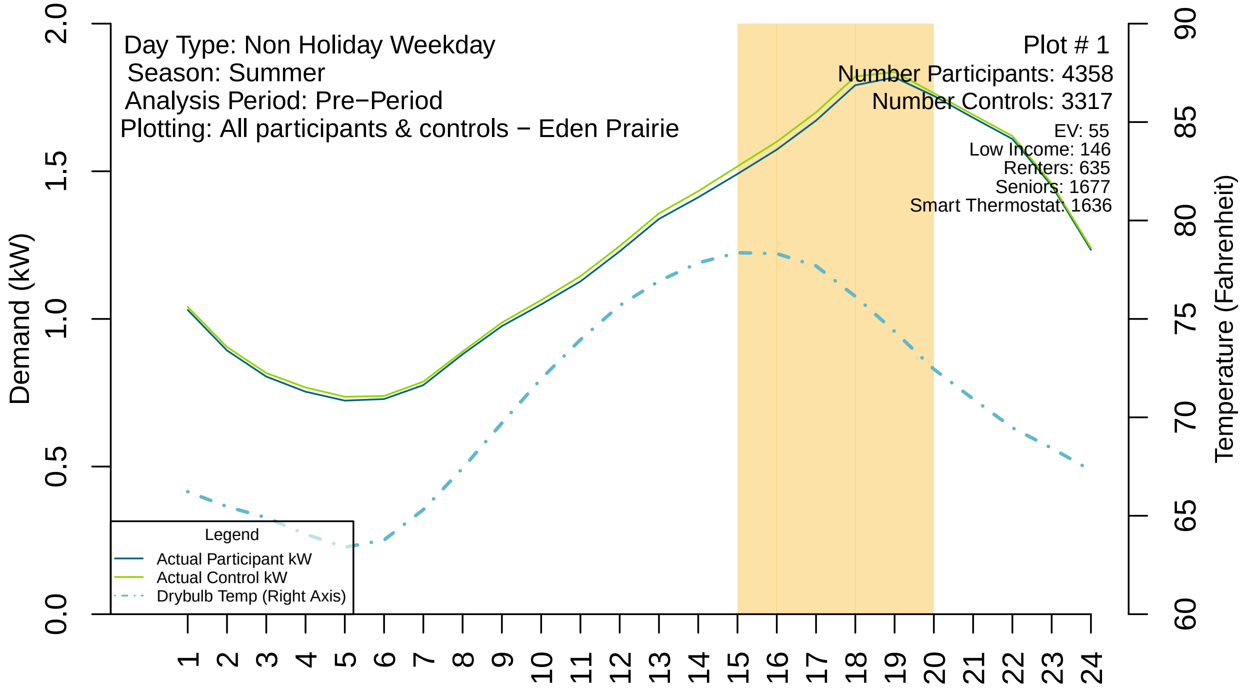

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: smart_tstat
Plot # 80
Number Participants: 2792
Number Controls: 2125
EV: 41
Low Income: 398
Renters: 941
Seniors: 1246
Smart Thermostat: 2792
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

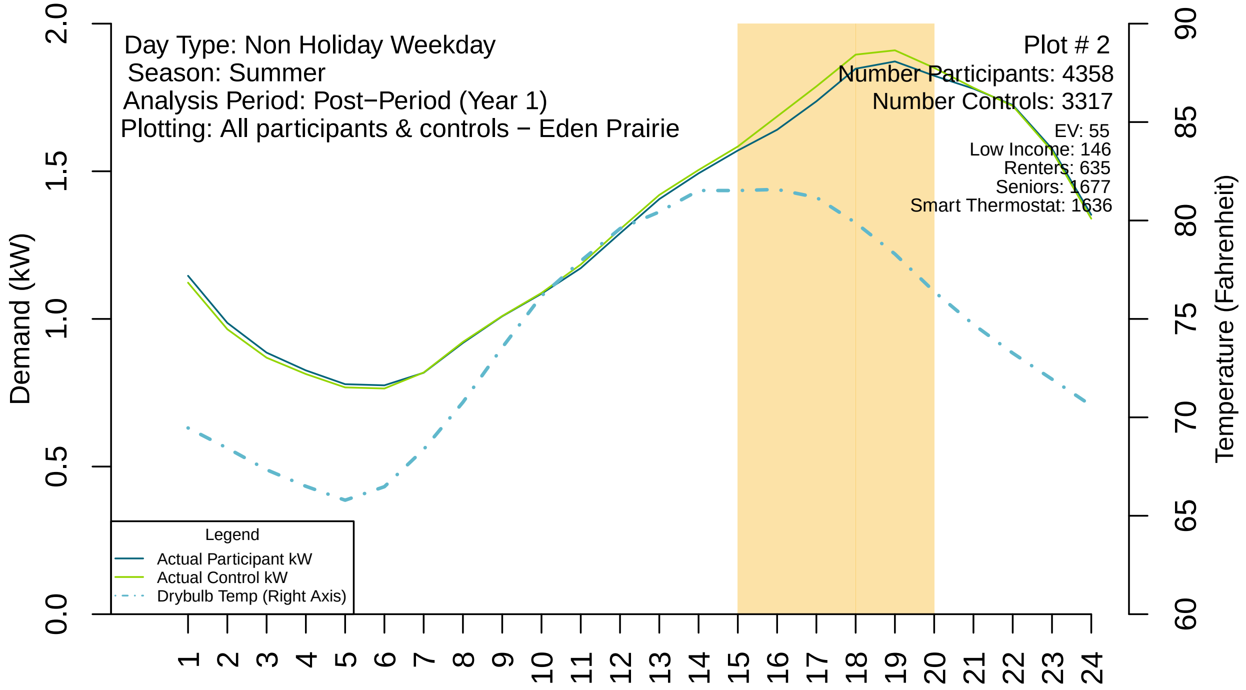

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: smart_tstat
Plot # 81
Number Participants: 2792
Number Controls: 2125
EV: 41
Low Income: 398
Renters: 941
Seniors: 1246
Smart Thermostat: 2792
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

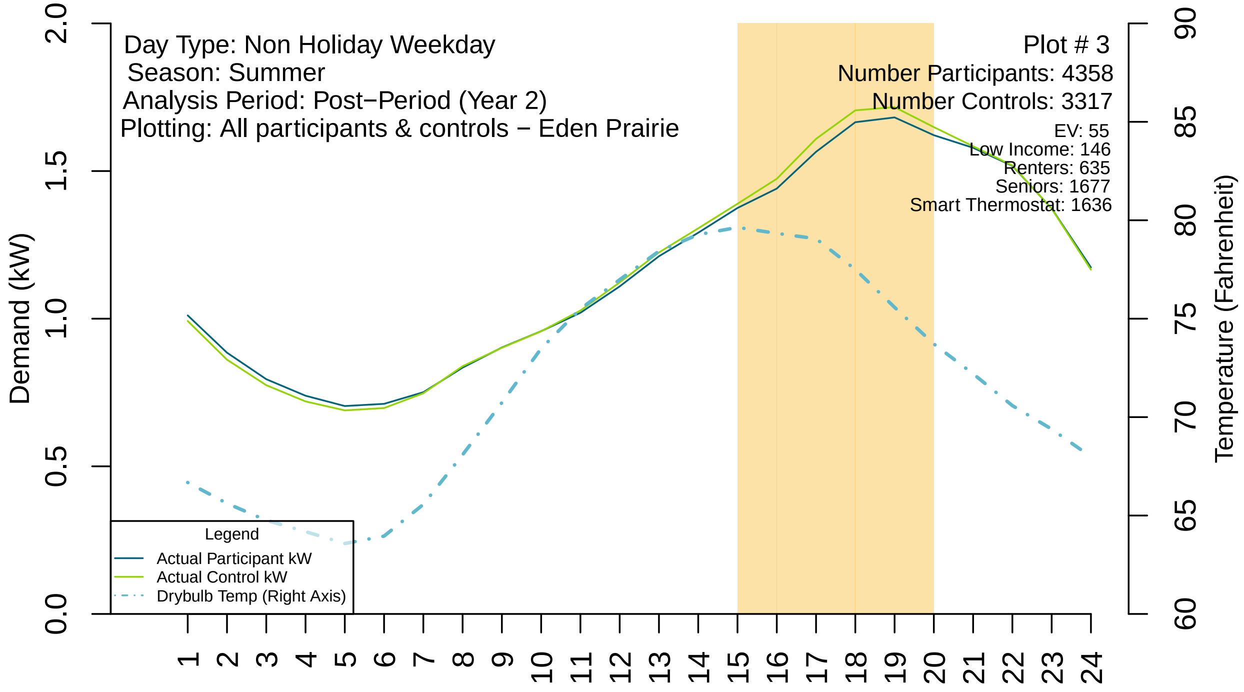

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Pre−Period
Plotting: smart_tstat
Plot # 82
Number Participants: 2792
Number Controls: 2125
EV: 41
Low Income: 398
Renters: 941
Seniors: 1246
Smart Thermostat: 2792
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

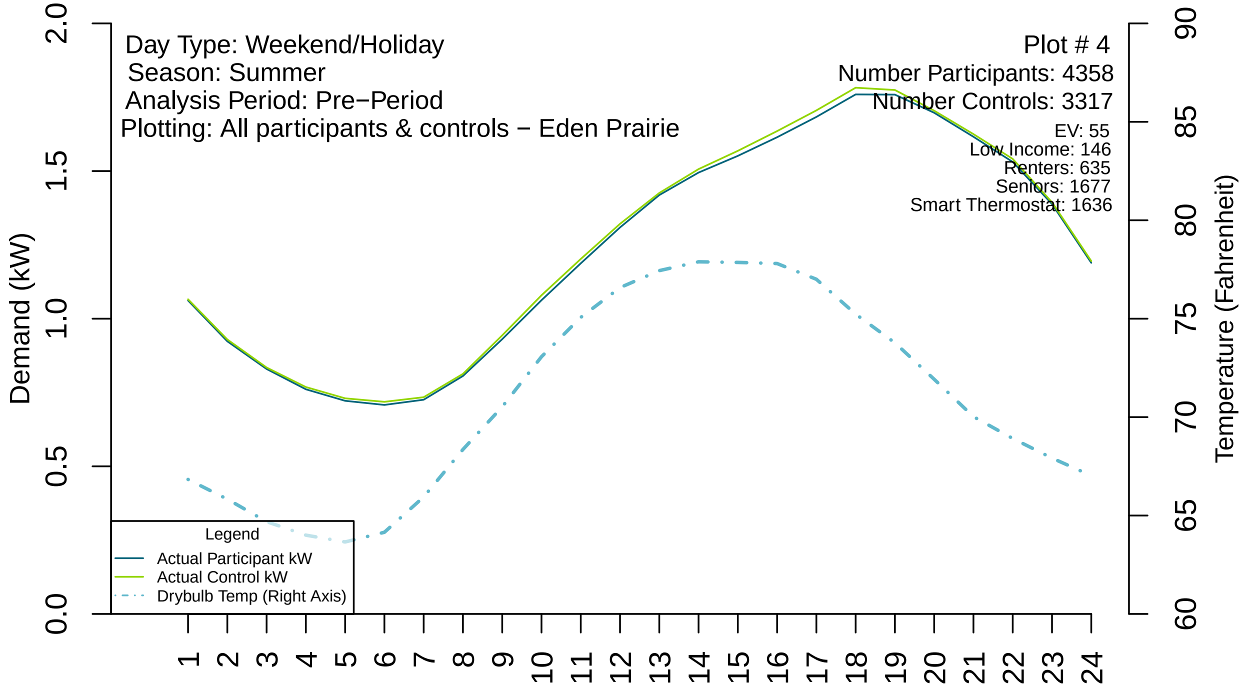

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: smart_tstat
Plot # 83
Number Participants: 2792
Number Controls: 2125
EV: 41
Low Income: 398
Renters: 941
Seniors: 1246
Smart Thermostat: 2792
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

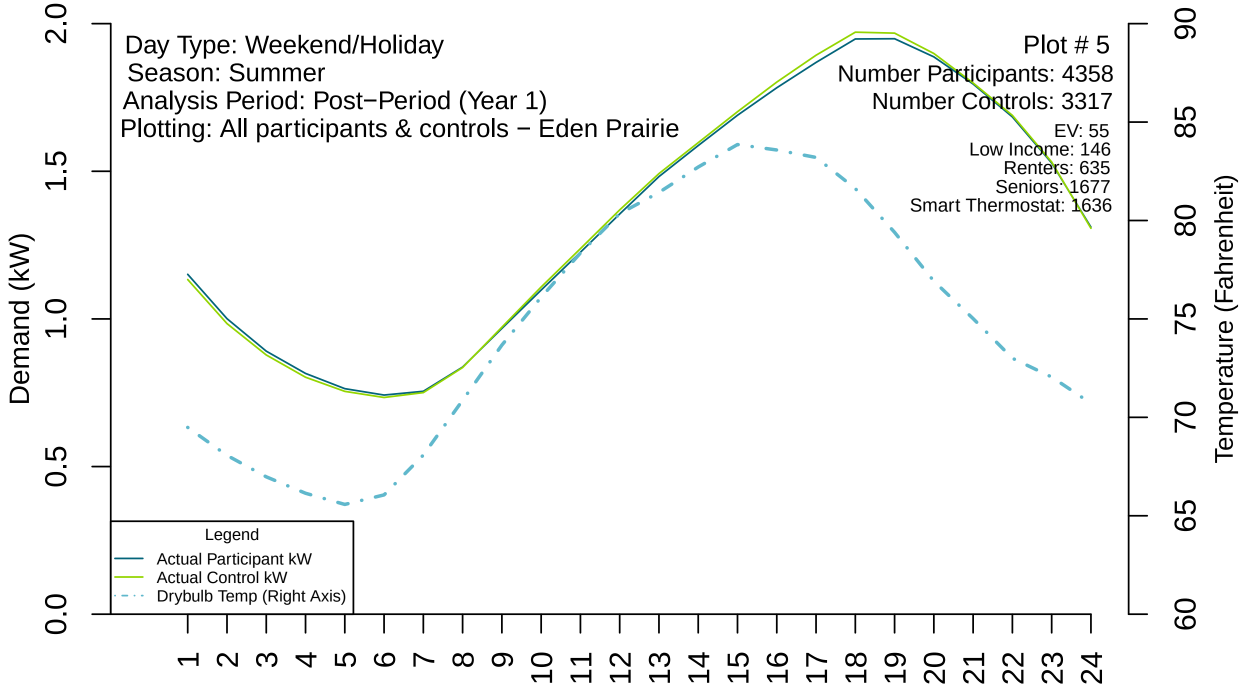

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: smart_tstat
Plot # 84
Number Participants: 2792
Number Controls: 2125
EV: 41
Low Income: 398
Renters: 941
Seniors: 1246
Smart Thermostat: 2792
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

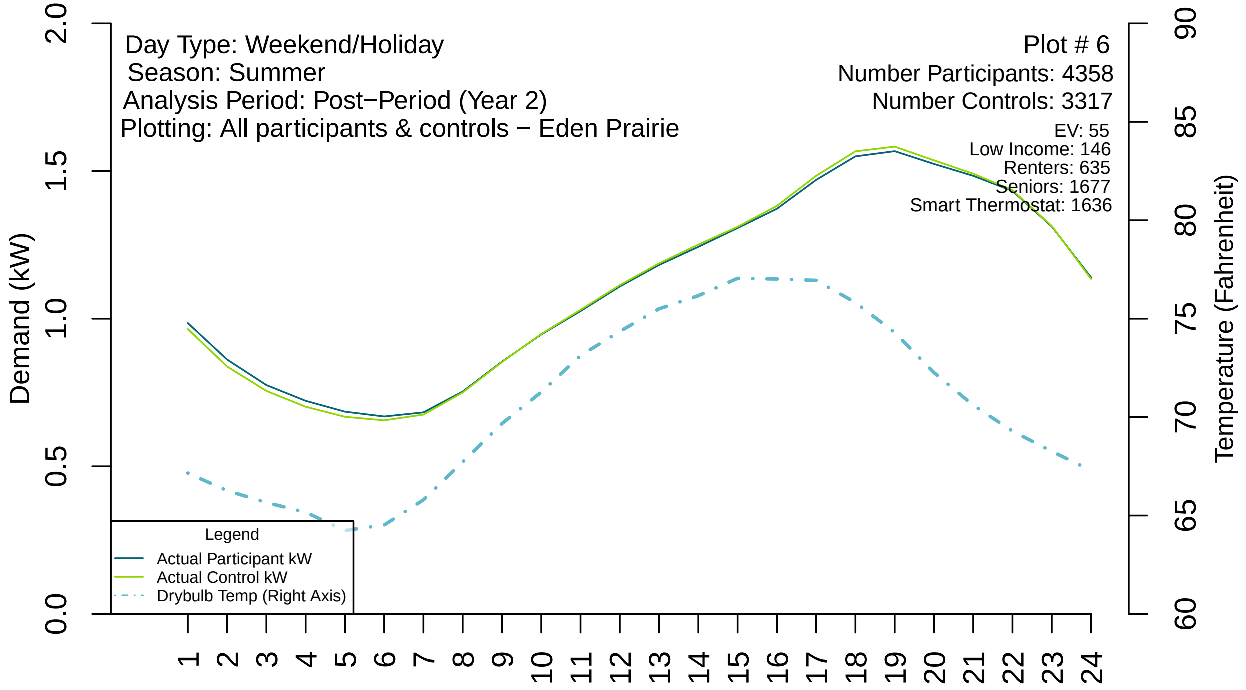

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Pre−Period
Plotting: All participants & controls − Eden Prairie
Plot # 1
Number Participants: 4358
Number Controls: 3317
EV: 55
Low Income: 146
Renters: 635
Seniors: 1677
Smart Thermostat: 1636
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

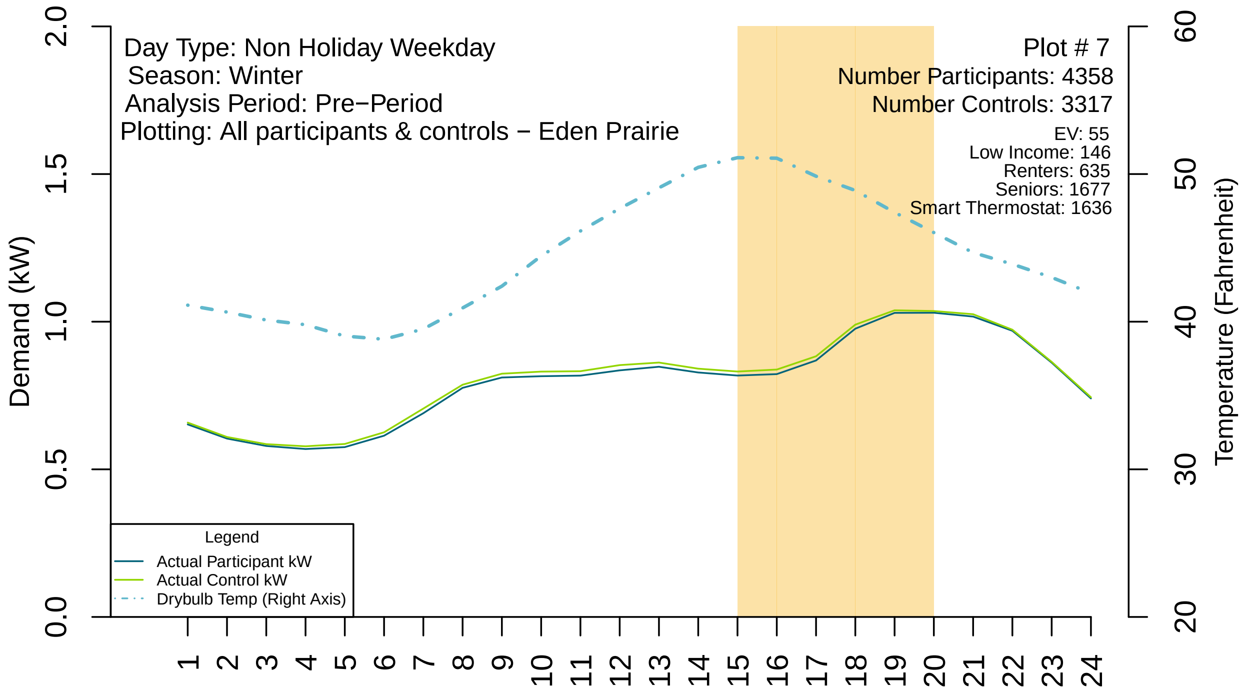

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: All participants & controls − Eden Prairie
Plot # 2
Number Participants: 4358
Number Controls: 3317
EV: 55
Low Income: 146
Renters: 635
Seniors: 1677
Smart Thermostat: 1636
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

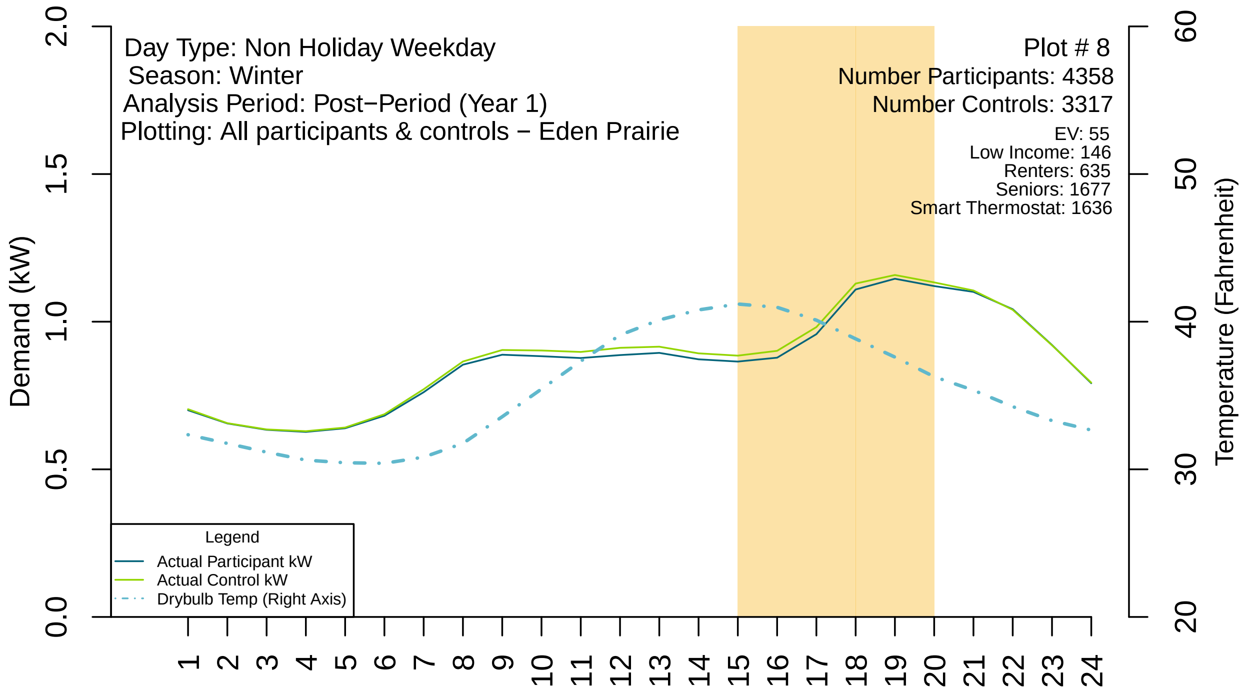

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: All participants & controls − Eden Prairie
Plot # 3
Number Participants: 4358
Number Controls: 3317
EV: 55
Low Income: 146
Renters: 635
Seniors: 1677
Smart Thermostat: 1636
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

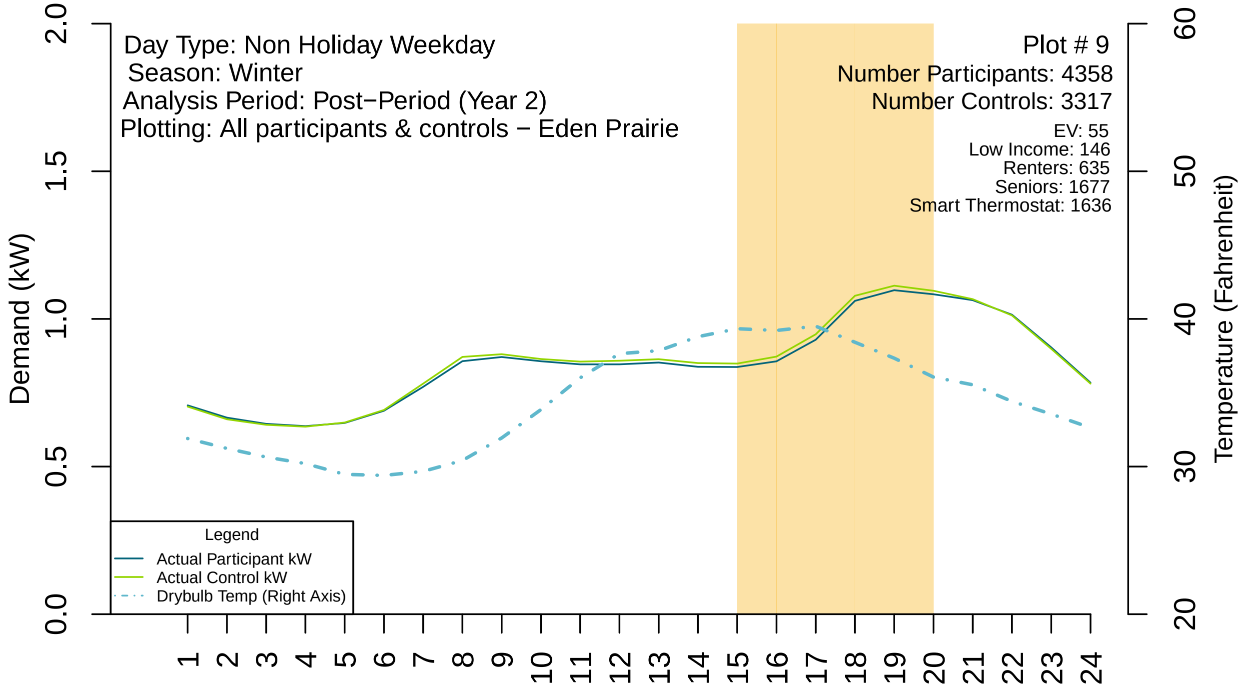

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Pre−Period
Plotting: All participants & controls − Eden Prairie
Plot # 4
Number Participants: 4358
Number Controls: 3317
EV: 55
Low Income: 146
Renters: 635
Seniors: 1677
Smart Thermostat: 1636
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

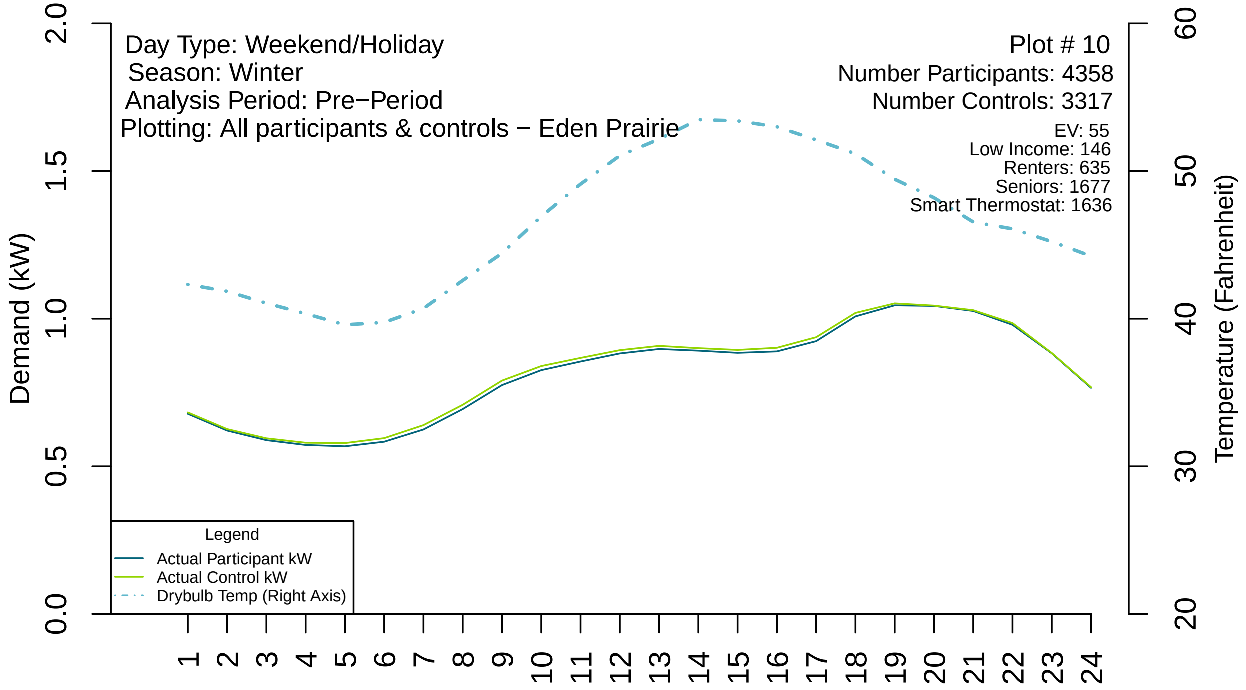

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: All participants & controls − Eden Prairie
Plot # 5
Number Participants: 4358
Number Controls: 3317
EV: 55
Low Income: 146
Renters: 635
Seniors: 1677
Smart Thermostat: 1636
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

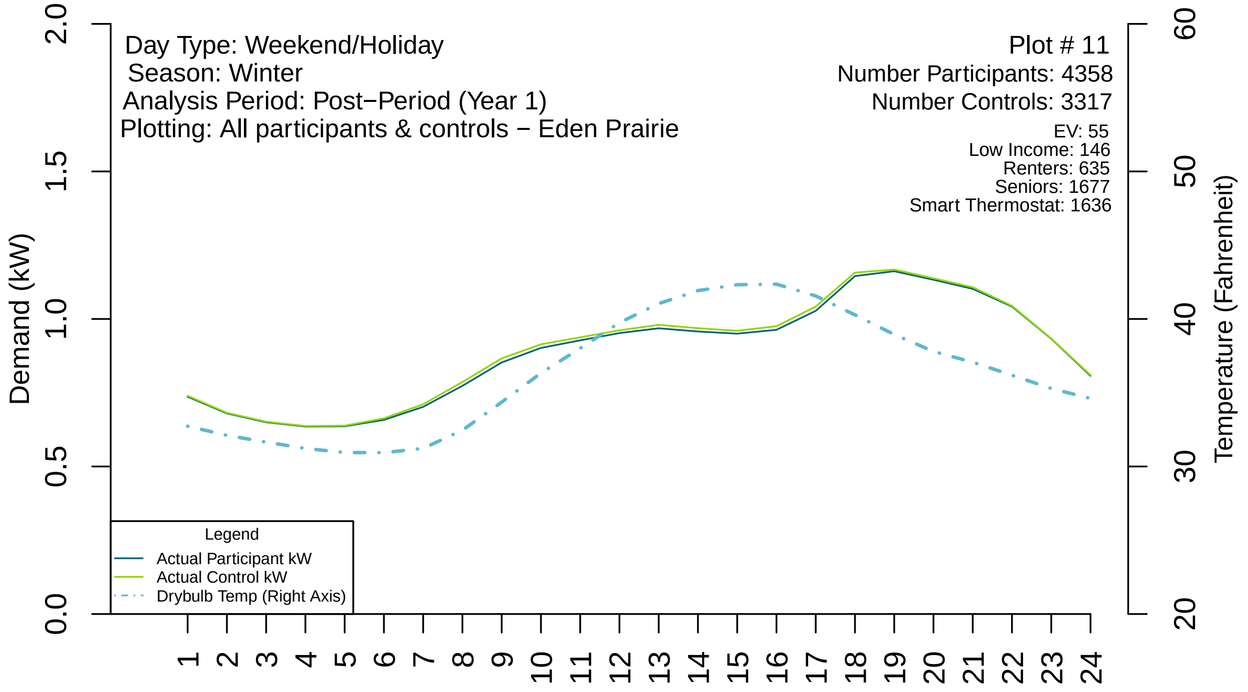

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: All participants & controls − Eden Prairie
Plot # 6
Number Participants: 4358
Number Controls: 3317
EV: 55
Low Income: 146
Renters: 635
Seniors: 1677
Smart Thermostat: 1636
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

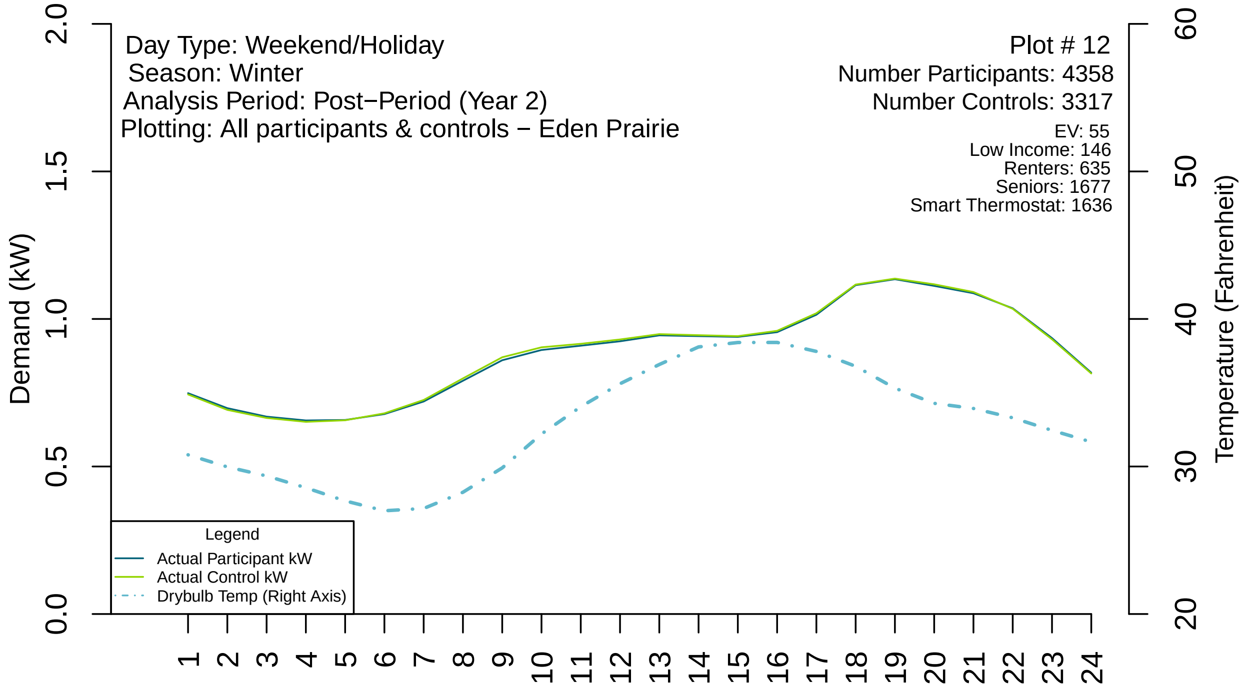

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Pre−Period
Plotting: All participants & controls − Eden Prairie
Plot # 7
Number Participants: 4358
Number Controls: 3317
EV: 55
Low Income: 146
Renters: 635
Seniors: 1677
Smart Thermostat: 1636
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

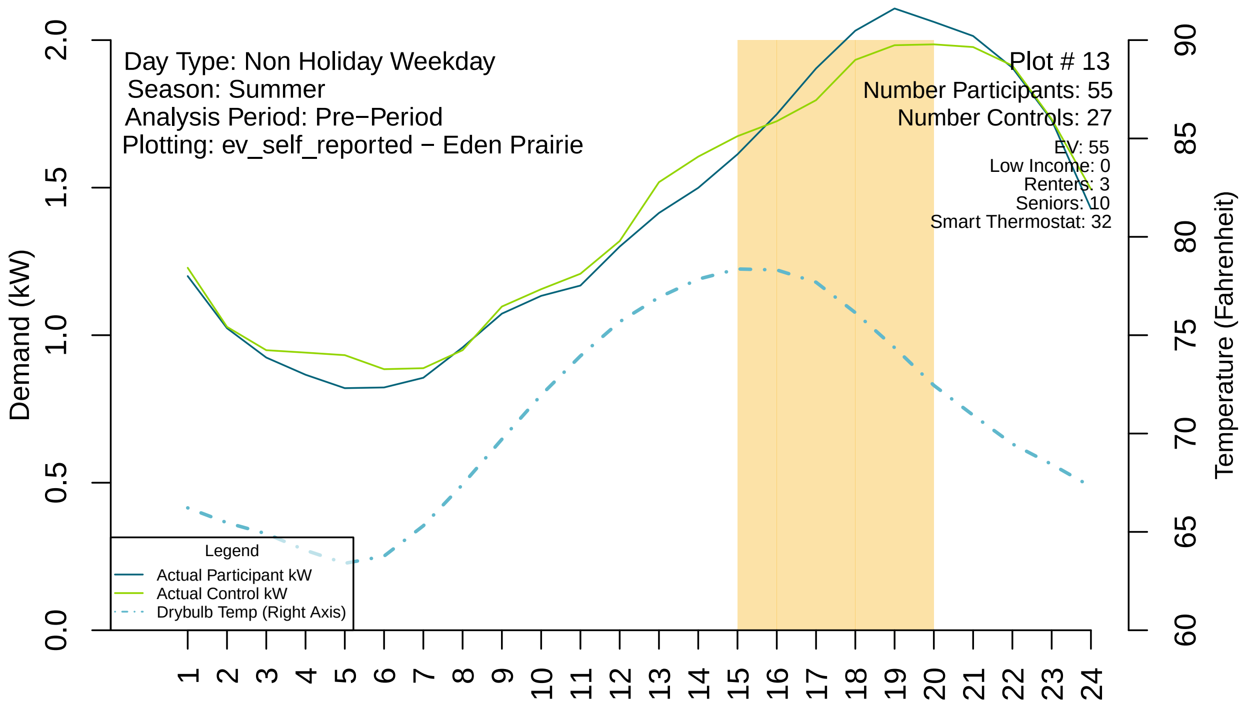

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: All participants & controls − Eden Prairie
Plot # 8
Number Participants: 4358
Number Controls: 3317
EV: 55
Low Income: 146
Renters: 635
Seniors: 1677
Smart Thermostat: 1636
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

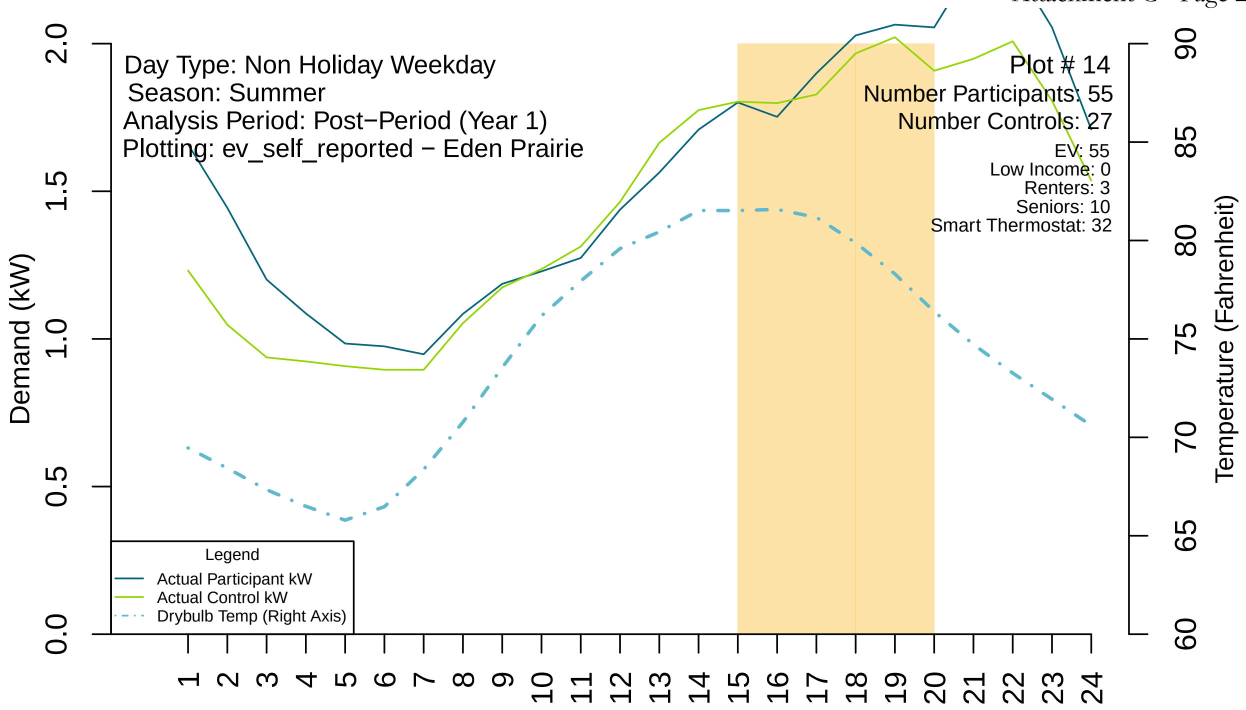

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: All participants & controls − Eden Prairie
Plot # 9
Number Participants: 4358
Number Controls: 3317
EV: 55
Low Income: 146
Renters: 635
Seniors: 1677
Smart Thermostat: 1636
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

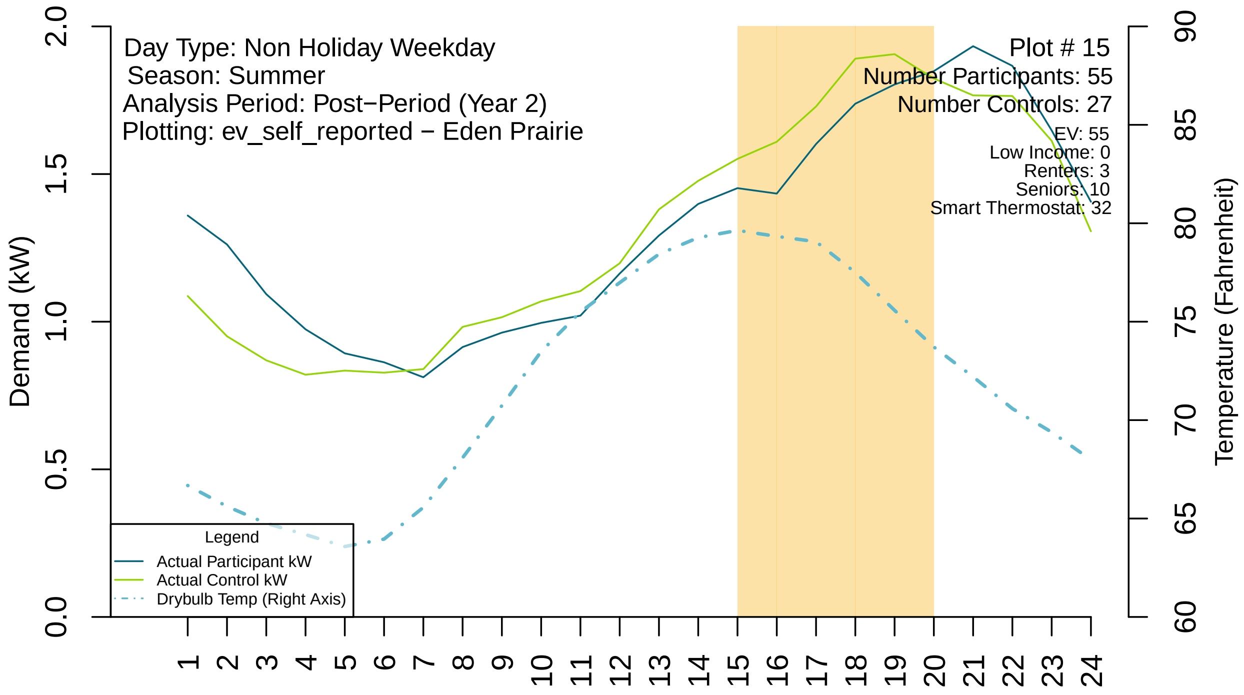

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Pre−Period
Plotting: All participants & controls − Eden Prairie
Plot # 10
Number Participants: 4358
Number Controls: 3317
EV: 55
Low Income: 146
Renters: 635
Seniors: 1677
Smart Thermostat: 1636
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

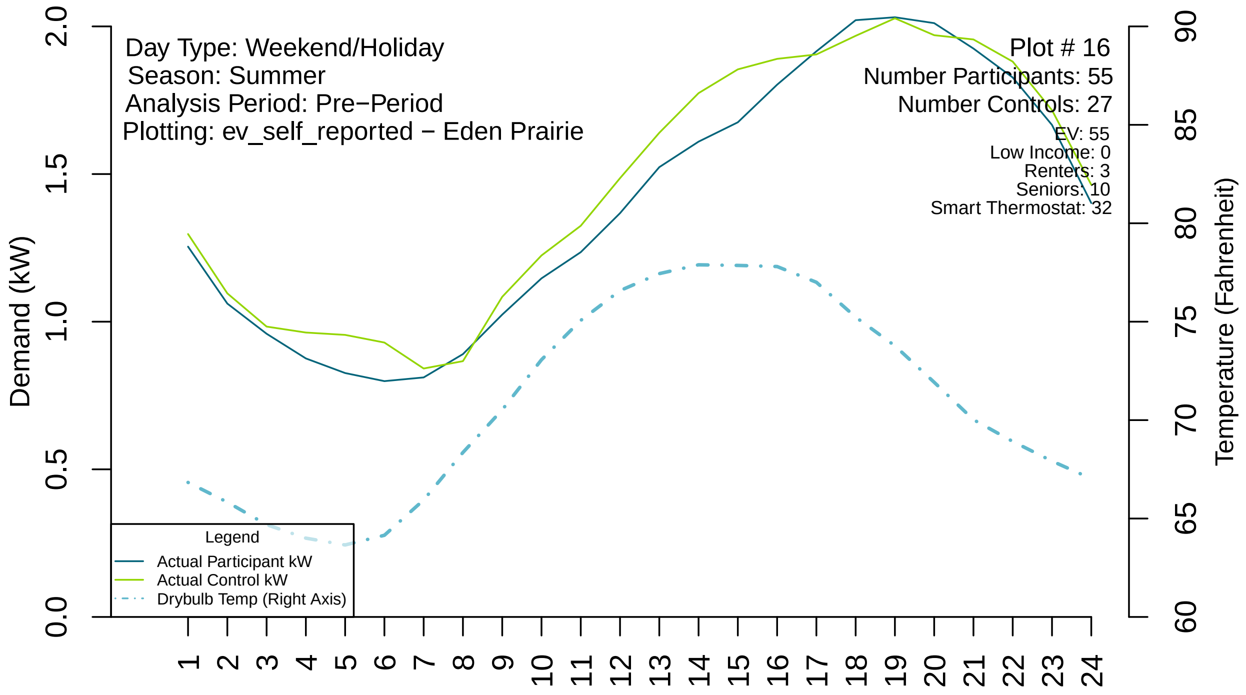

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: All participants & controls − Eden Prairie
Plot # 11
Number Participants: 4358
Number Controls: 3317
EV: 55
Low Income: 146
Renters: 635
Seniors: 1677
Smart Thermostat: 1636
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

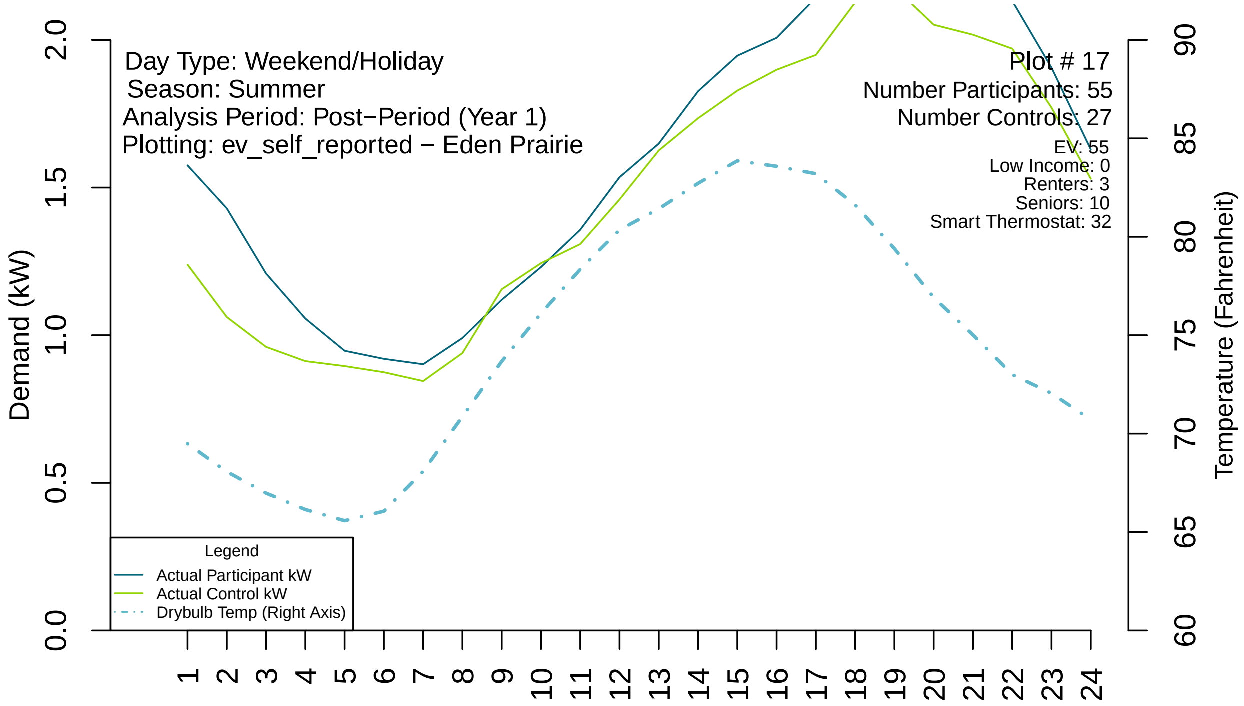

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: All participants & controls − Eden Prairie
Plot # 12
Number Participants: 4358
Number Controls: 3317
EV: 55
Low Income: 146
Renters: 635
Seniors: 1677
Smart Thermostat: 1636
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

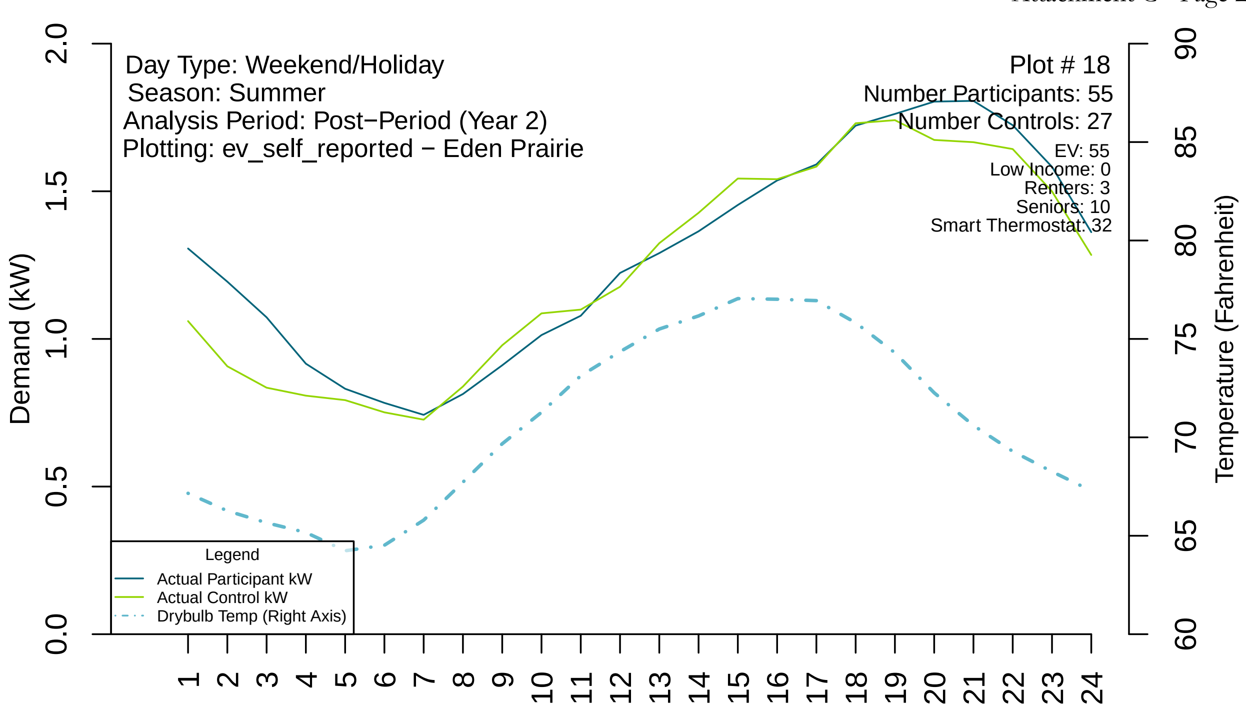

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Pre−Period
Plotting: ev_self_reported − Eden Prairie
Plot # 13
Number Participants: 55
Number Controls: 27
EV: 55
Low Income: 0
Renters: 3
Seniors: 10
Smart Thermostat: 32
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

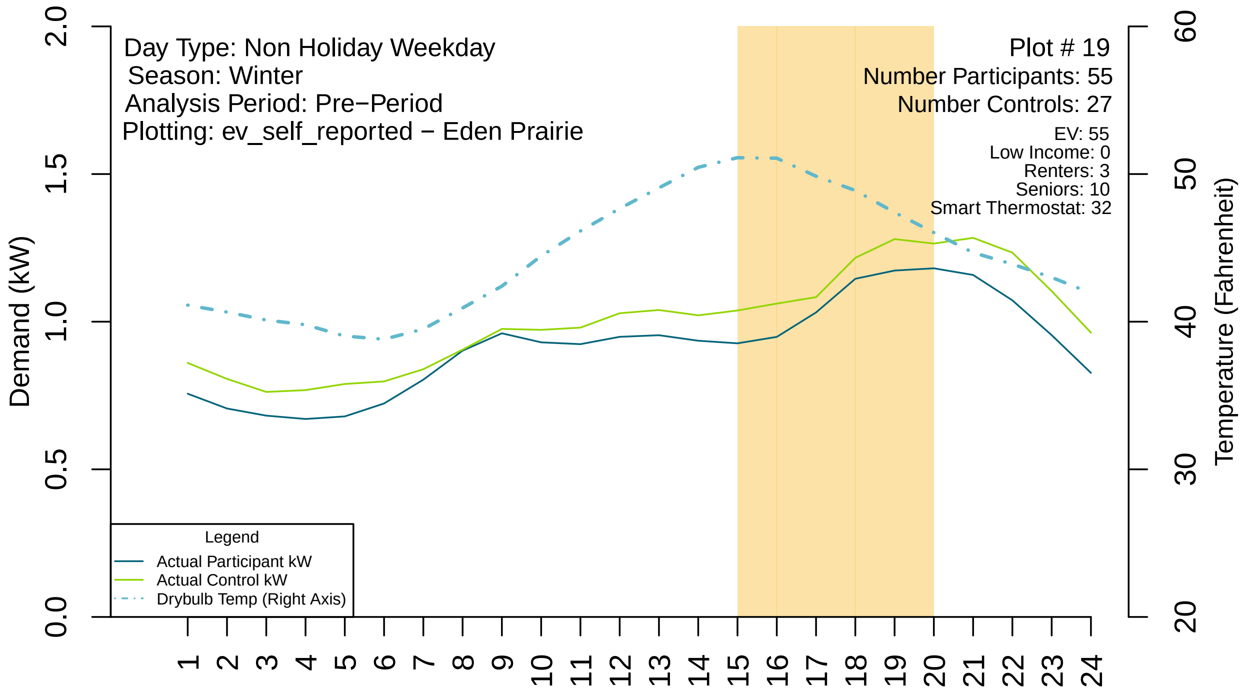

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: ev_self_reported − Eden Prairie
Plot # 14
Number Participants: 55
Number Controls: 27
EV: 55
Low Income: 0
Renters: 3
Seniors: 10
Smart Thermostat: 32
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

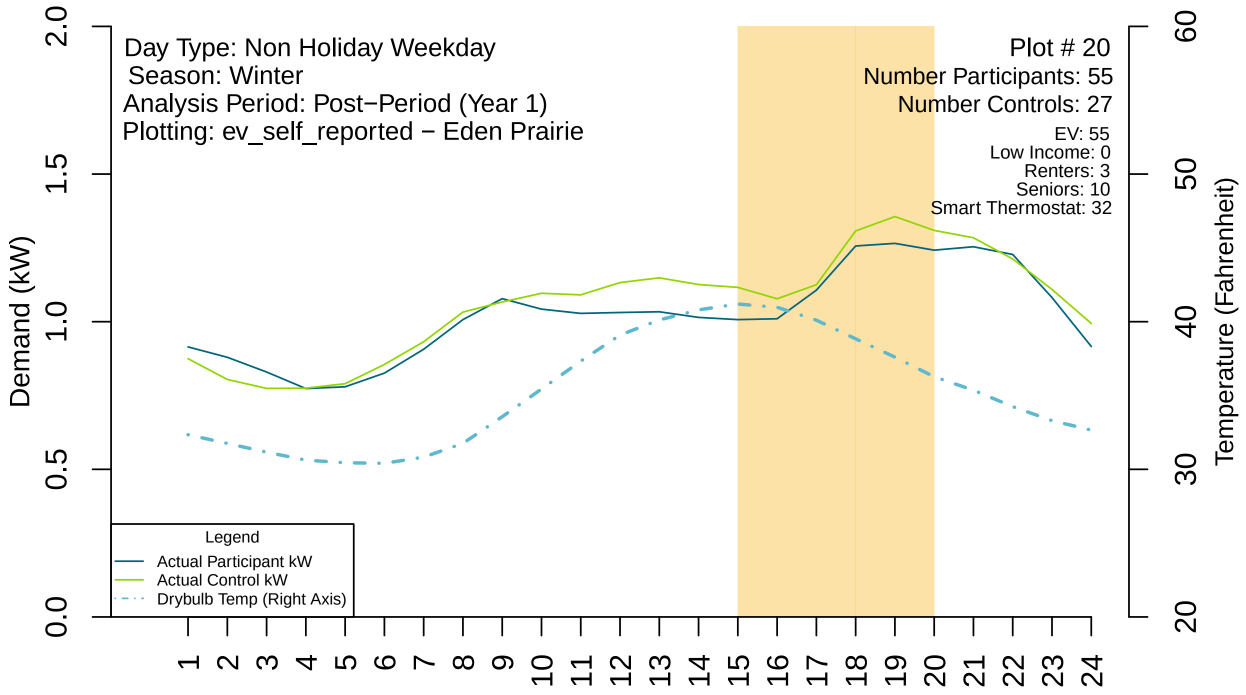

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: ev_self_reported − Eden Prairie
Plot # 15
Number Participants: 55
Number Controls: 27
EV: 55
Low Income: 0
Renters: 3
Seniors: 10
Smart Thermostat: 32
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

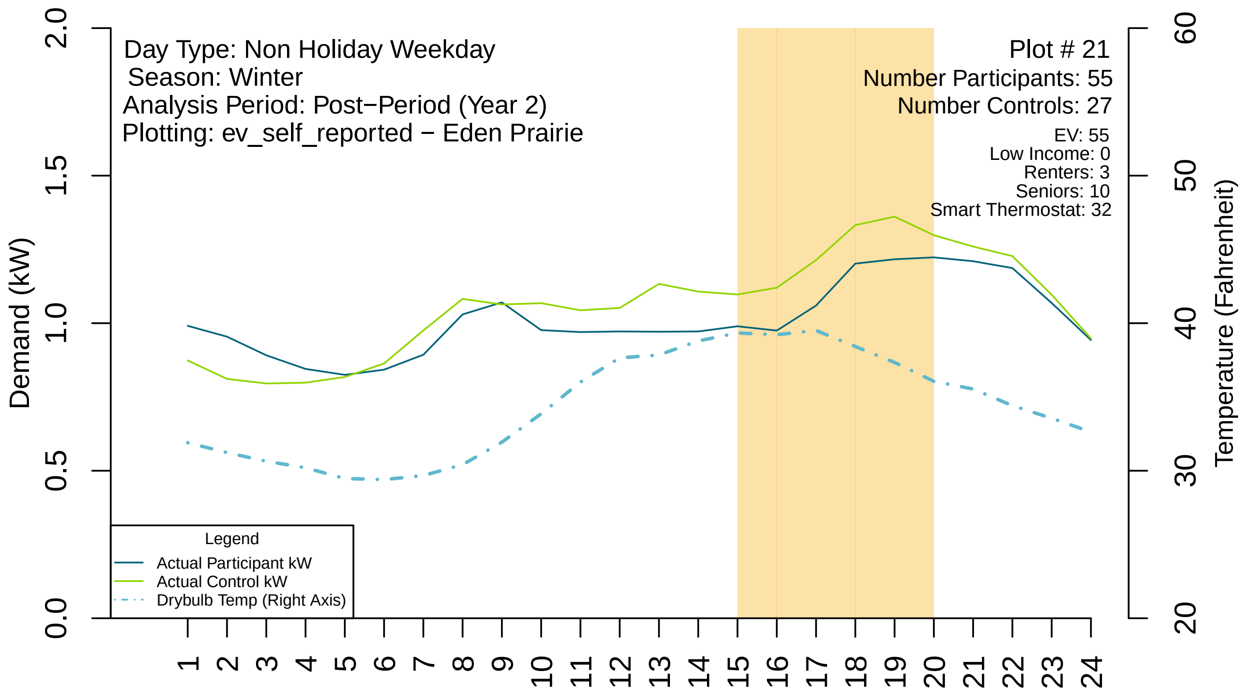

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Pre−Period
Plotting: ev_self_reported − Eden Prairie
Plot # 16
Number Participants: 55
Number Controls: 27
EV: 55
Low Income: 0
Renters: 3
Seniors: 10
Smart Thermostat: 32
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

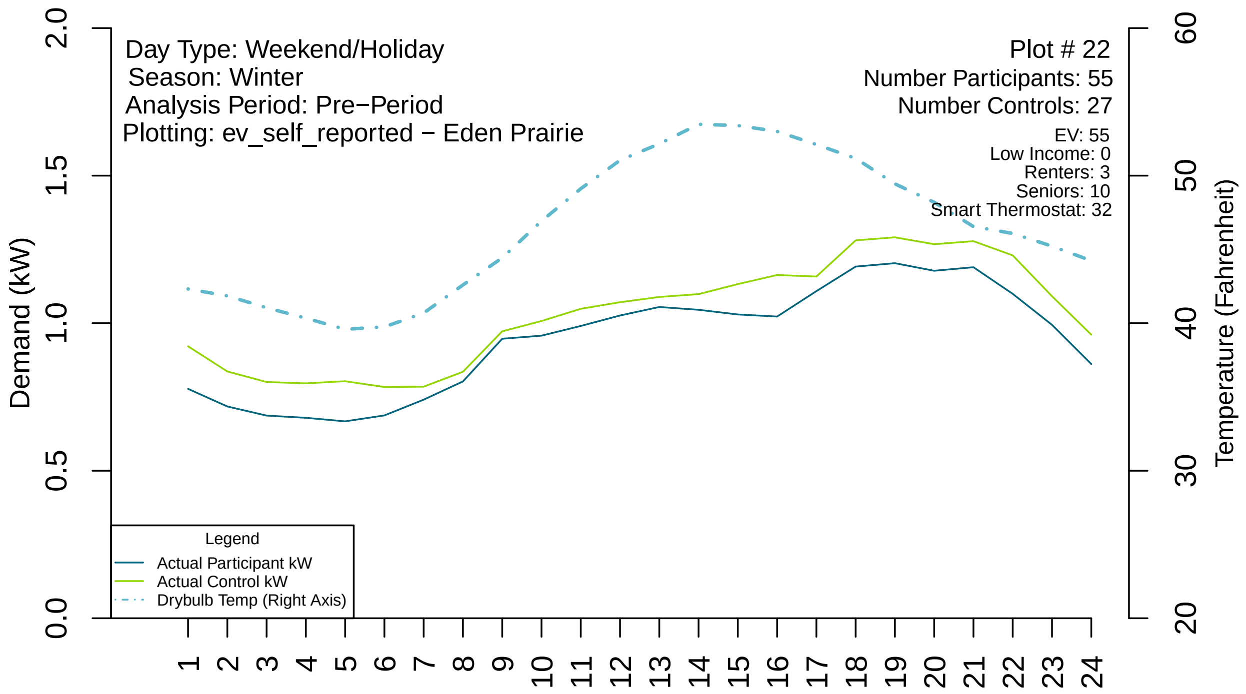

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: ev_self_reported − Eden Prairie
Plot # 17
Number Participants: 55
Number Controls: 27
EV: 55
Low Income: 0
Renters: 3
Seniors: 10
Smart Thermostat: 32
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

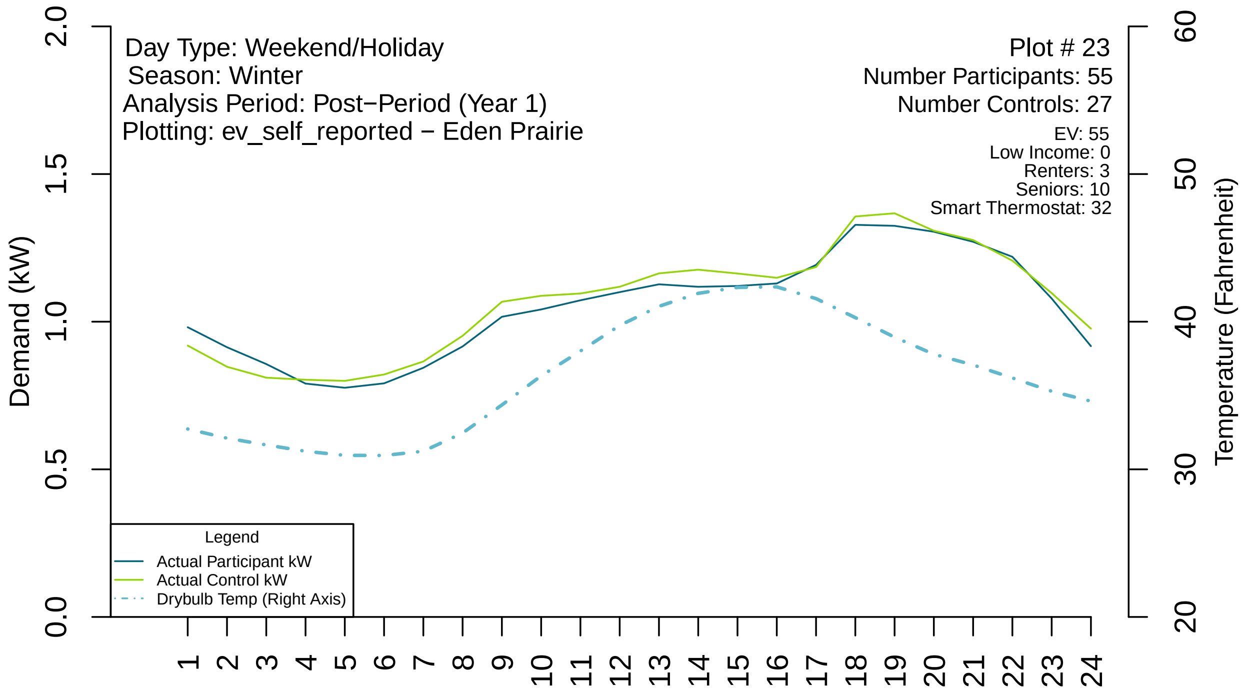

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: ev_self_reported − Eden Prairie
Plot # 18
Number Participants: 55
Number Controls: 27
EV: 55
Low Income: 0
Renters: 3
Seniors: 10
Smart Thermostat: 32
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

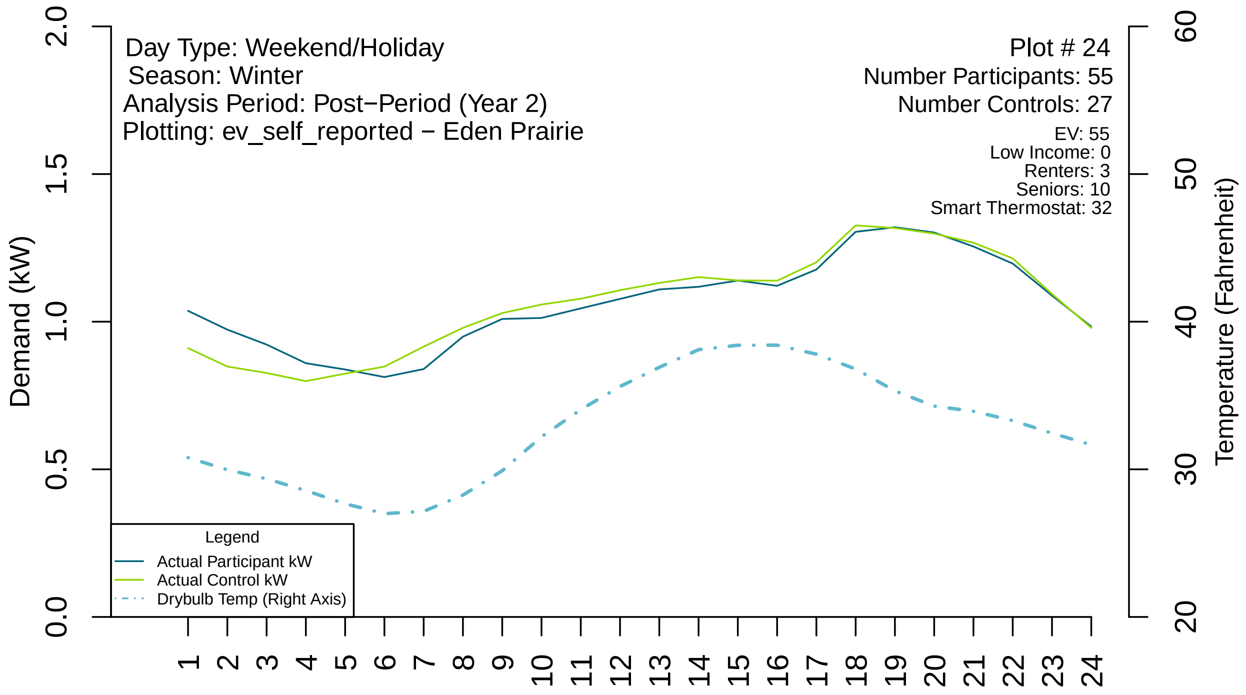

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Pre−Period
Plotting: ev_self_reported − Eden Prairie
Plot # 19
Number Participants: 55
Number Controls: 27
EV: 55
Low Income: 0
Renters: 3
Seniors: 10
Smart Thermostat: 32
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

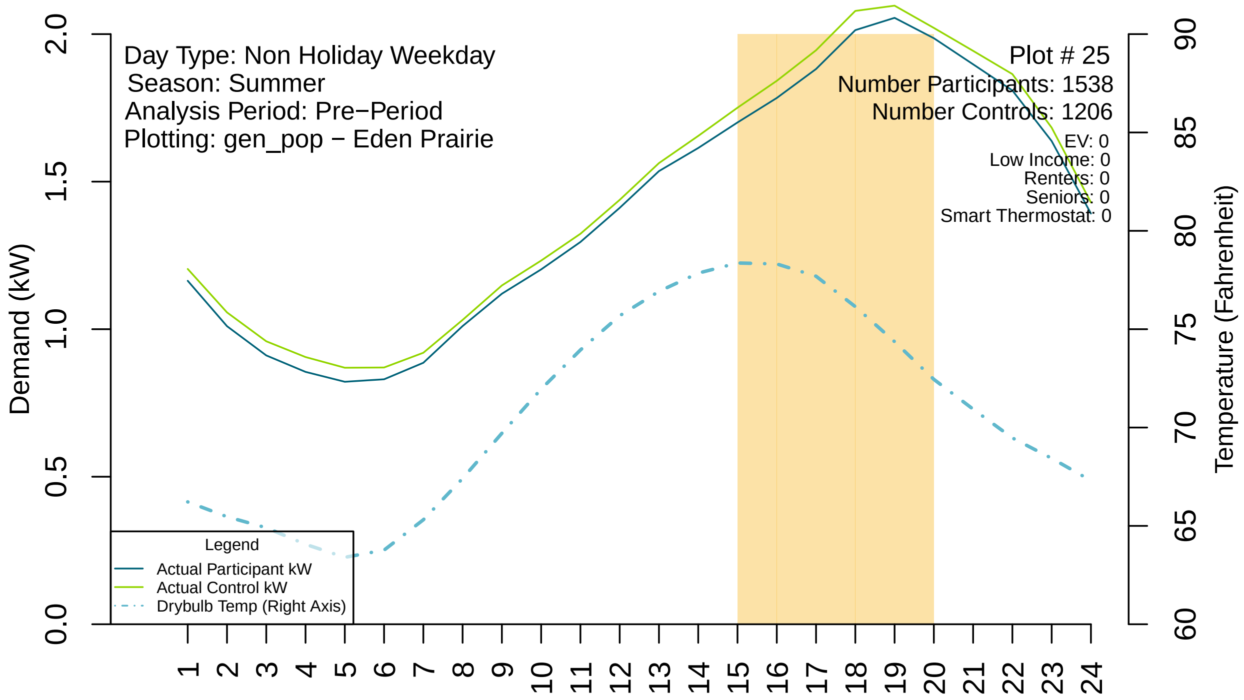

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: ev_self_reported − Eden Prairie
Plot # 20
Number Participants: 55
Number Controls: 27
EV: 55
Low Income: 0
Renters: 3
Seniors: 10
Smart Thermostat: 32
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

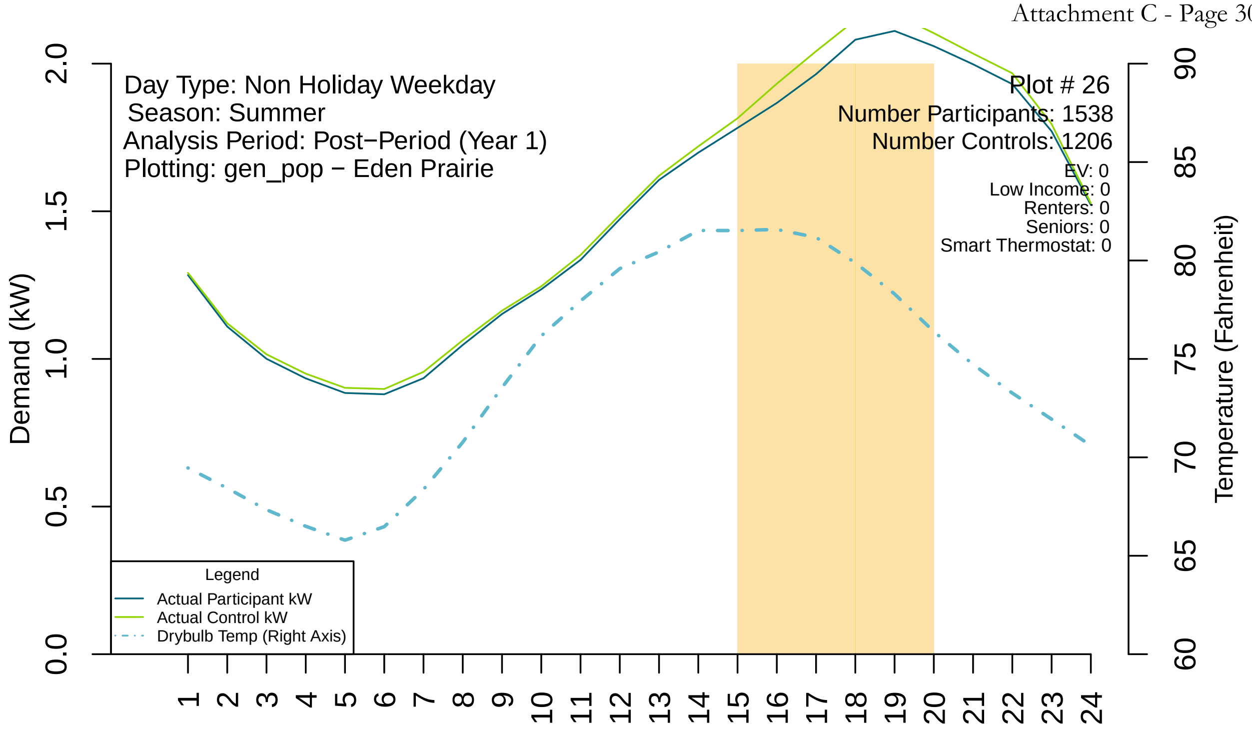

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: ev_self_reported − Eden Prairie
Plot # 21
Number Participants: 55
Number Controls: 27
EV: 55
Low Income: 0
Renters: 3
Seniors: 10
Smart Thermostat: 32
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

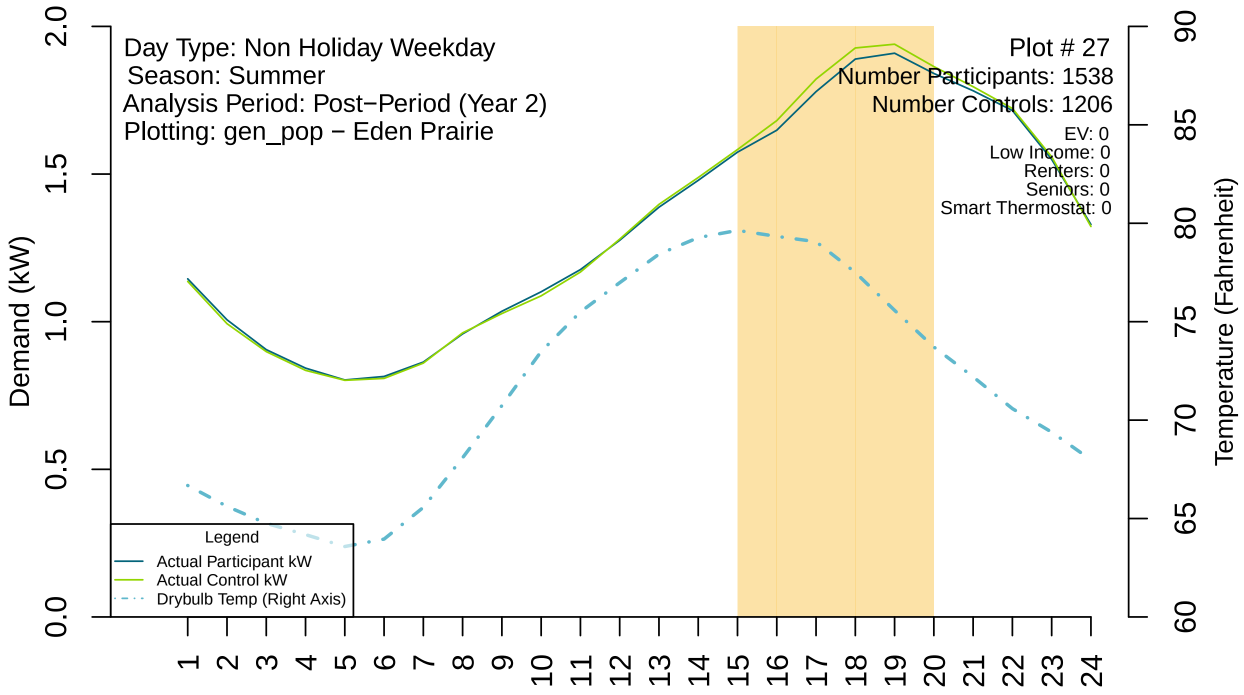

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Pre−Period
Plotting: ev_self_reported − Eden Prairie
Plot # 22
Number Participants: 55
Number Controls: 27
EV: 55
Low Income: 0
Renters: 3
Seniors: 10
Smart Thermostat: 32
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

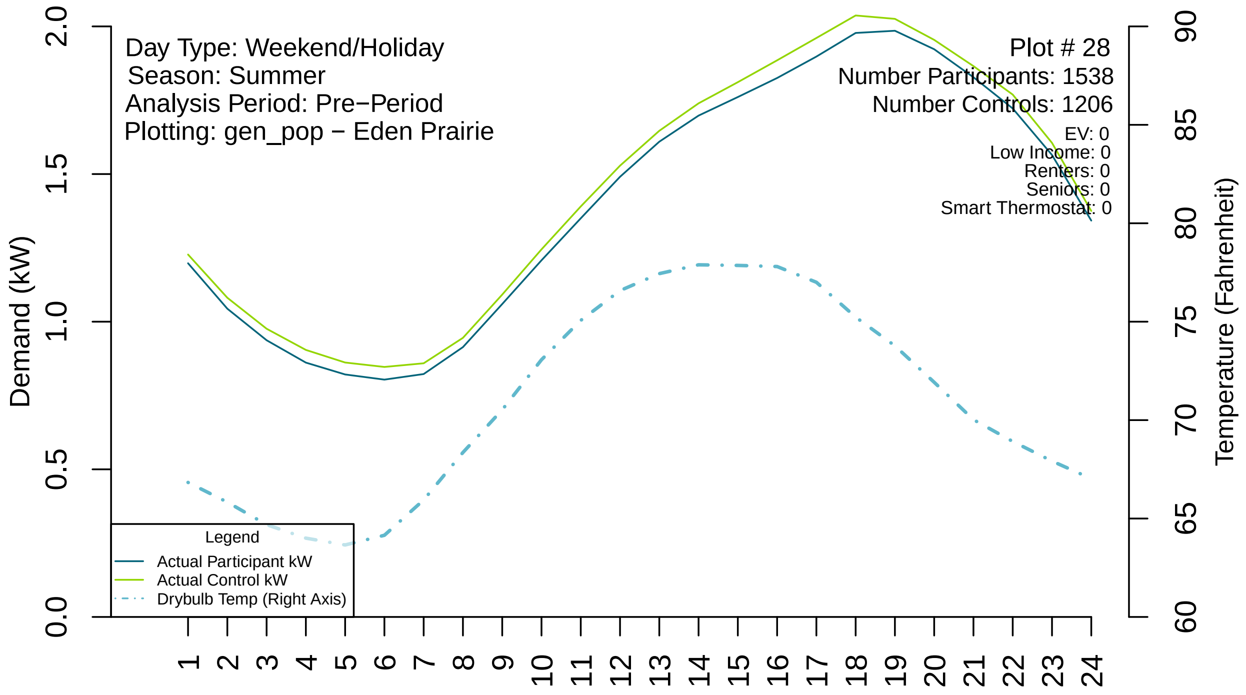

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: ev_self_reported − Eden Prairie
Plot # 23
Number Participants: 55
Number Controls: 27
EV: 55
Low Income: 0
Renters: 3
Seniors: 10
Smart Thermostat: 32
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

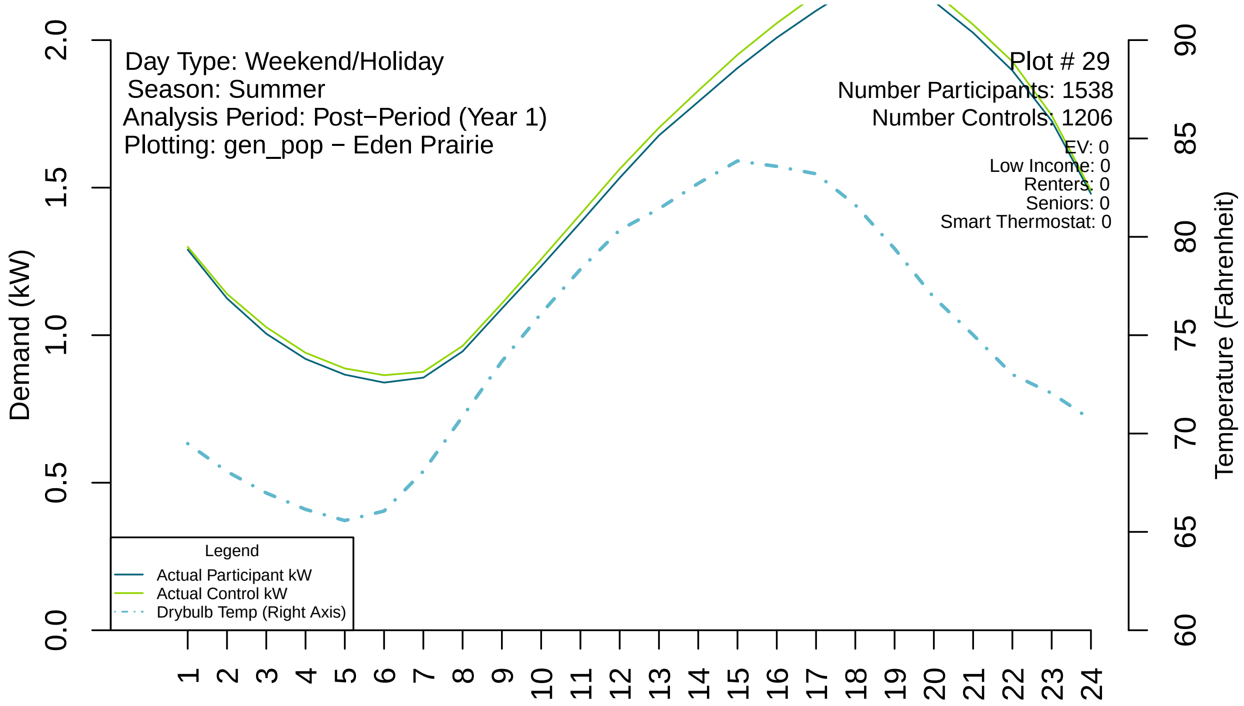

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: ev_self_reported − Eden Prairie
Plot # 24
Number Participants: 55
Number Controls: 27
EV: 55
Low Income: 0
Renters: 3
Seniors: 10
Smart Thermostat: 32
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

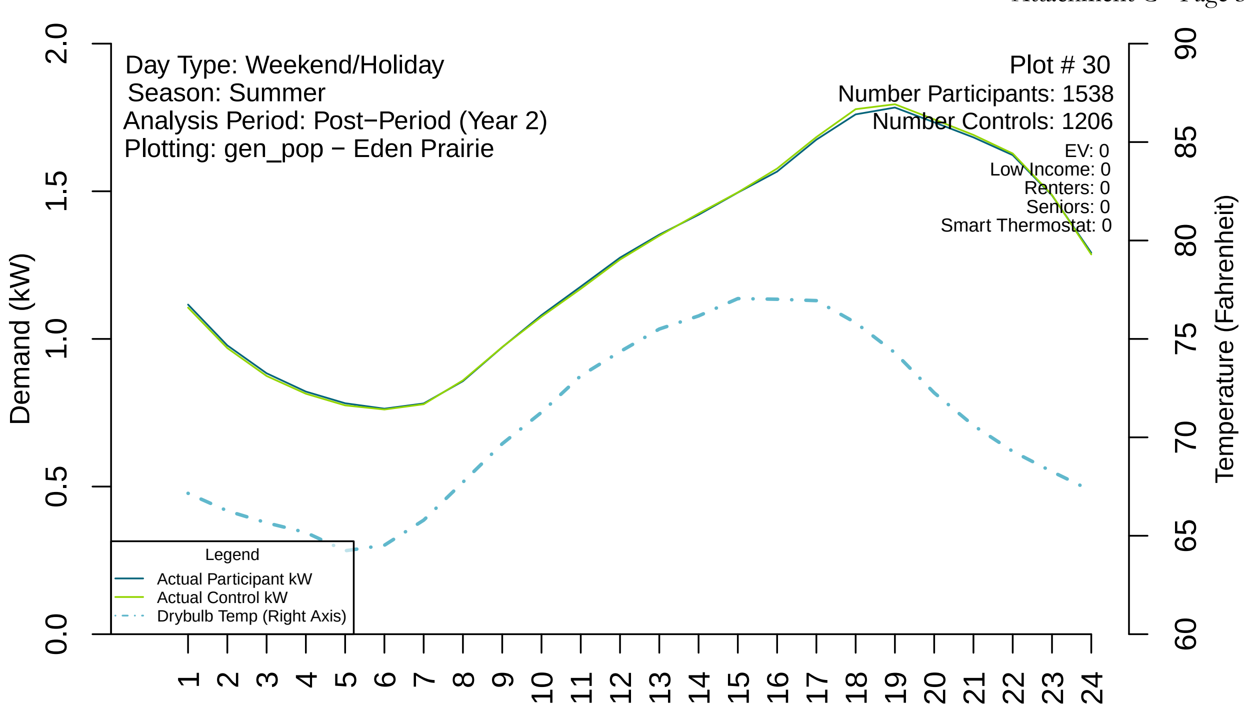

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Pre−Period
Plotting: gen_pop − Eden Prairie
Plot # 25
Number Participants: 1538
Number Controls: 1206
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)
0.0 0.5 1.0 1.5 2.0
60 65 70 75 80 85 90
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

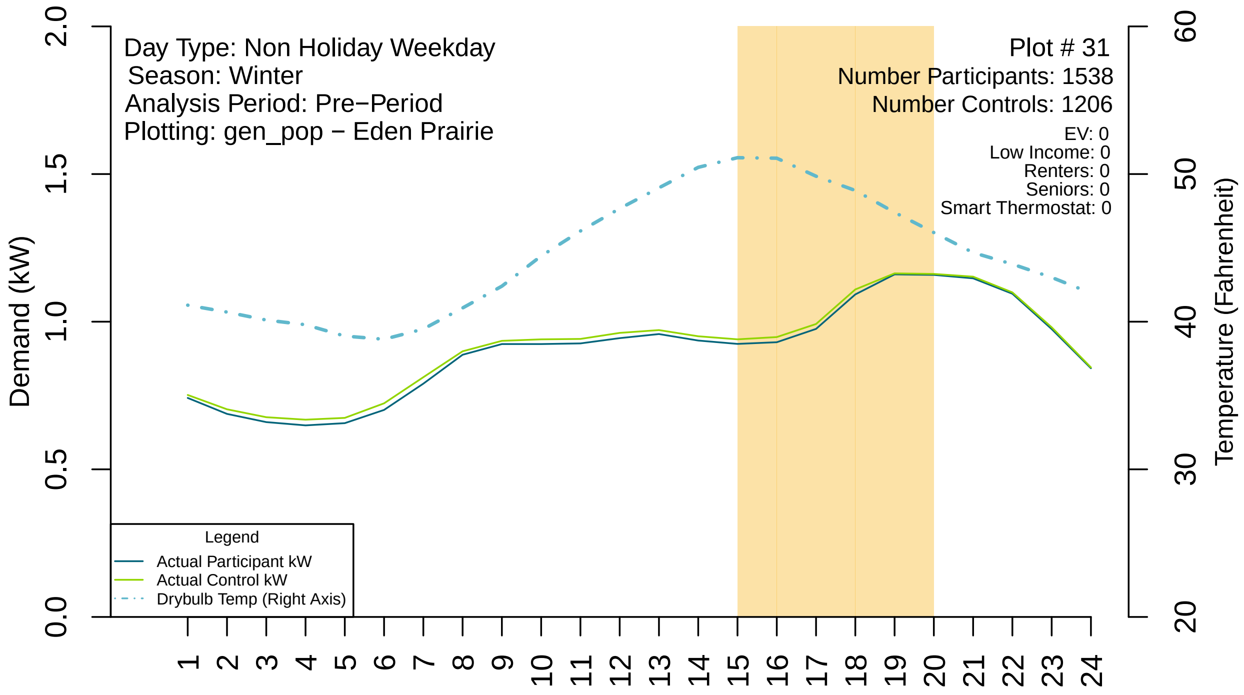

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: gen_pop − Eden Prairie
Plot # 26
Number Participants: 1538
Number Controls: 1206
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)
0.0 0.5 1.0 1.5 2.0
60 65 70 75 80 85 90
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

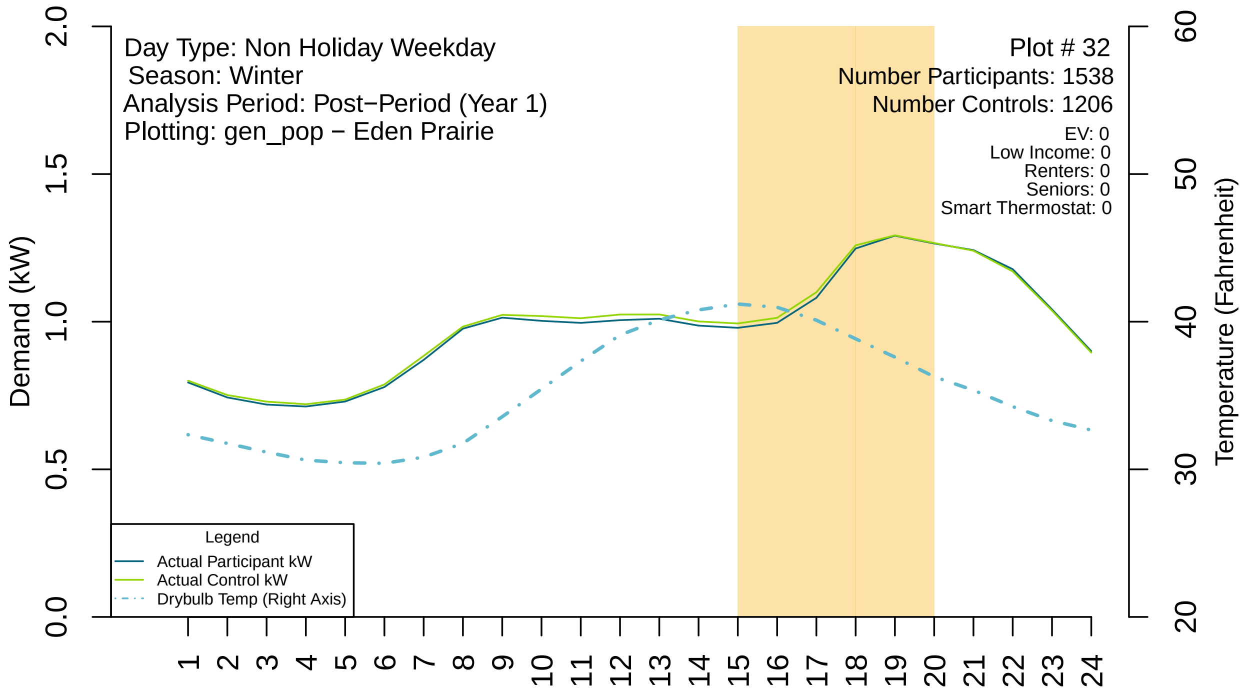

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: gen_pop − Eden Prairie
Plot # 27
Number Participants: 1538
Number Controls: 1206
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)
0.0 0.5 1.0 1.5 2.0
60 65 70 75 80 85 90
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

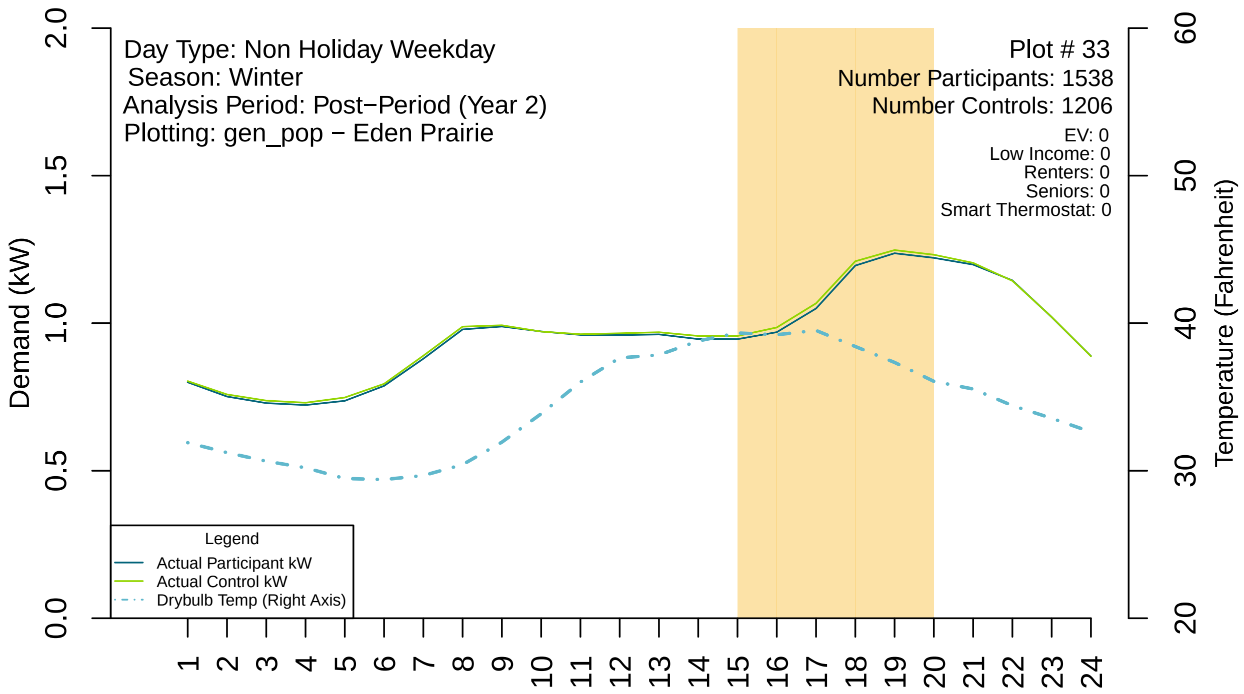

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Pre−Period
Plotting: gen_pop − Eden Prairie
Plot # 28
Number Participants: 1538
Number Controls: 1206
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)
0.0 0.5 1.0 1.5 2.0
60 65 70 75 80 85 90
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

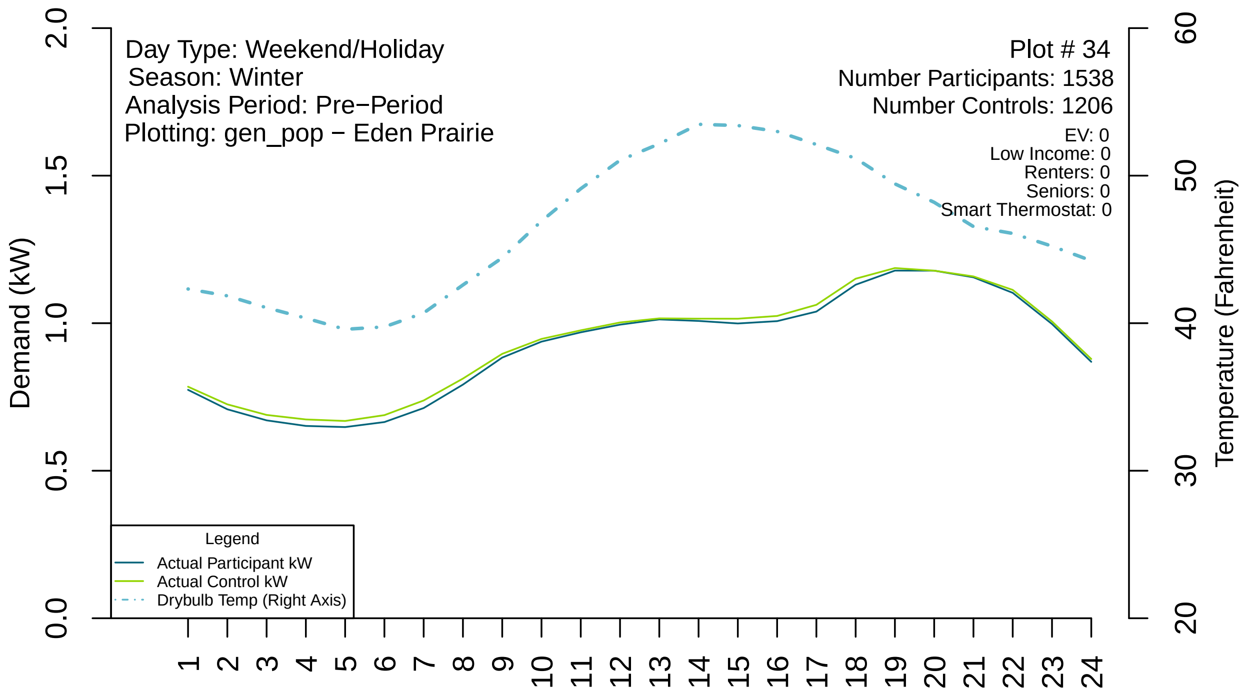

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: gen_pop − Eden Prairie
Plot # 29
Number Participants: 1538
Number Controls: 1206
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

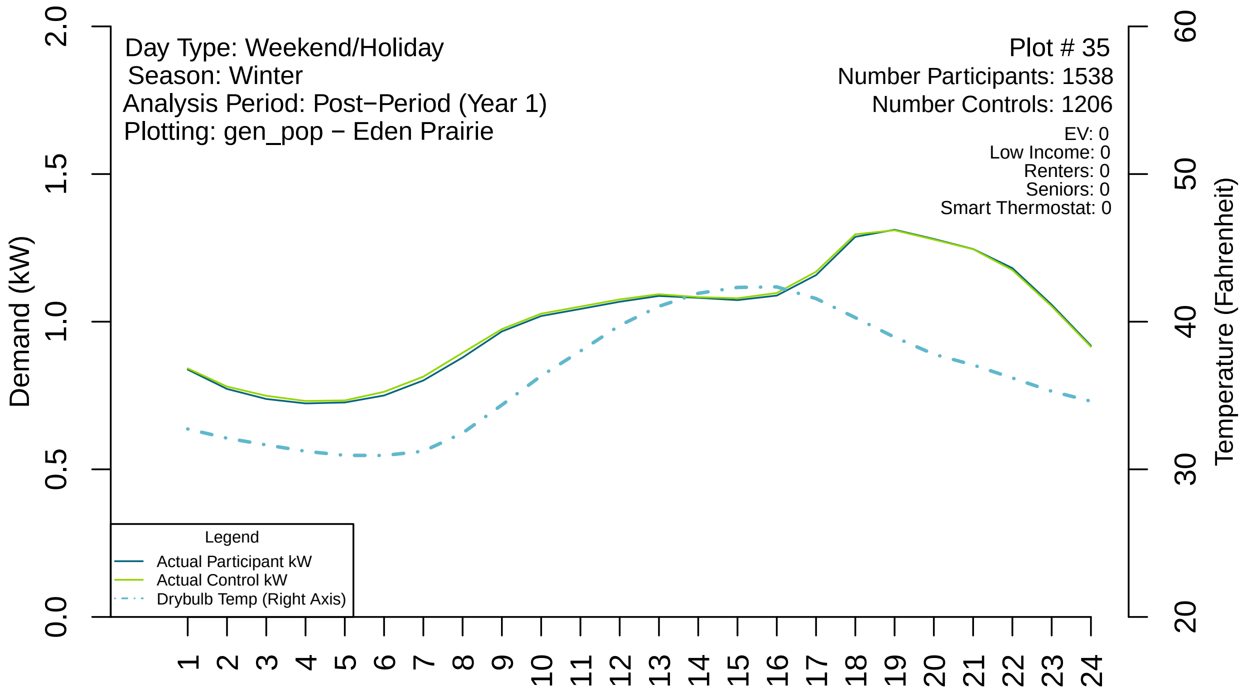

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: gen_pop − Eden Prairie
Plot # 30
Number Participants: 1538
Number Controls: 1206
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

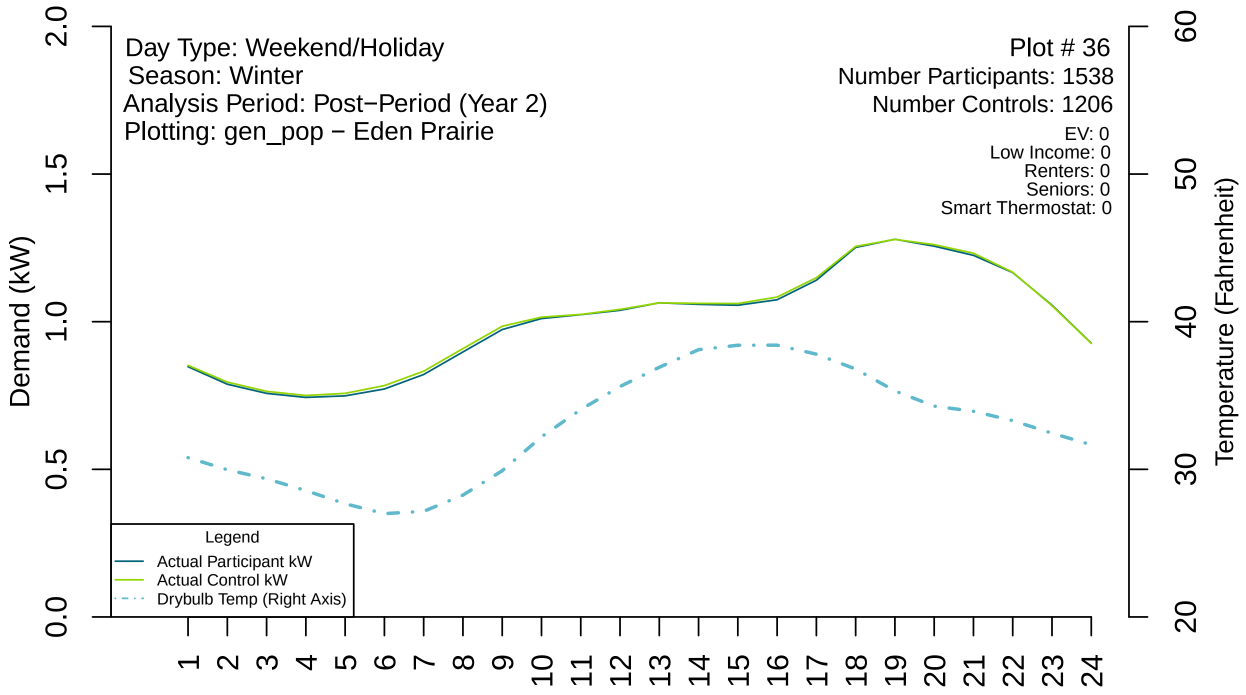

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Pre−Period
Plotting: gen_pop − Eden Prairie
Plot # 31
Number Participants: 1538
Number Controls: 1206
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

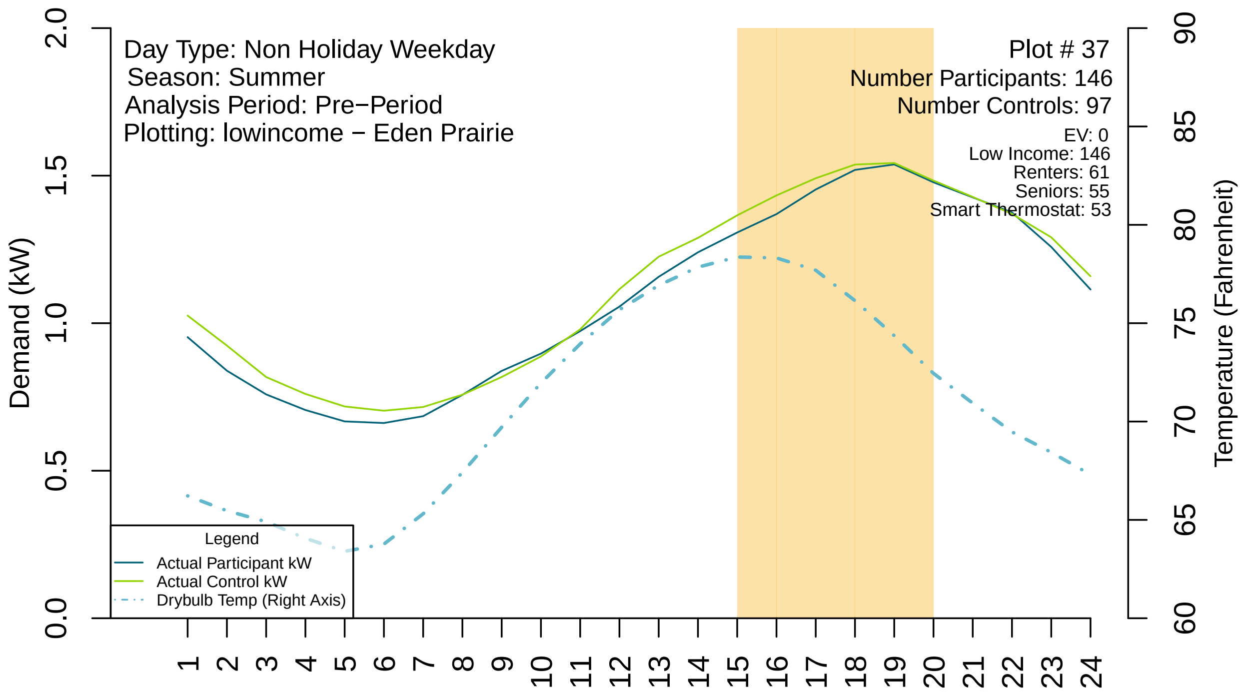

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: gen_pop − Eden Prairie
Plot # 32
Number Participants: 1538
Number Controls: 1206
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

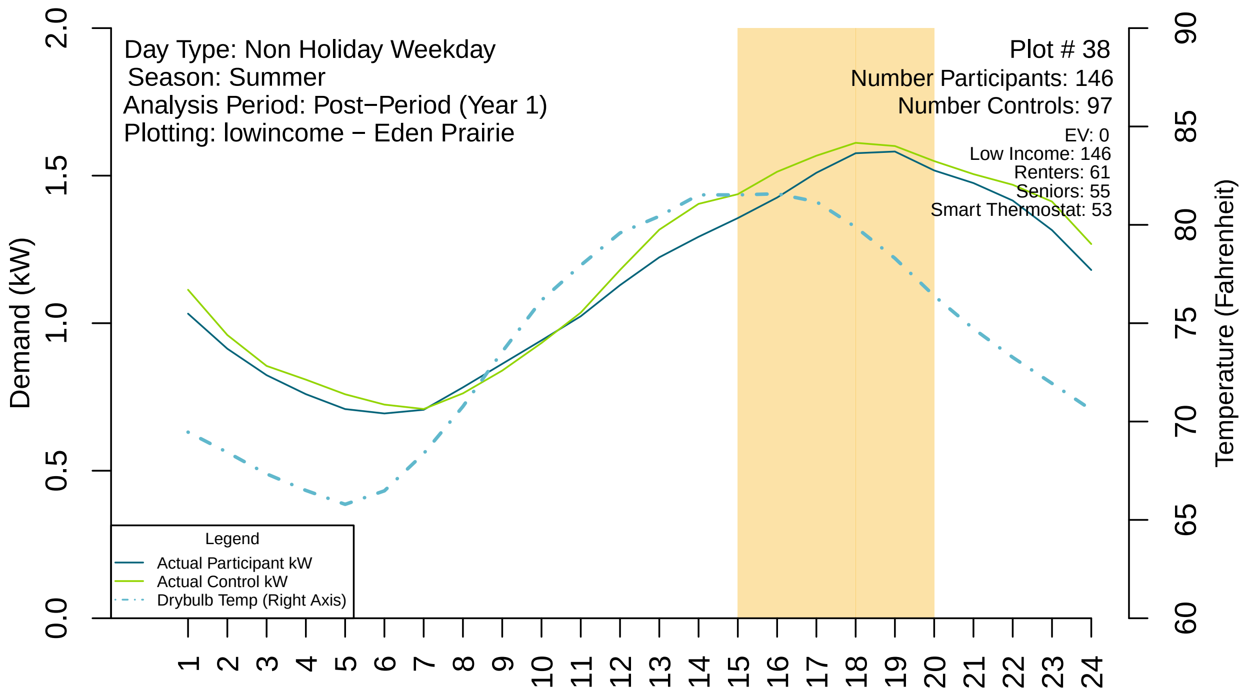

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: gen_pop − Eden Prairie
Plot # 33
Number Participants: 1538
Number Controls: 1206
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

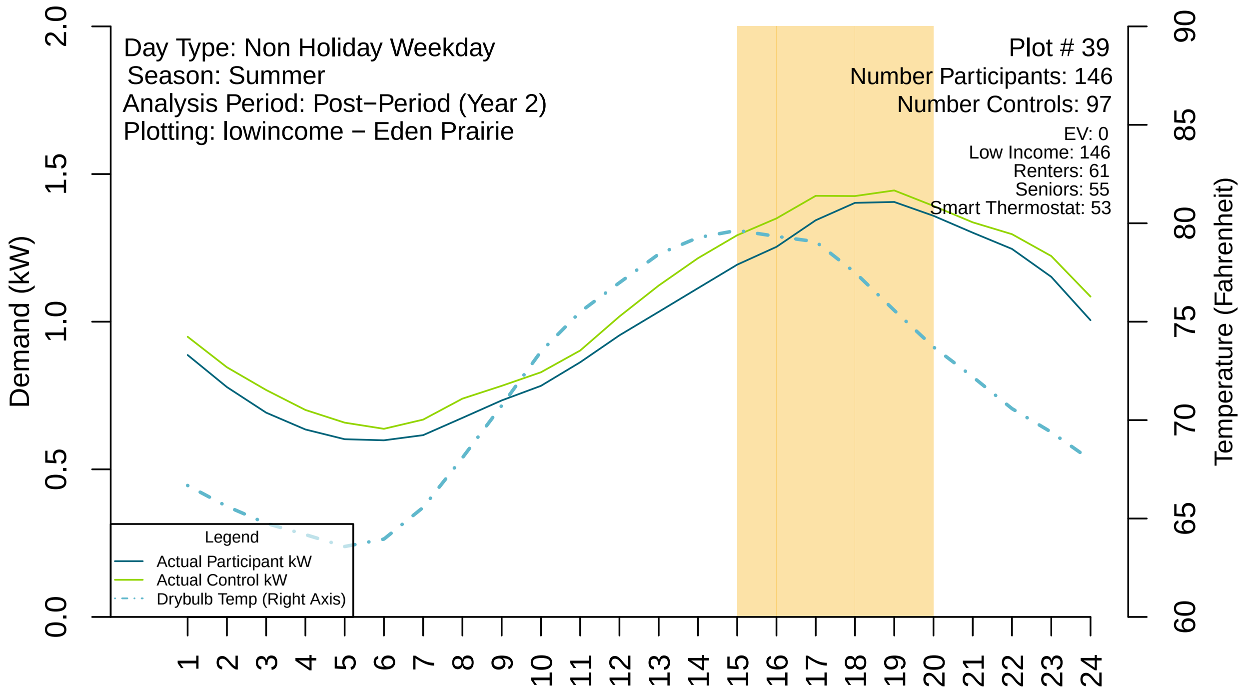

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Pre−Period
Plotting: gen_pop − Eden Prairie
Plot # 34
Number Participants: 1538
Number Controls: 1206
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

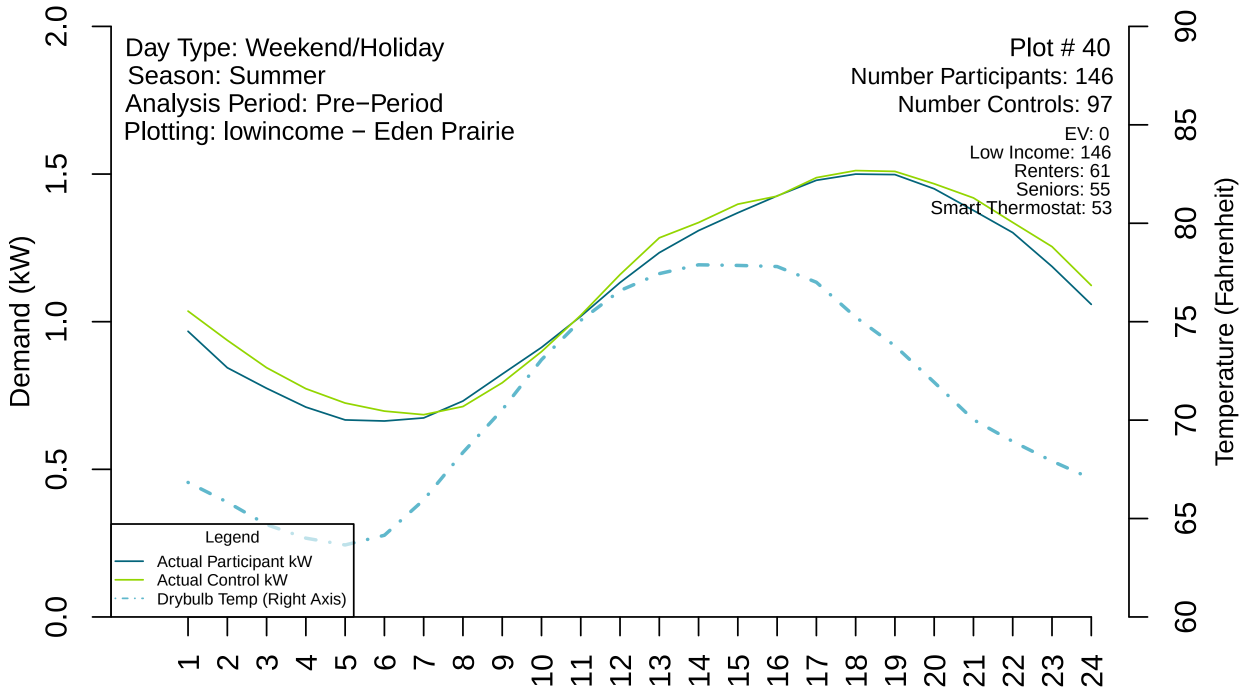

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: gen_pop − Eden Prairie
Plot # 35
Number Participants: 1538
Number Controls: 1206
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

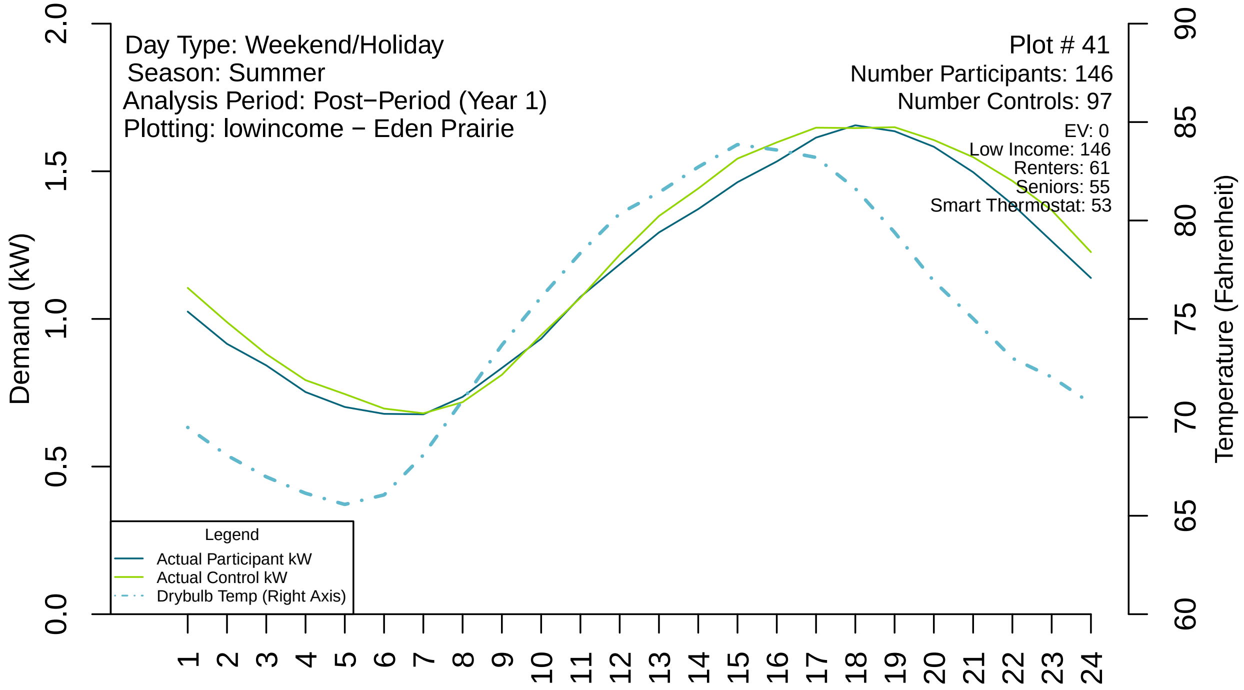

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: gen_pop − Eden Prairie
Plot # 36
Number Participants: 1538
Number Controls: 1206
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

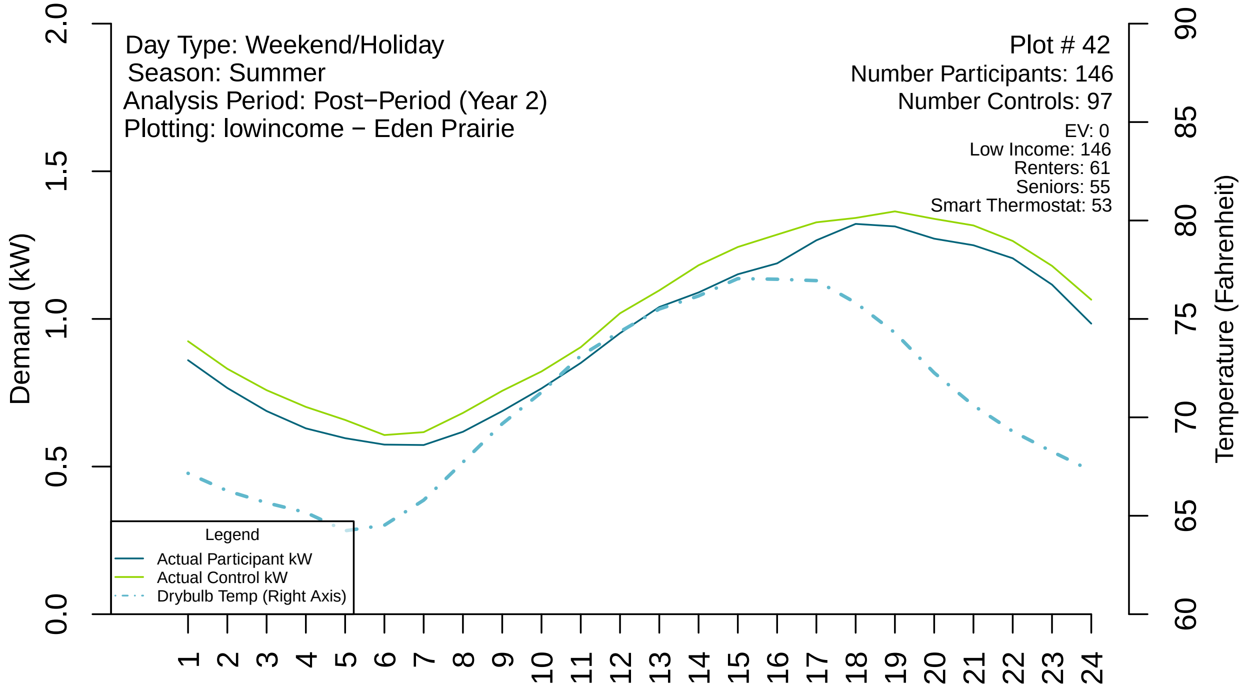

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Pre−Period
Plotting: lowincome − Eden Prairie
Plot # 37
Number Participants: 146
Number Controls: 97
EV: 0
Low Income: 146
Renters: 61
Seniors: 55
Smart Thermostat: 53
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

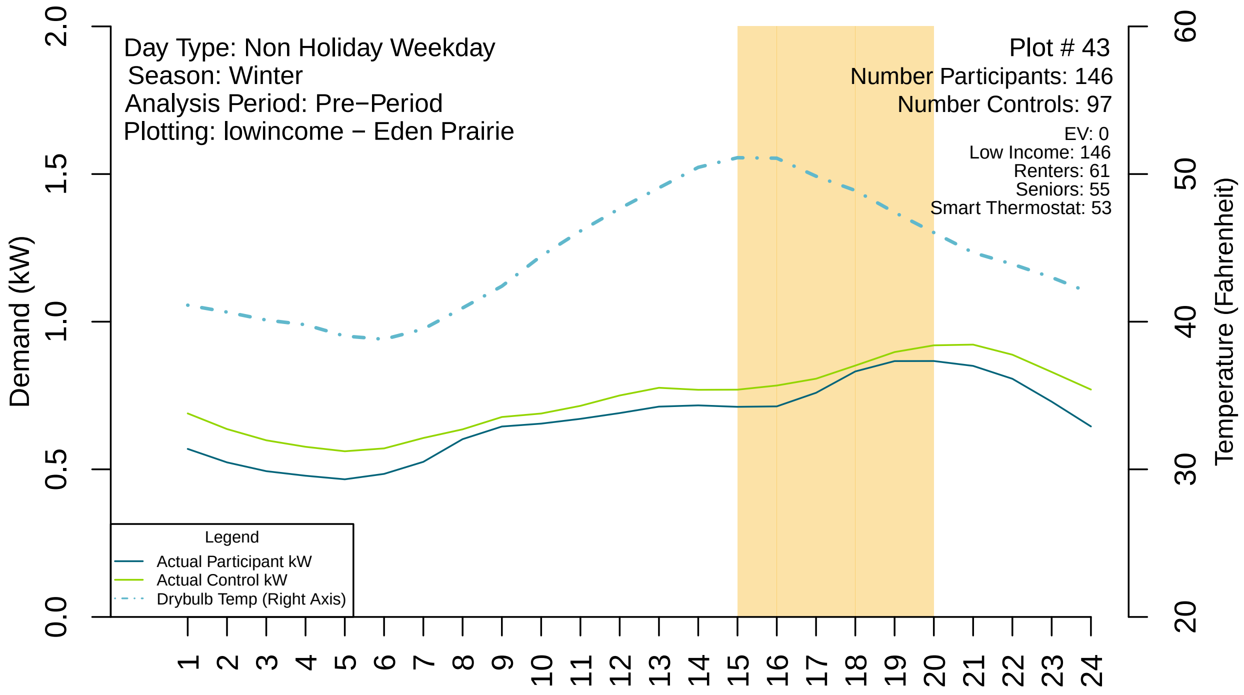

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: lowincome − Eden Prairie
Plot # 38
Number Participants: 146
Number Controls: 97
EV: 0
Low Income: 146
Renters: 61
Seniors: 55
Smart Thermostat: 53
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

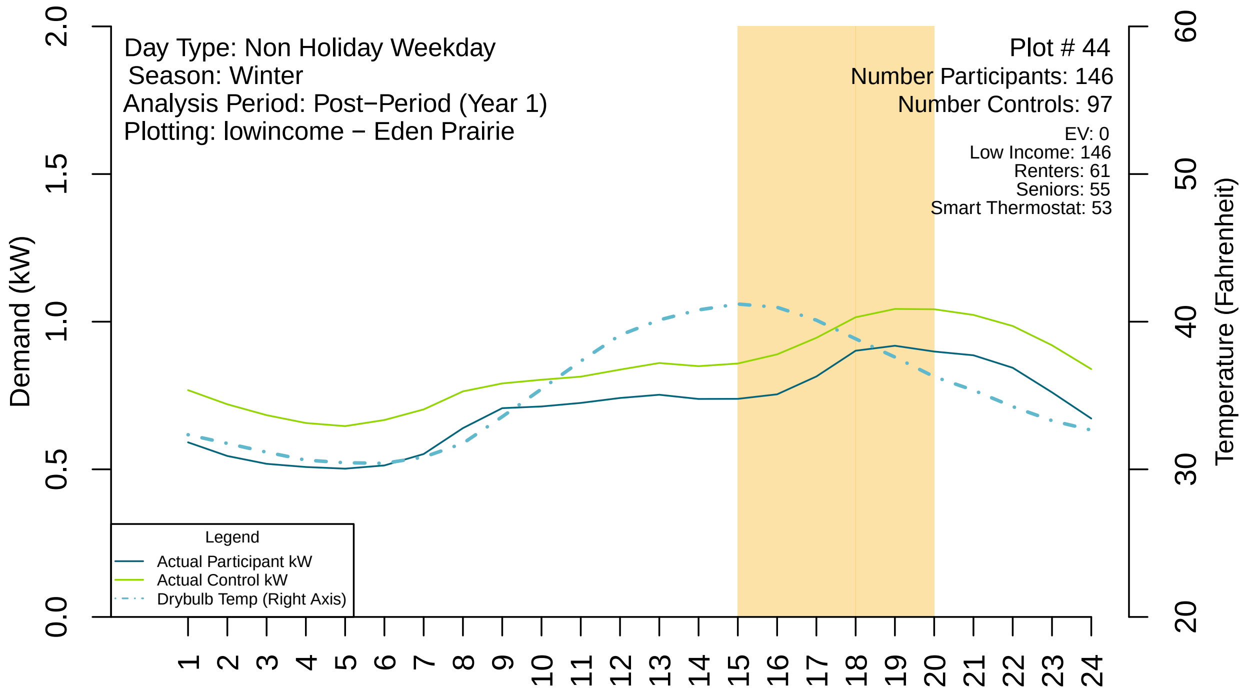

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: lowincome − Eden Prairie
Plot # 39
Number Participants: 146
Number Controls: 97
EV: 0
Low Income: 146
Renters: 61
Seniors: 55
Smart Thermostat: 53
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

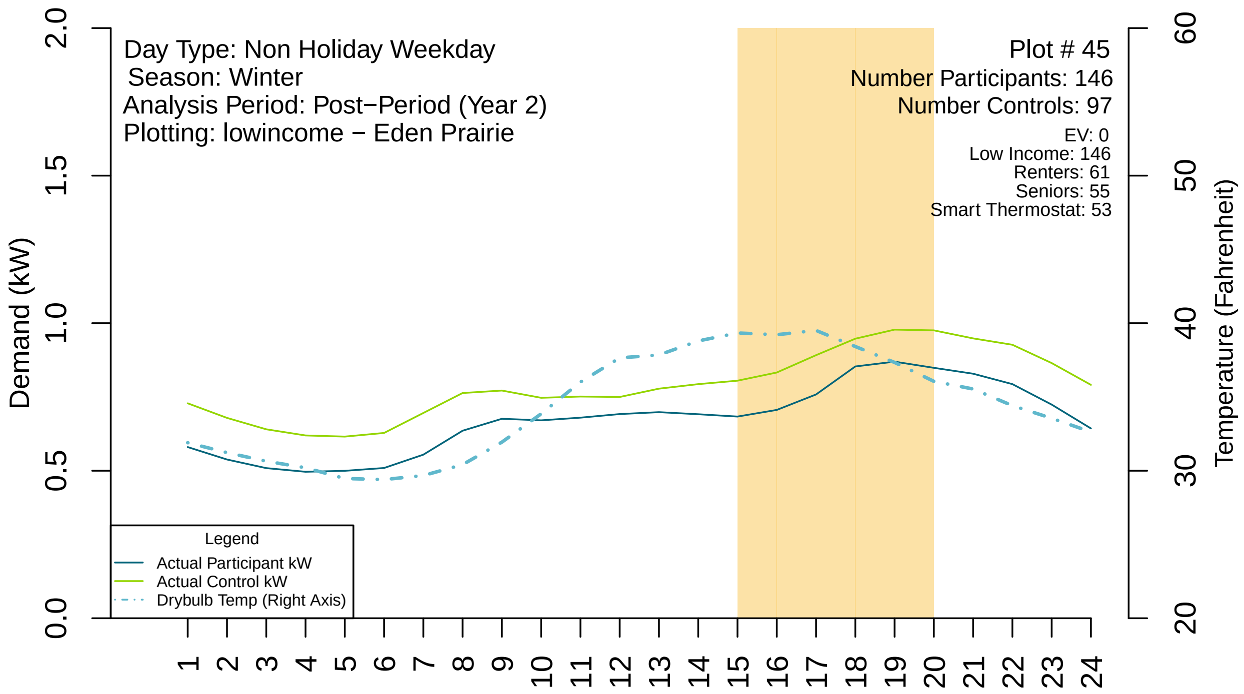

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Pre−Period
Plotting: lowincome − Eden Prairie
Plot # 40
Number Participants: 146
Number Controls: 97
EV: 0
Low Income: 146
Renters: 61
Seniors: 55
Smart Thermostat: 53
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

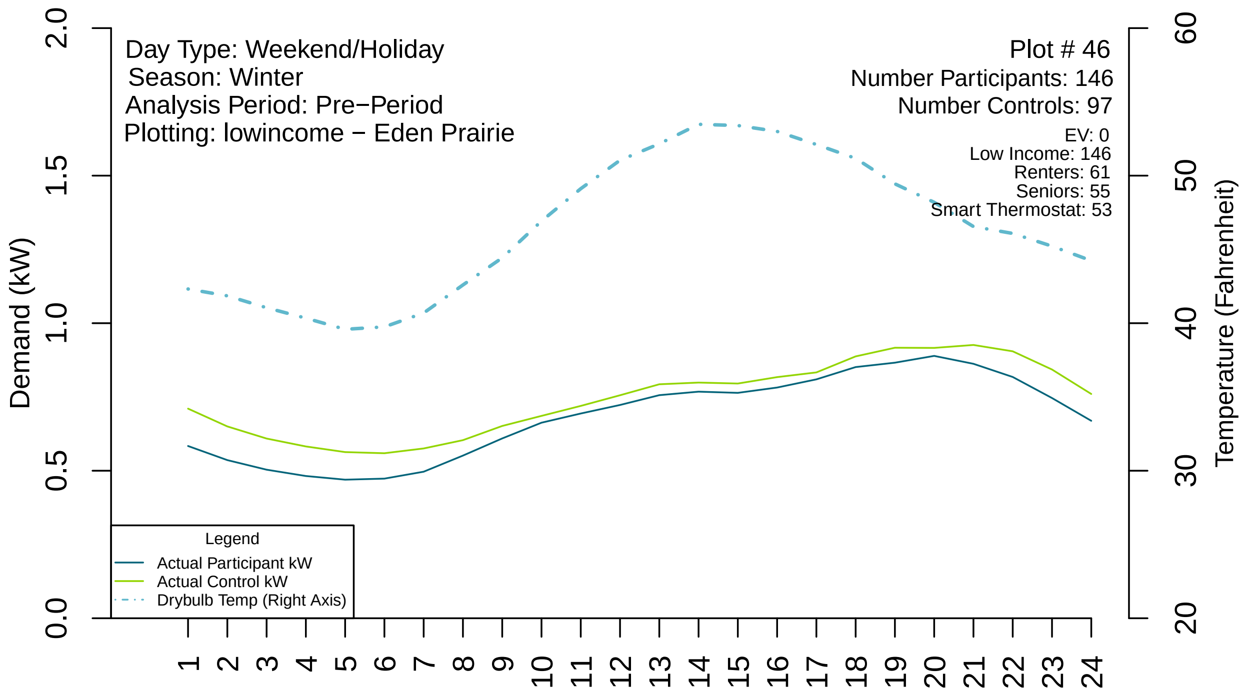

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: lowincome − Eden Prairie
Plot # 41
Number Participants: 146
Number Controls: 97
EV: 0
Low Income: 146
Renters: 61
Seniors: 55
Smart Thermostat: 53
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

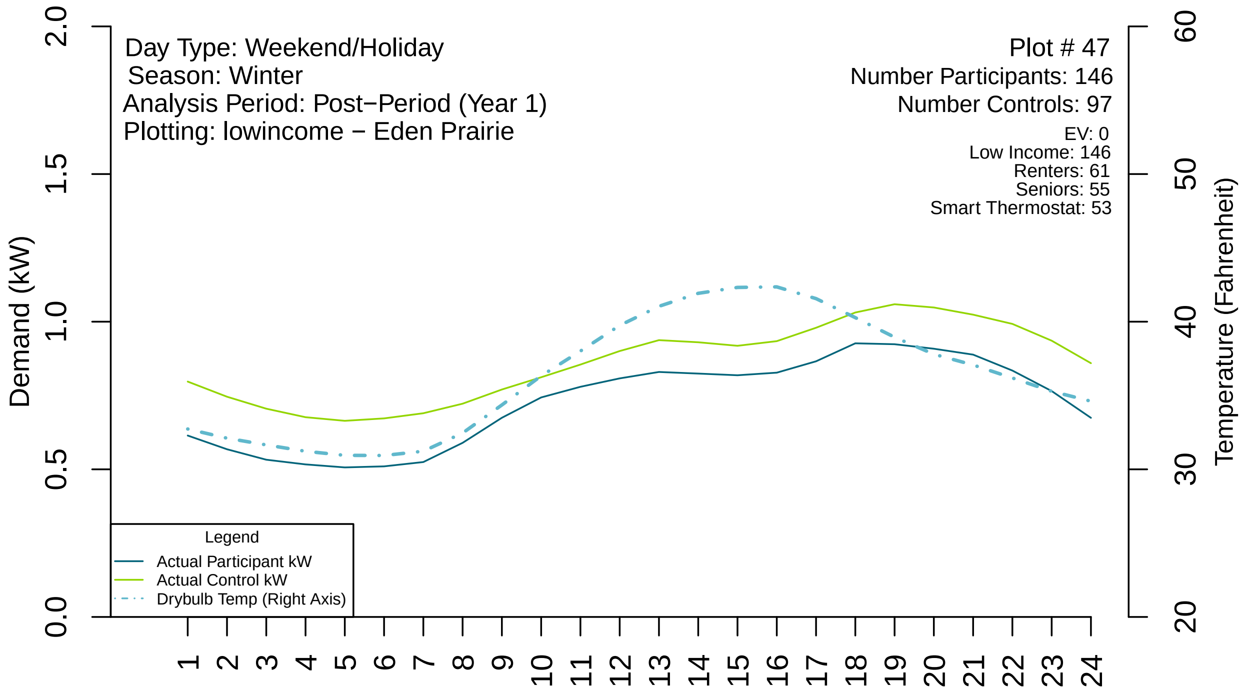

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: lowincome − Eden Prairie
Plot # 42
Number Participants: 146
Number Controls: 97
EV: 0
Low Income: 146
Renters: 61
Seniors: 55
Smart Thermostat: 53
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

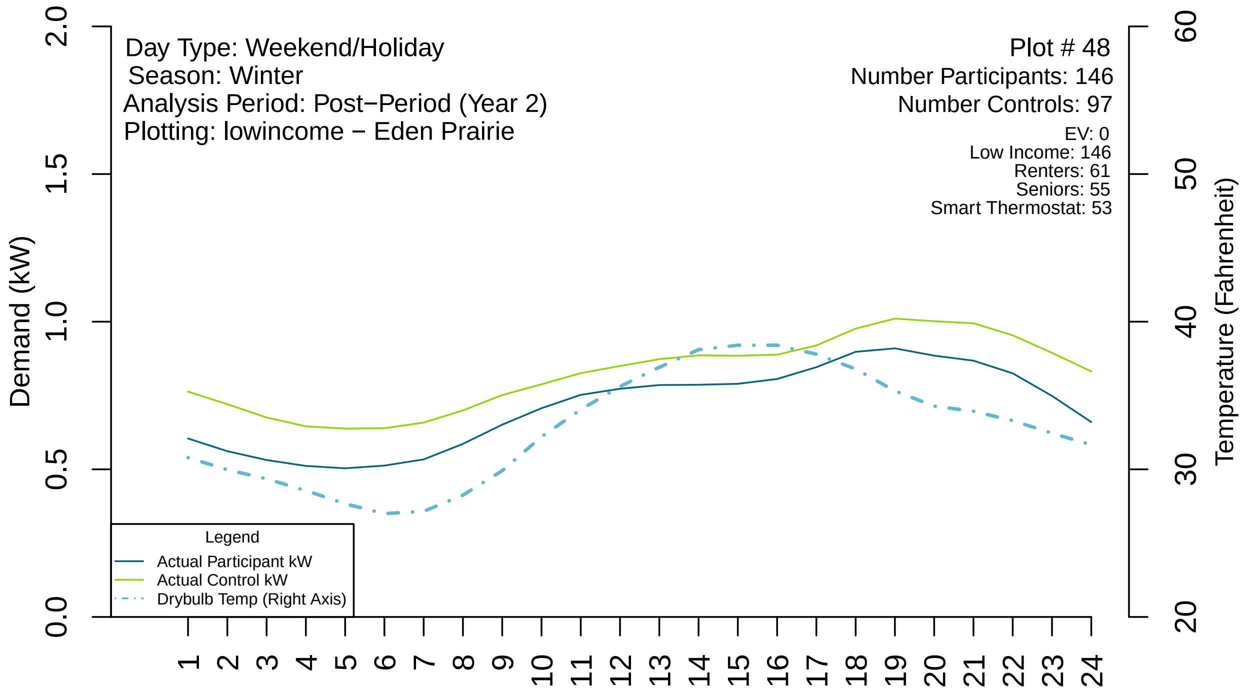

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Pre−Period
Plotting: lowincome − Eden Prairie
Plot # 43
Number Participants: 146
Number Controls: 97
EV: 0
Low Income: 146
Renters: 61
Seniors: 55
Smart Thermostat: 53
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

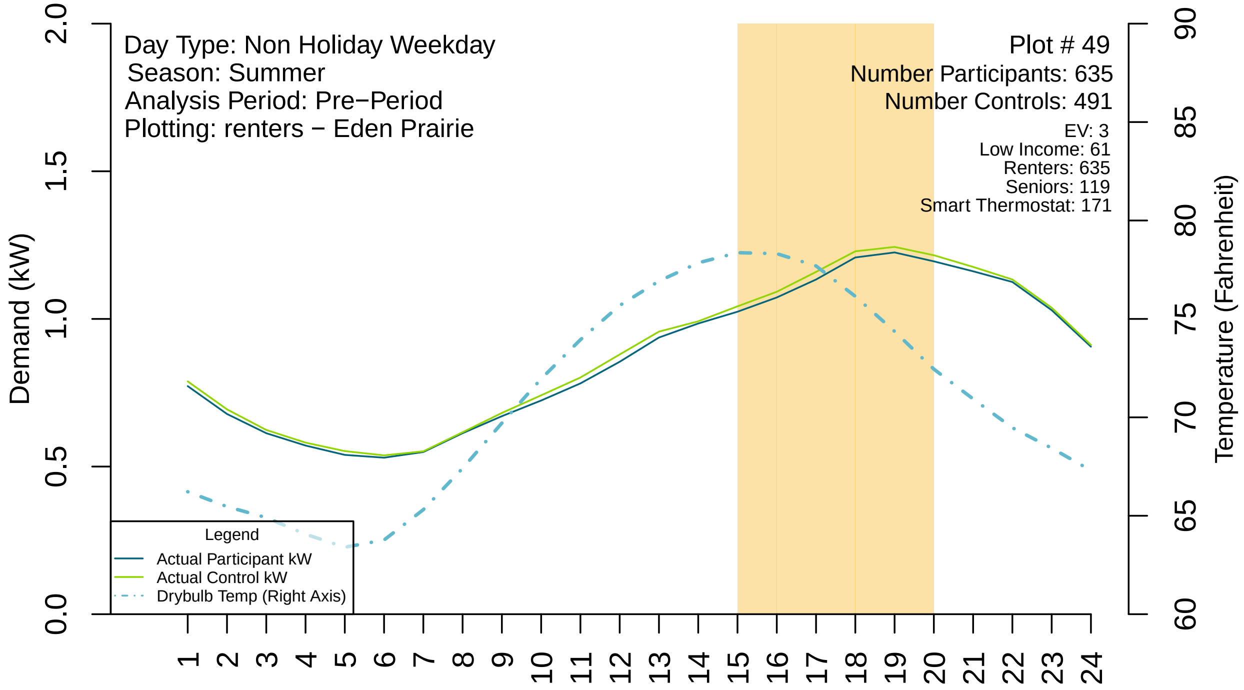

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: lowincome − Eden Prairie
Plot # 44
Number Participants: 146
Number Controls: 97
EV: 0
Low Income: 146
Renters: 61
Seniors: 55
Smart Thermostat: 53
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

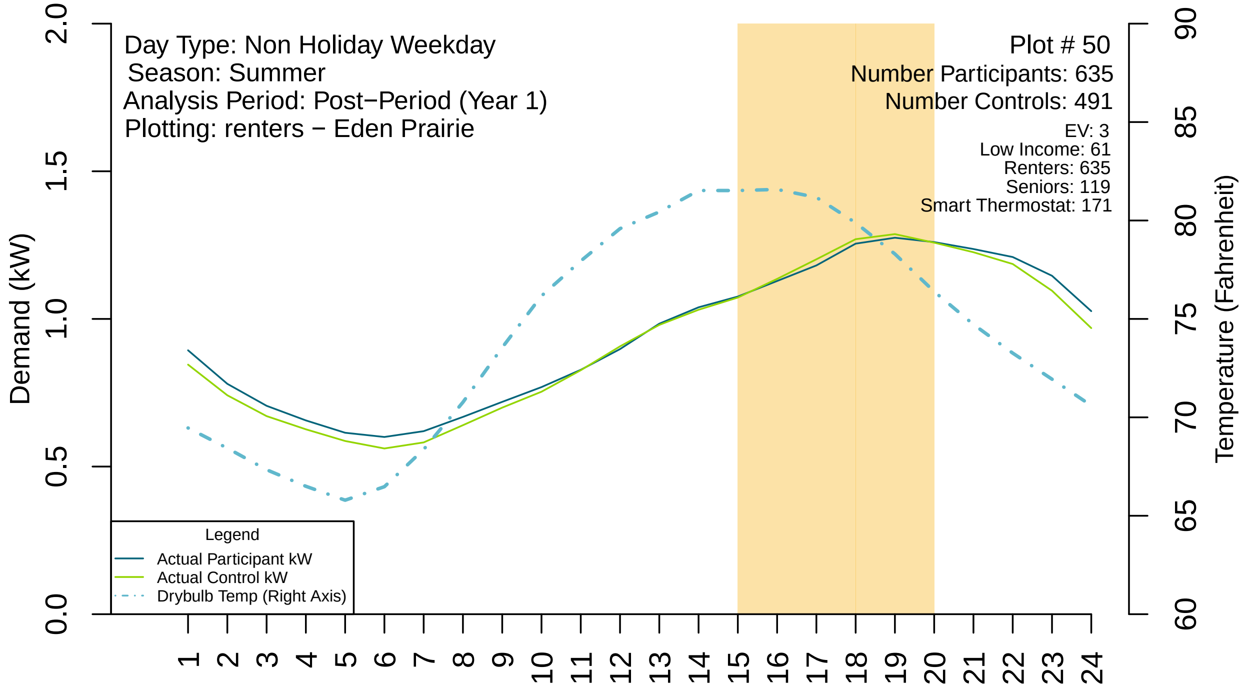

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: lowincome − Eden Prairie
Plot # 45
Number Participants: 146
Number Controls: 97
EV: 0
Low Income: 146
Renters: 61
Seniors: 55
Smart Thermostat: 53
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

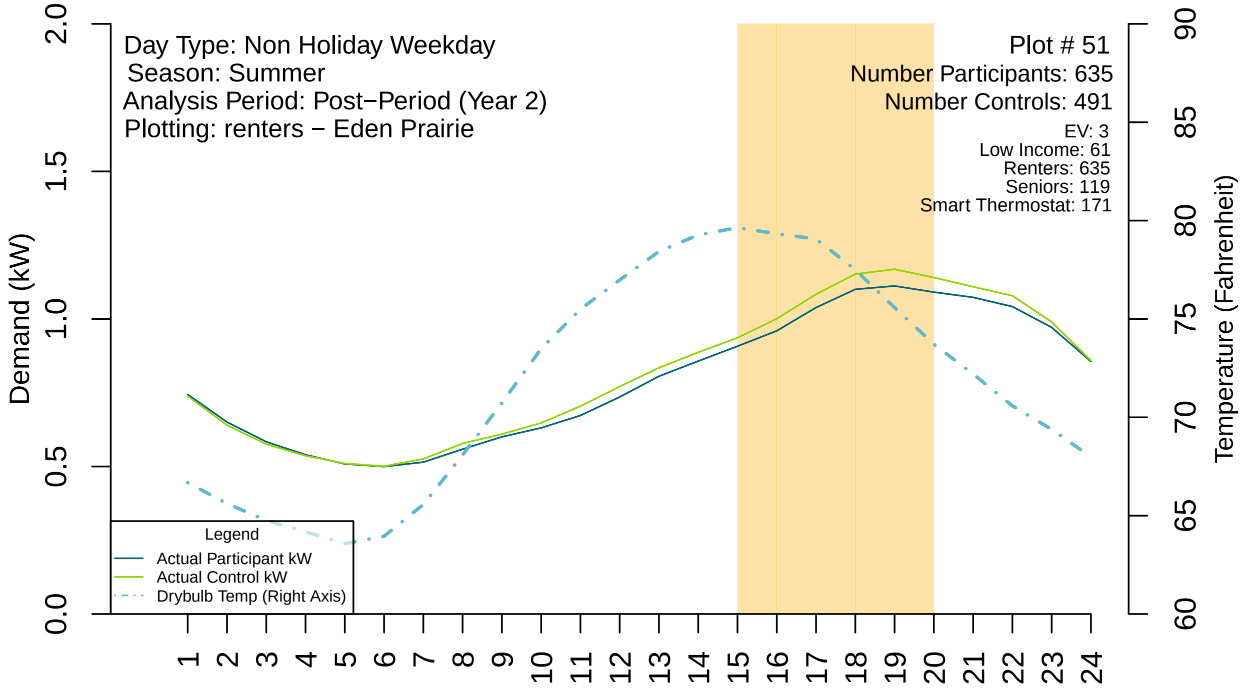

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Pre−Period
Plotting: lowincome − Eden Prairie
Plot # 46
Number Participants: 146
Number Controls: 97
EV: 0
Low Income: 146
Renters: 61
Seniors: 55
Smart Thermostat: 53
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

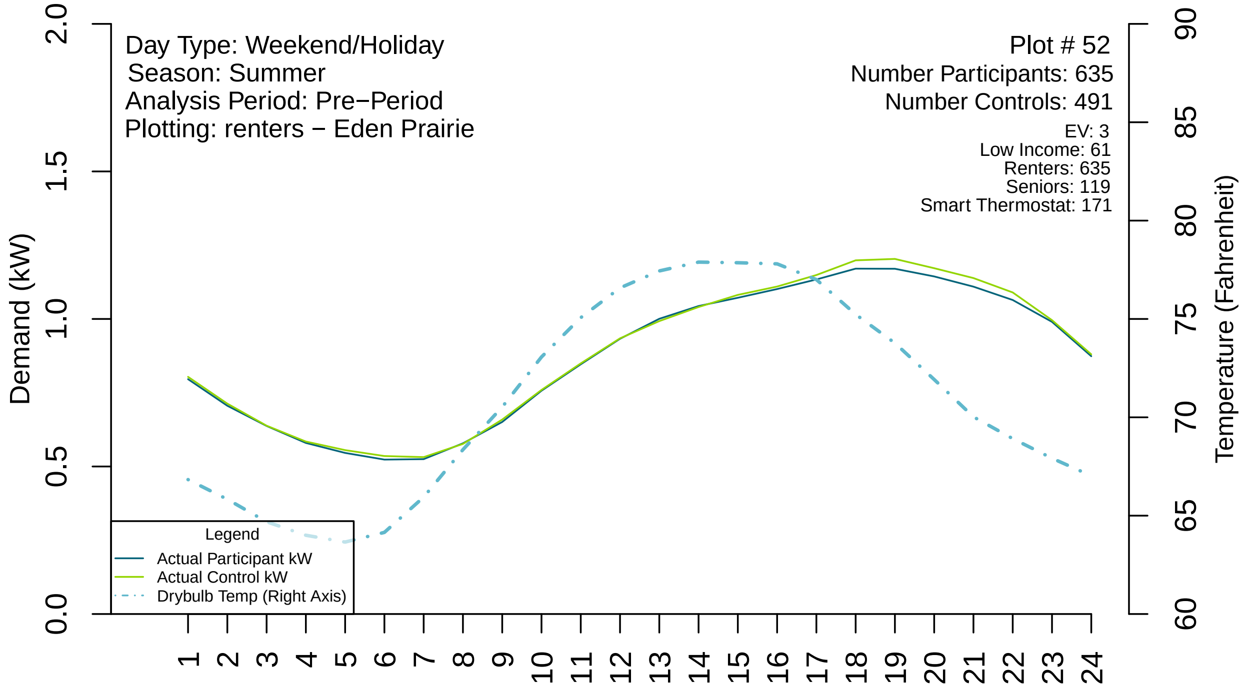

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: lowincome − Eden Prairie
Plot # 47
Number Participants: 146
Number Controls: 97
EV: 0
Low Income: 146
Renters: 61
Seniors: 55
Smart Thermostat: 53
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

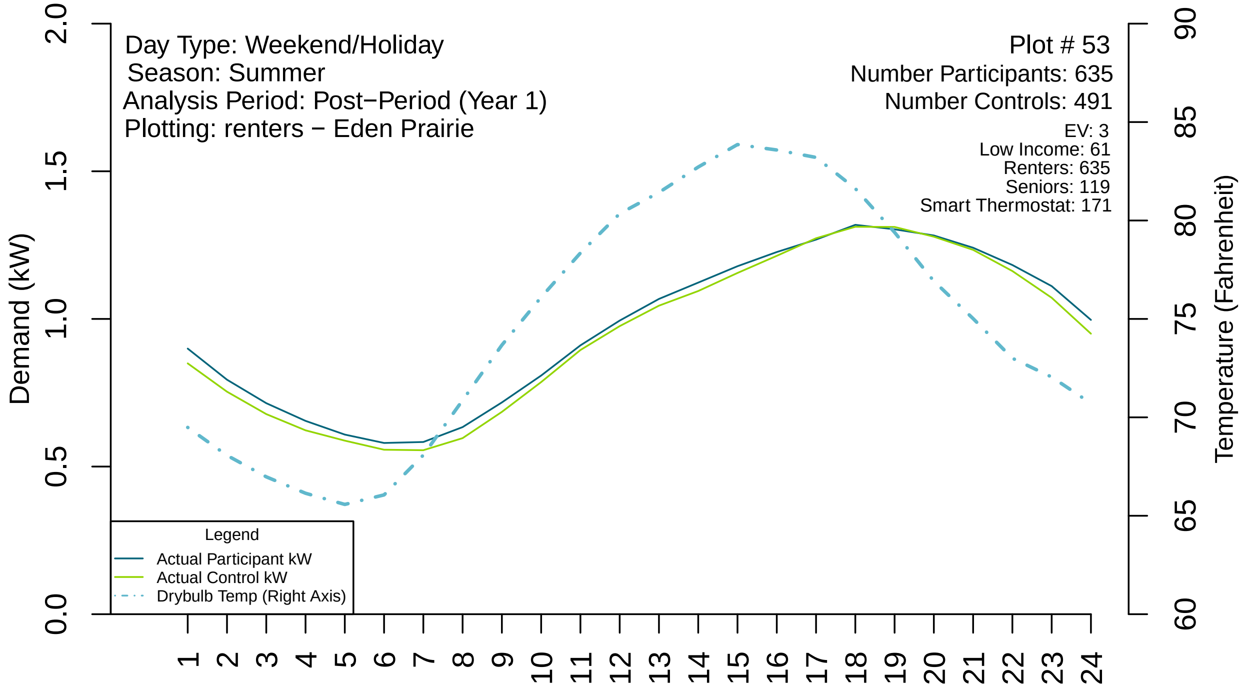

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: lowincome − Eden Prairie
Plot # 48
Number Participants: 146
Number Controls: 97
EV: 0
Low Income: 146
Renters: 61
Seniors: 55
Smart Thermostat: 53
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

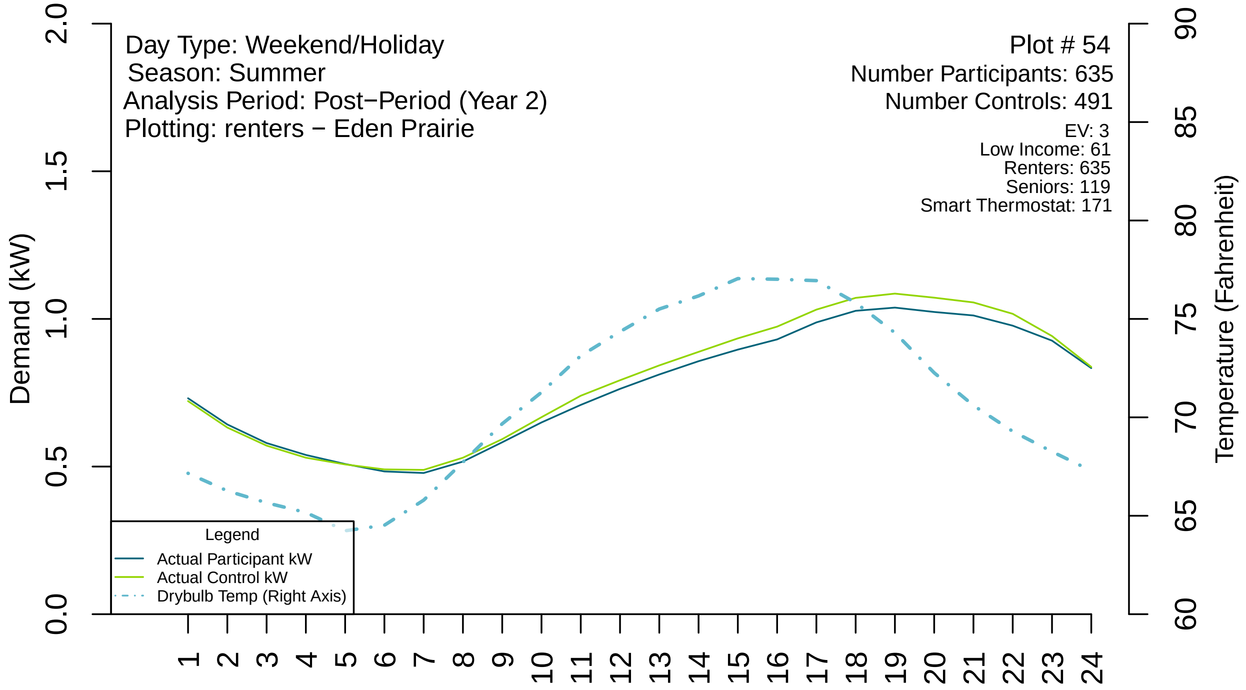

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Pre−Period
Plotting: renters − Eden Prairie
Plot # 49
Number Participants: 635
Number Controls: 491
EV: 3
Low Income: 61
Renters: 635
Seniors: 119
Smart Thermostat: 171
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

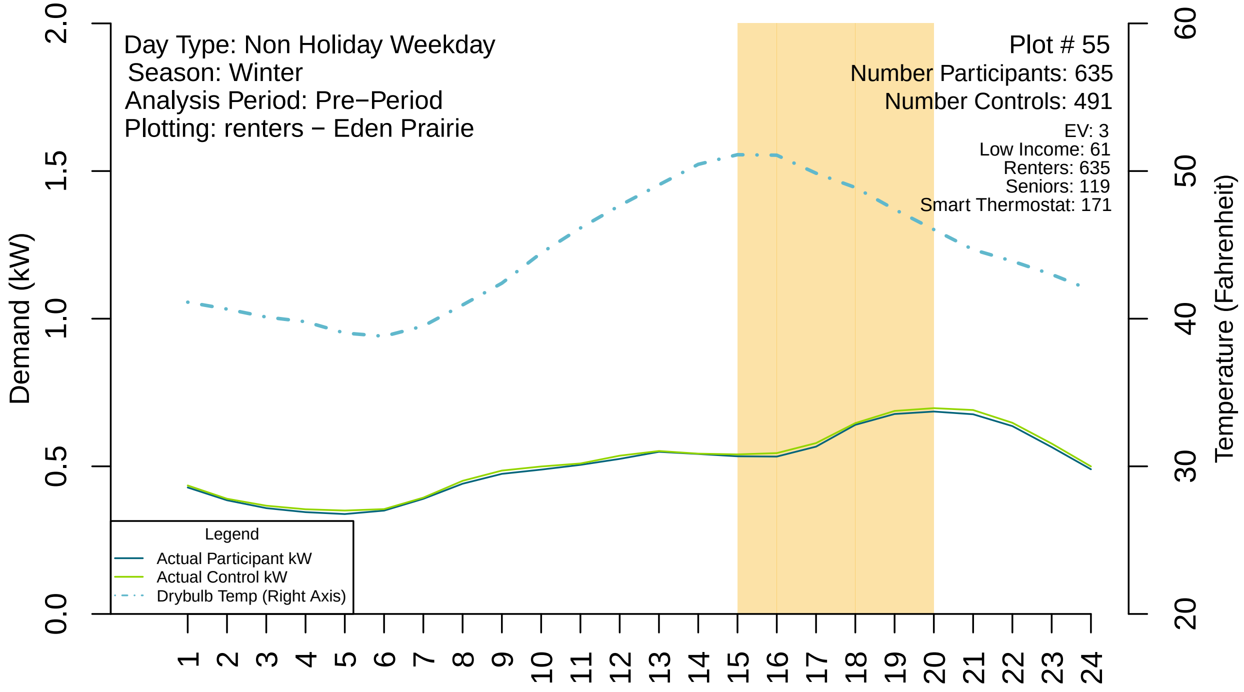

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: renters − Eden Prairie
Plot # 50
Number Participants: 635
Number Controls: 491
EV: 3
Low Income: 61
Renters: 635
Seniors: 119
Smart Thermostat: 171
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

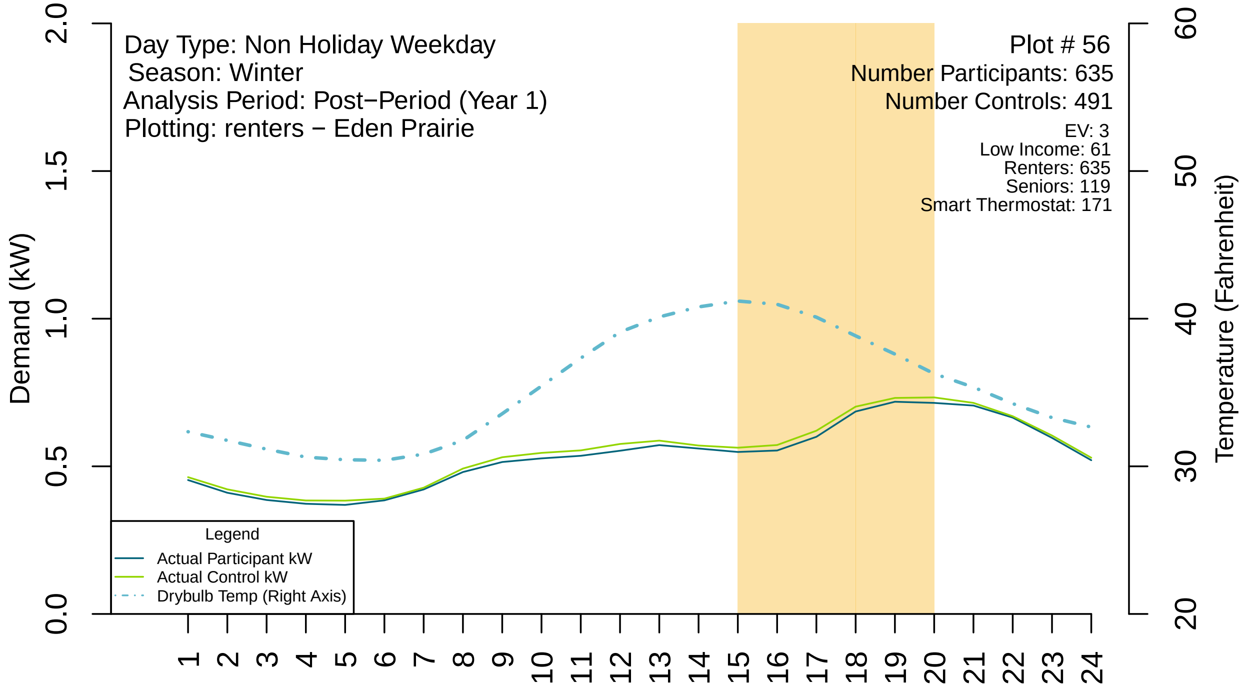

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: renters − Eden Prairie
Plot # 51
Number Participants: 635
Number Controls: 491
EV: 3
Low Income: 61
Renters: 635
Seniors: 119
Smart Thermostat: 171
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

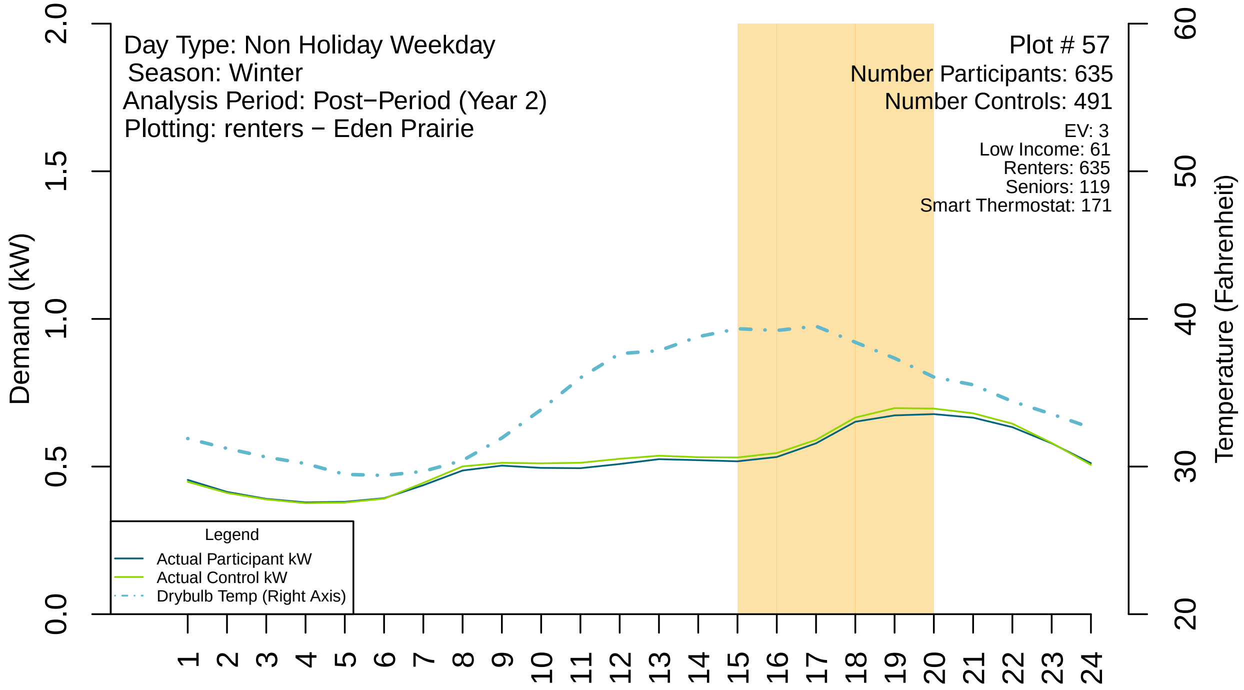

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Pre−Period
Plotting: renters − Eden Prairie
Plot # 52
Number Participants: 635
Number Controls: 491
EV: 3
Low Income: 61
Renters: 635
Seniors: 119
Smart Thermostat: 171
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

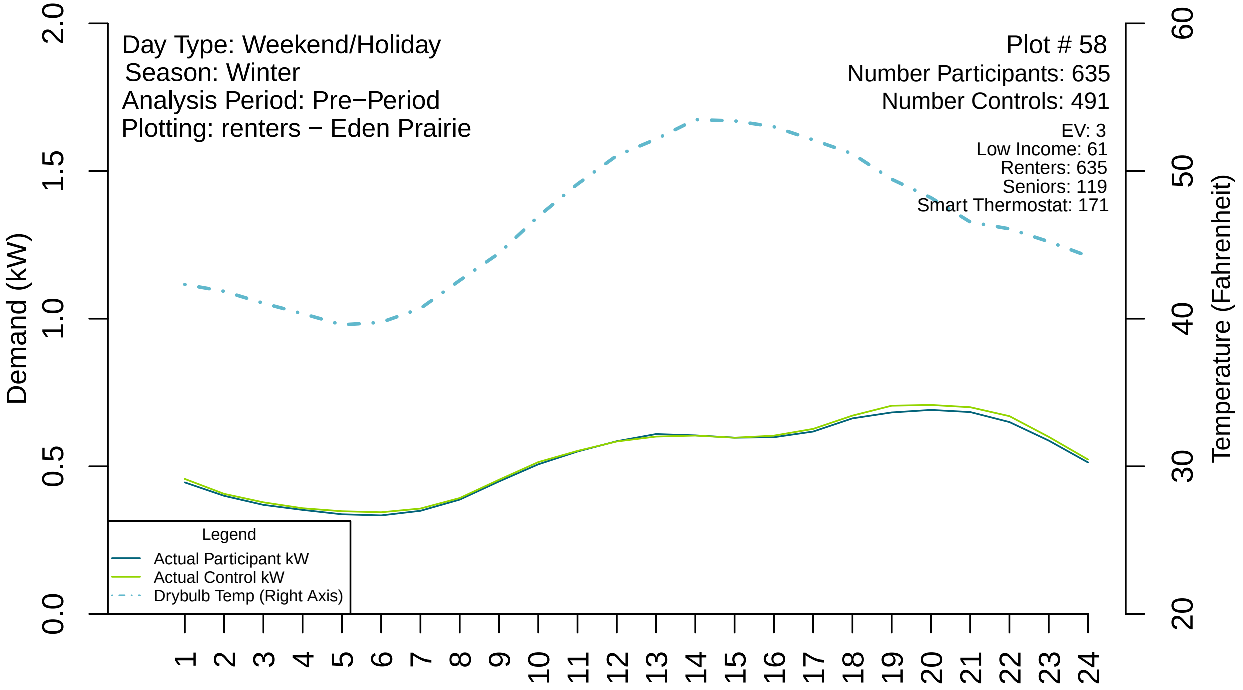

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: renters − Eden Prairie
Plot # 53
Number Participants: 635
Number Controls: 491
EV: 3
Low Income: 61
Renters: 635
Seniors: 119
Smart Thermostat: 171
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

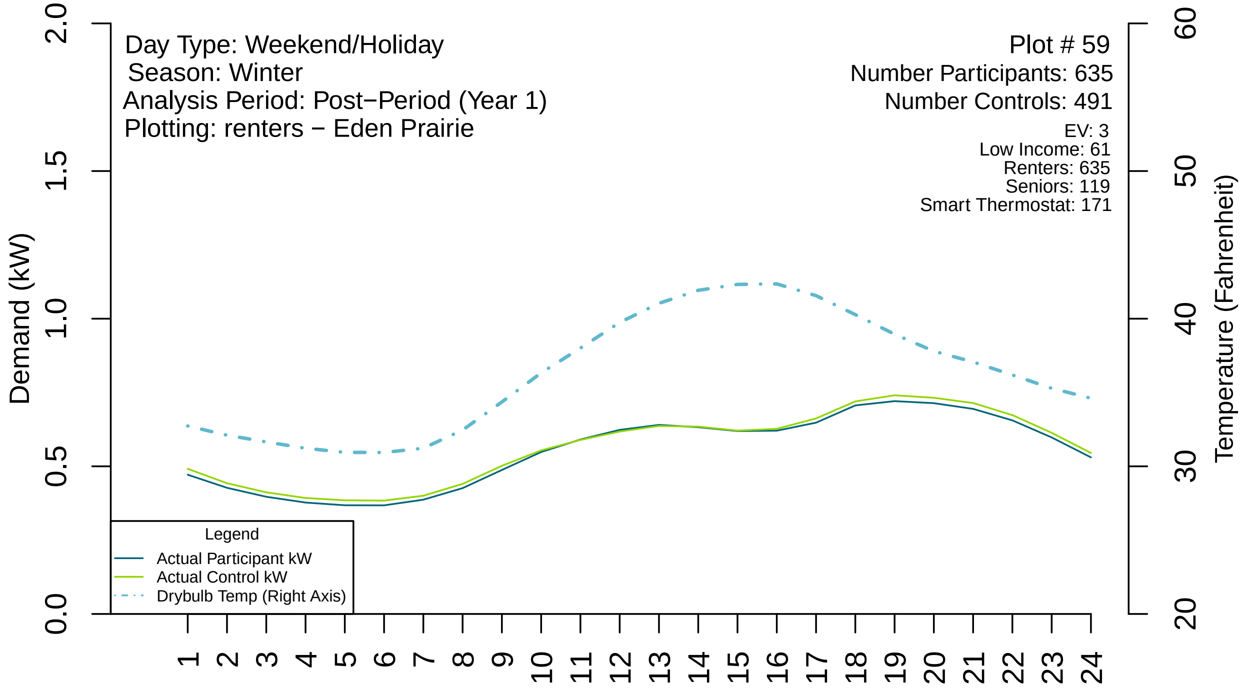

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: renters − Eden Prairie
Plot # 54
Number Participants: 635
Number Controls: 491
EV: 3
Low Income: 61
Renters: 635
Seniors: 119
Smart Thermostat: 171
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

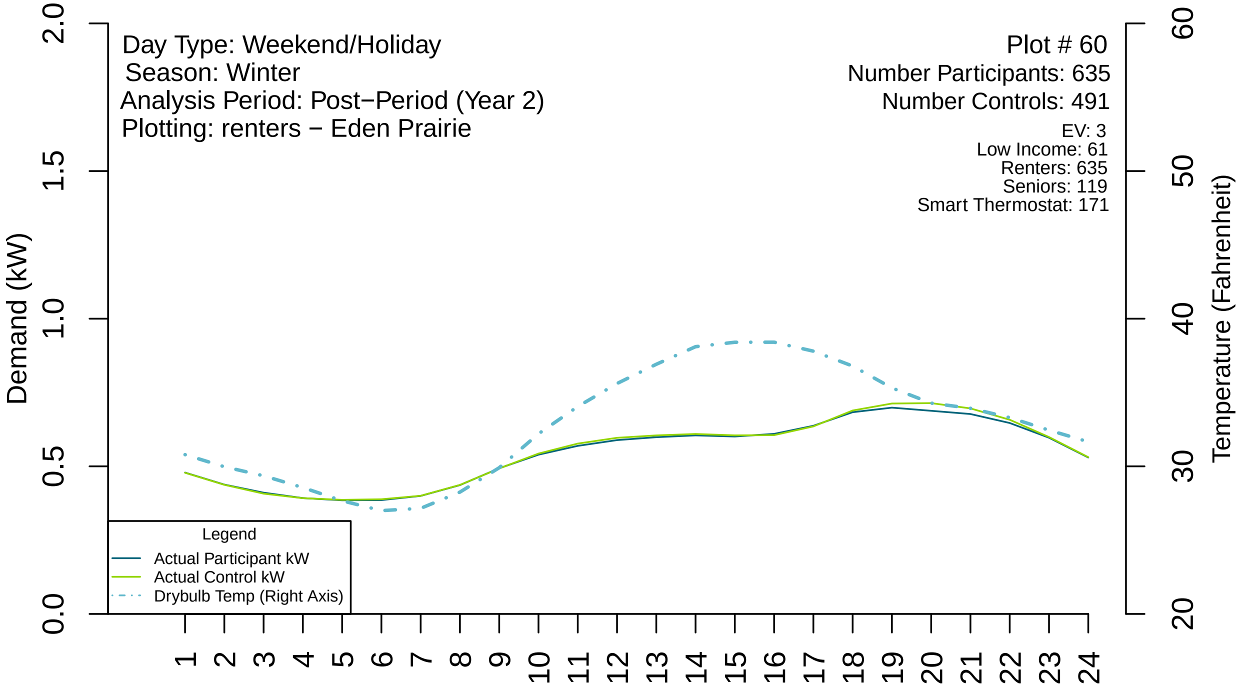

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Pre−Period
Plotting: renters − Eden Prairie
Plot # 55
Number Participants: 635
Number Controls: 491
EV: 3
Low Income: 61
Renters: 635
Seniors: 119
Smart Thermostat: 171
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

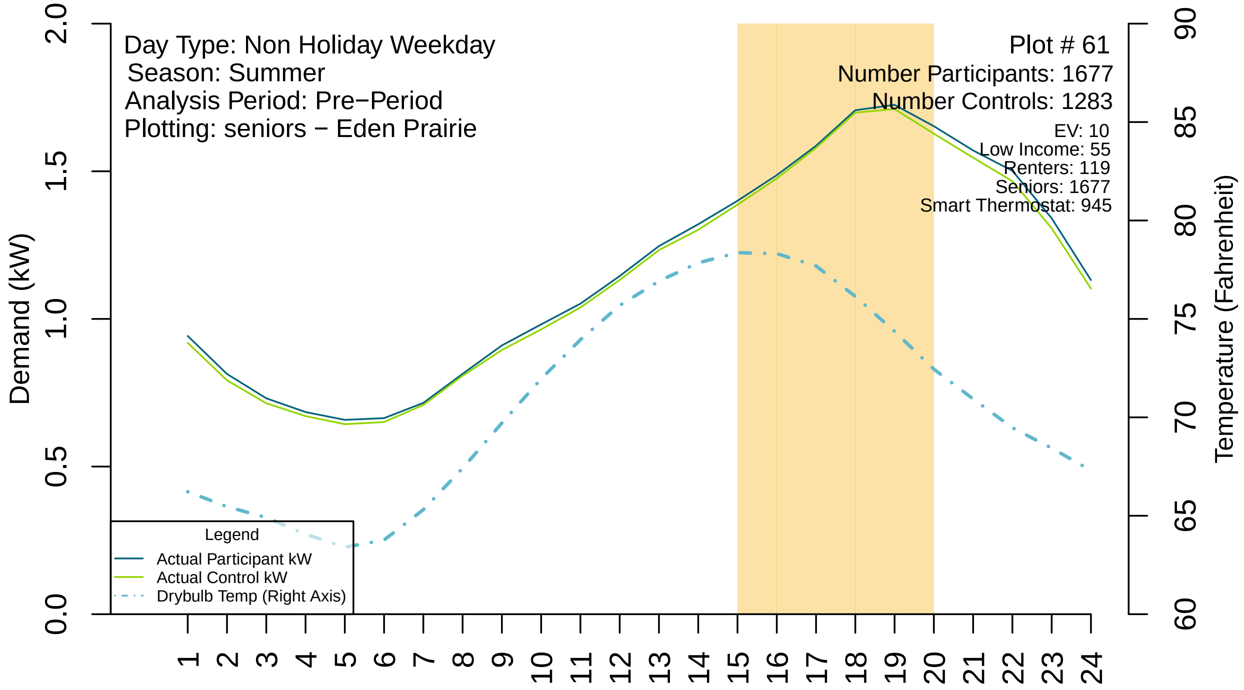

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: renters − Eden Prairie
Plot # 56
Number Participants: 635
Number Controls: 491
EV: 3
Low Income: 61
Renters: 635
Seniors: 119
Smart Thermostat: 171
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

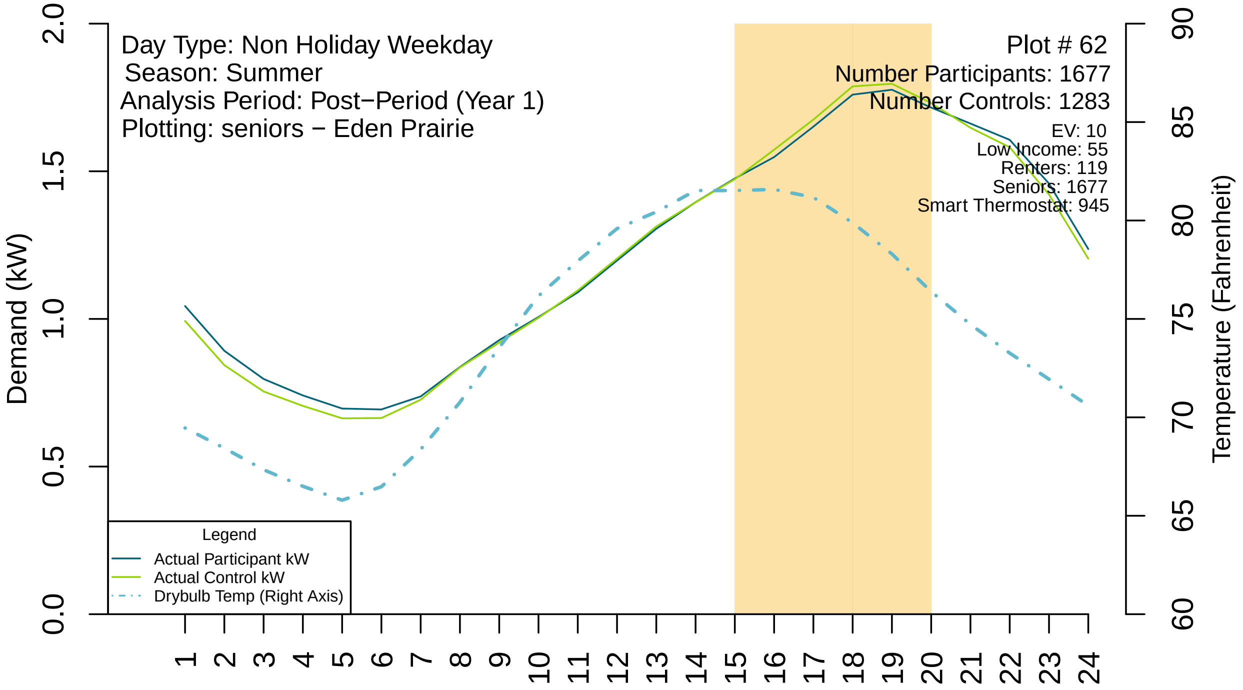

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: renters − Eden Prairie
Plot # 57
Number Participants: 635
Number Controls: 491
EV: 3
Low Income: 61
Renters: 635
Seniors: 119
Smart Thermostat: 171
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

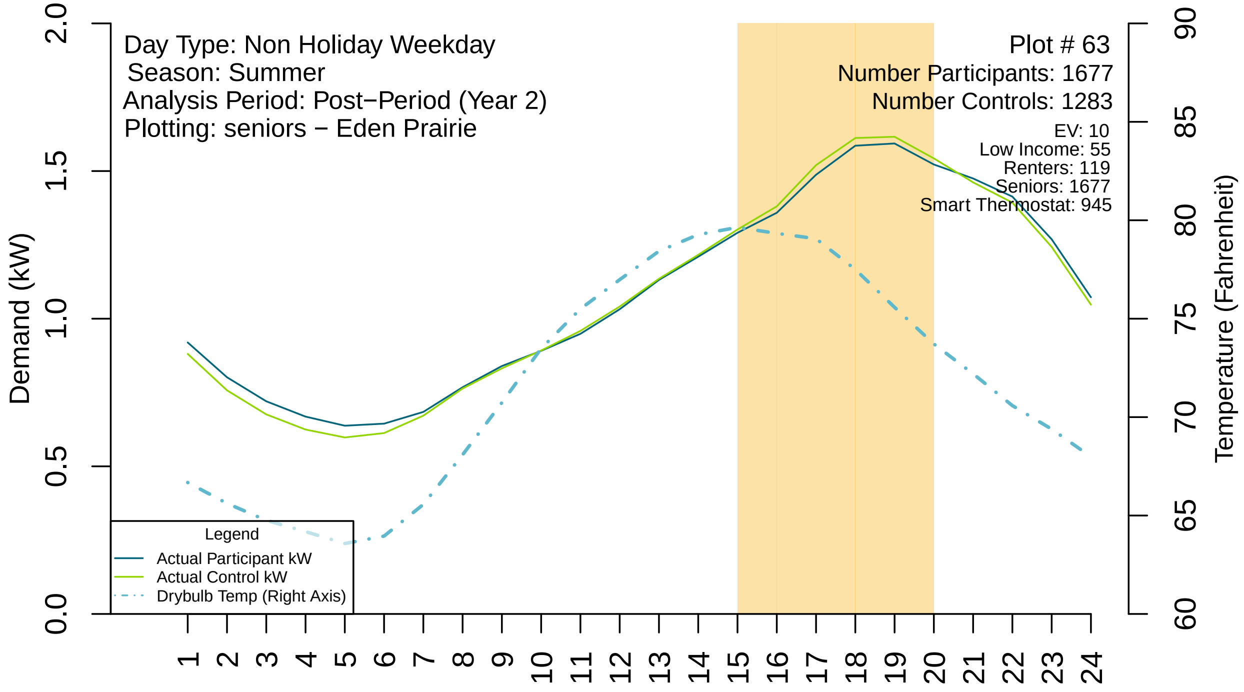

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Pre−Period
Plotting: renters − Eden Prairie
Plot # 58
Number Participants: 635
Number Controls: 491
EV: 3
Low Income: 61
Renters: 635
Seniors: 119
Smart Thermostat: 171
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

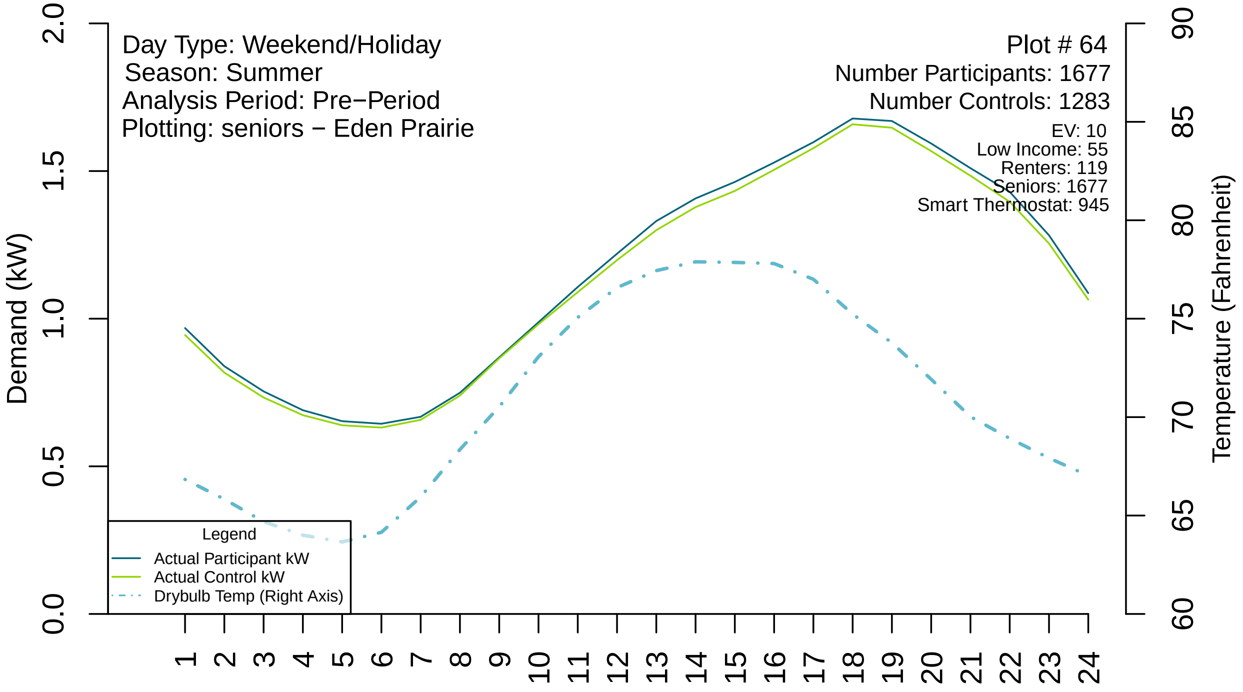

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: renters − Eden Prairie
Plot # 59
Number Participants: 635
Number Controls: 491
EV: 3
Low Income: 61
Renters: 635
Seniors: 119
Smart Thermostat: 171
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

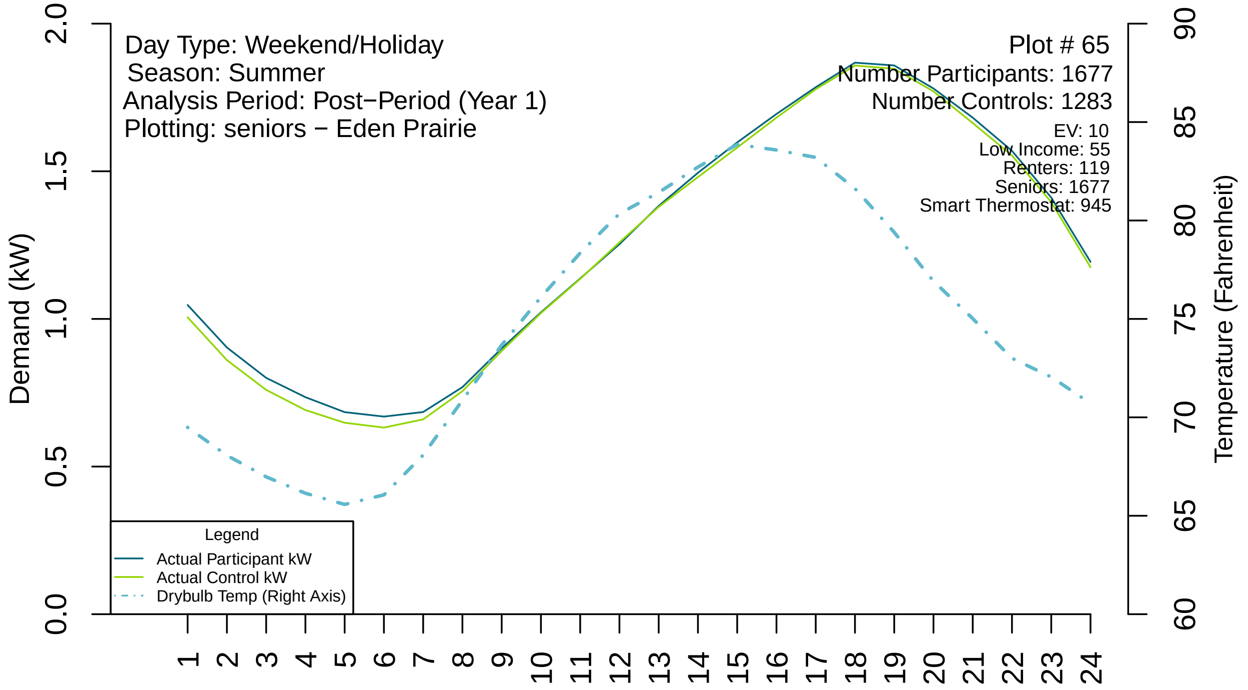

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: renters − Eden Prairie
Plot # 60
Number Participants: 635
Number Controls: 491
EV: 3
Low Income: 61
Renters: 635
Seniors: 119
Smart Thermostat: 171
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

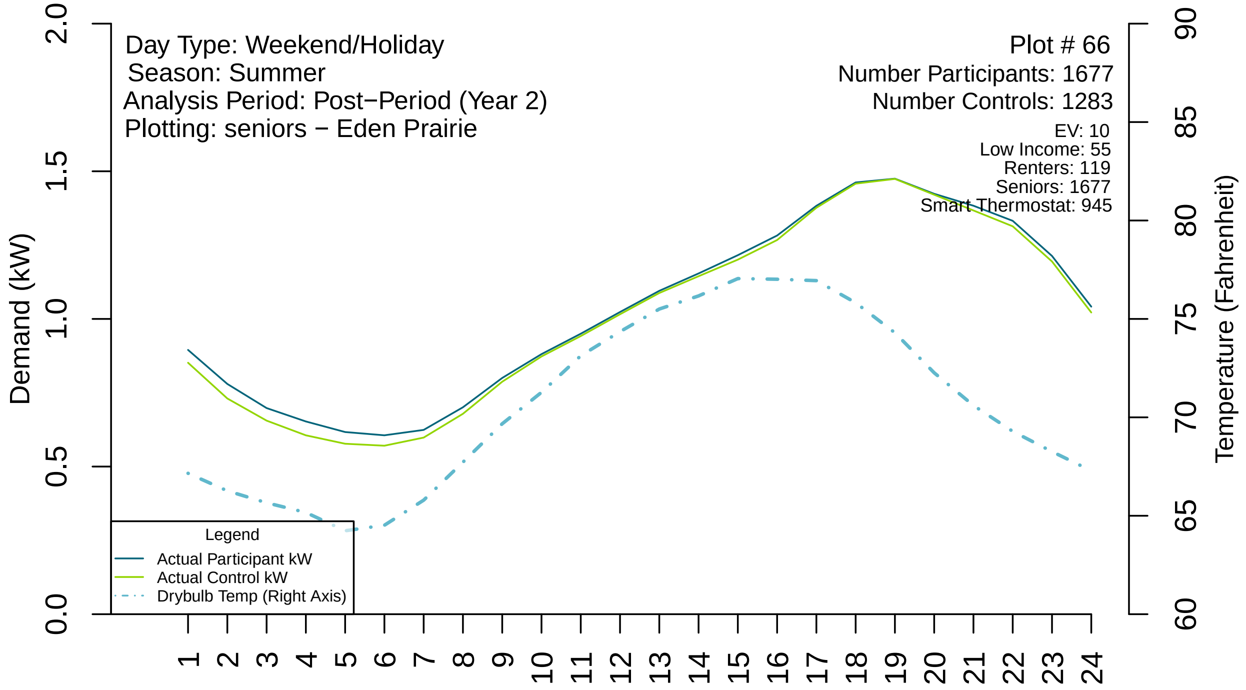

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Pre−Period
Plotting: seniors − Eden Prairie
Plot # 61
Number Participants: 1677
Number Controls: 1283
EV: 10
Low Income: 55
Renters: 119
Seniors: 1677
Smart Thermostat: 945
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

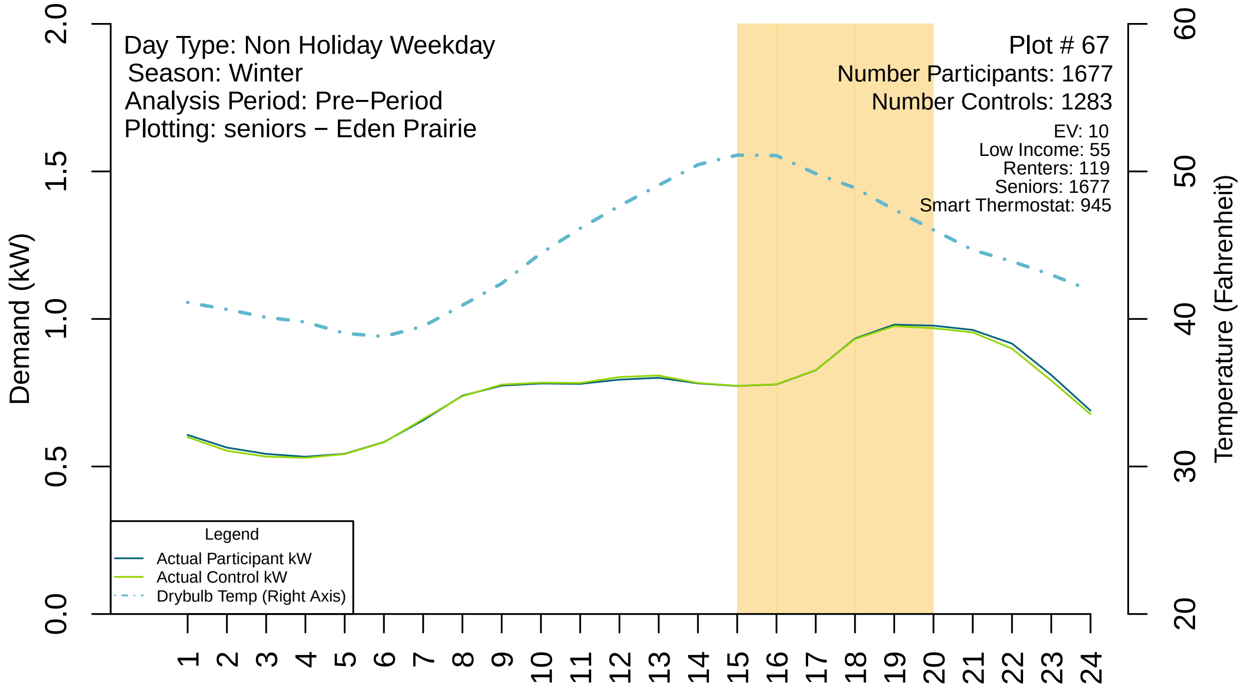

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: seniors − Eden Prairie
Plot # 62
Number Participants: 1677
Number Controls: 1283
EV: 10
Low Income: 55
Renters: 119
Seniors: 1677
Smart Thermostat: 945
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

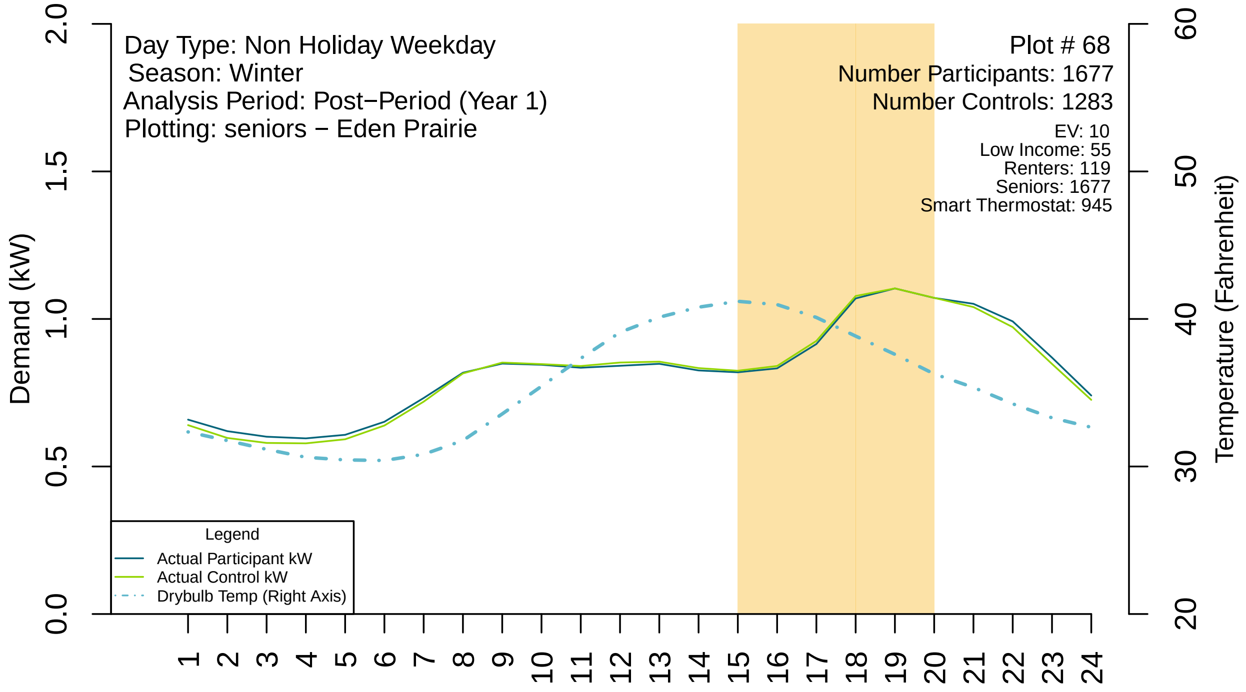

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: seniors − Eden Prairie
Plot # 63
Number Participants: 1677
Number Controls: 1283
EV: 10
Low Income: 55
Renters: 119
Seniors: 1677
Smart Thermostat: 945
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

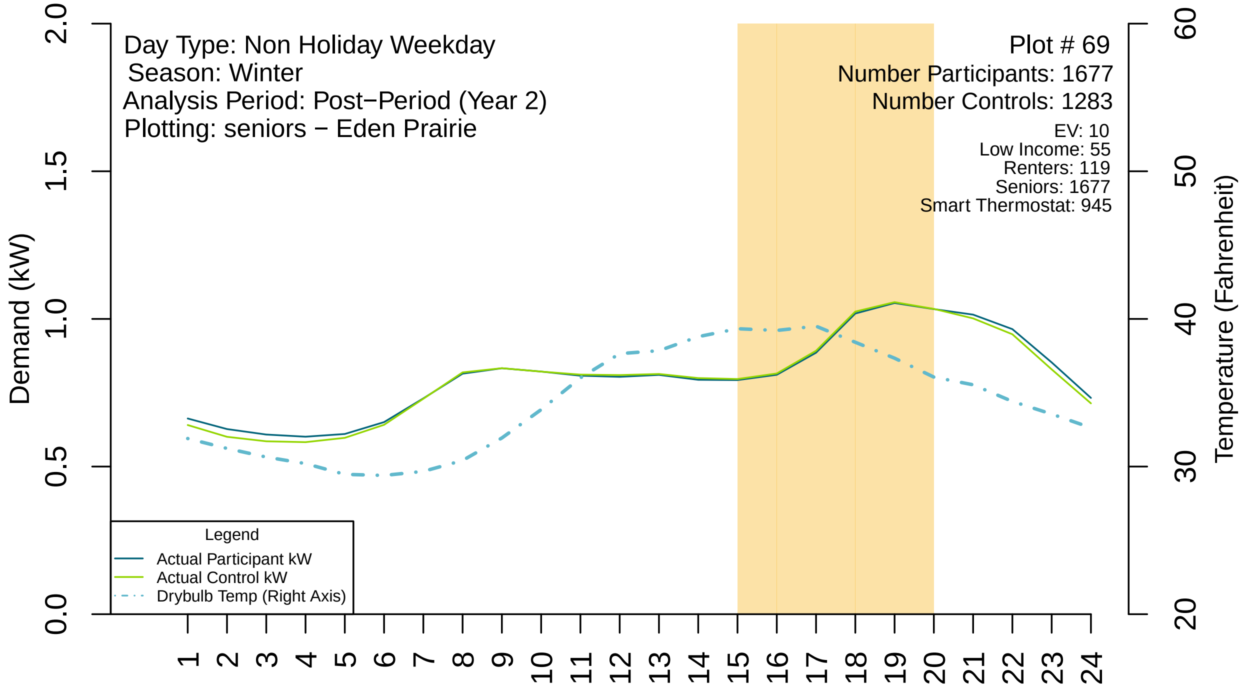

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Pre−Period
Plotting: seniors − Eden Prairie
Plot # 64
Number Participants: 1677
Number Controls: 1283
EV: 10
Low Income: 55
Renters: 119
Seniors: 1677
Smart Thermostat: 945
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

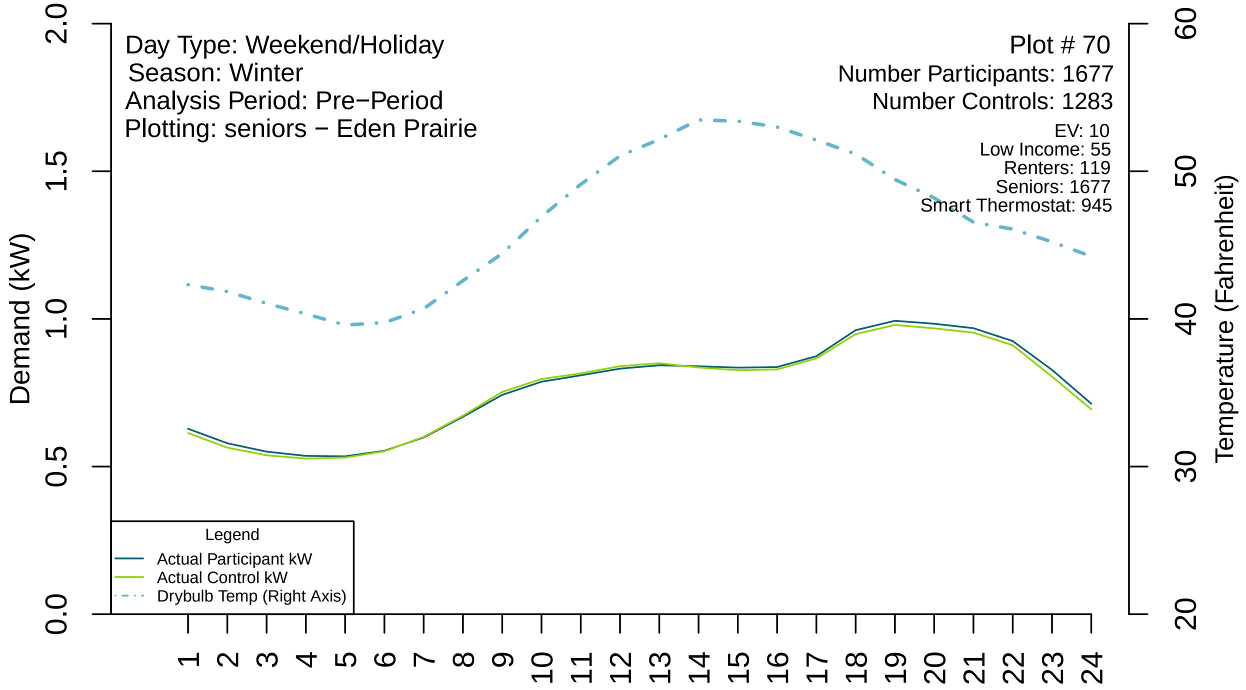

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: seniors − Eden Prairie
Plot # 65
Number Participants: 1677
Number Controls: 1283
EV: 10
Low Income: 55
Renters: 119
Seniors: 1677
Smart Thermostat: 945
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

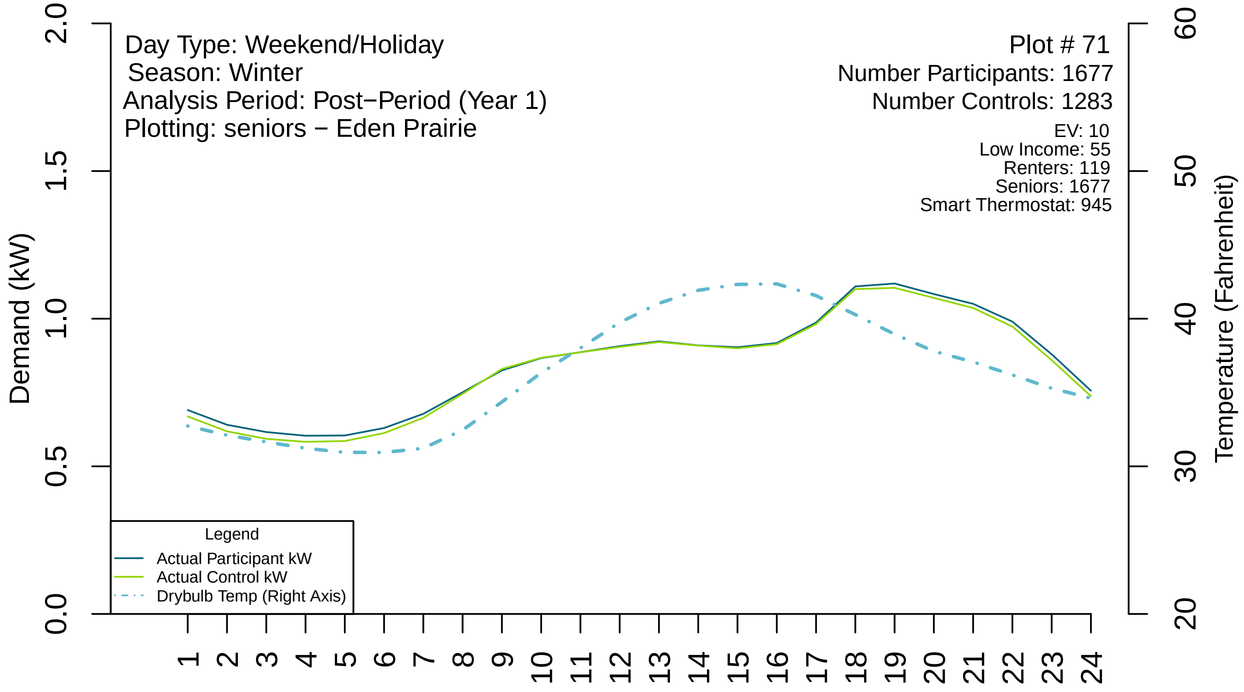

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: seniors − Eden Prairie
Plot # 66
Number Participants: 1677
Number Controls: 1283
EV: 10
Low Income: 55
Renters: 119
Seniors: 1677
Smart Thermostat: 945
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

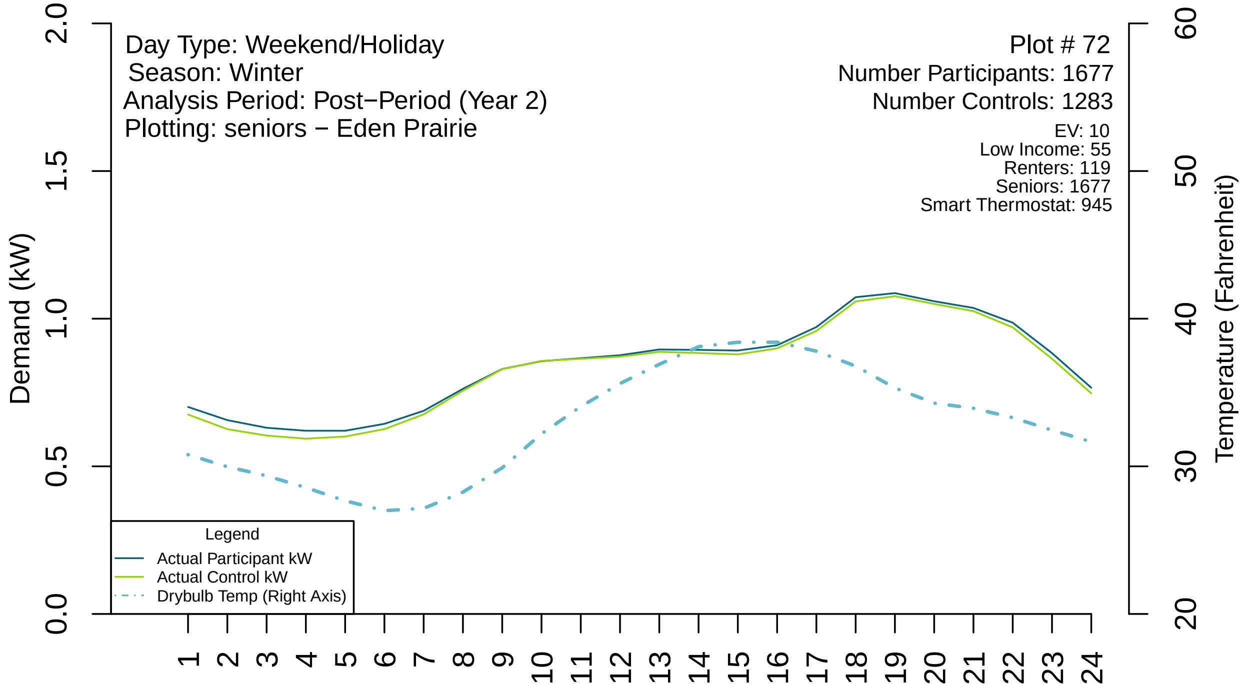

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Pre−Period
Plotting: seniors − Eden Prairie
Plot # 67
Number Participants: 1677
Number Controls: 1283
EV: 10
Low Income: 55
Renters: 119
Seniors: 1677
Smart Thermostat: 945
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

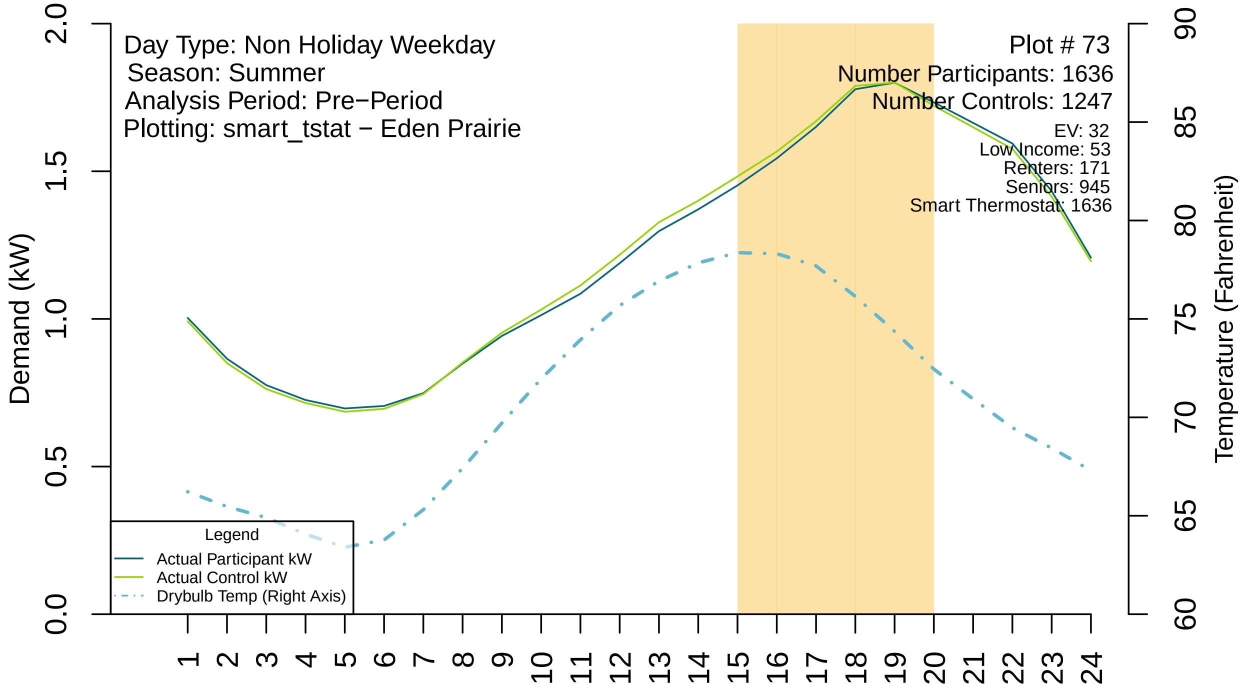

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: seniors − Eden Prairie
Plot # 68
Number Participants: 1677
Number Controls: 1283
EV: 10
Low Income: 55
Renters: 119
Seniors: 1677
Smart Thermostat: 945
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

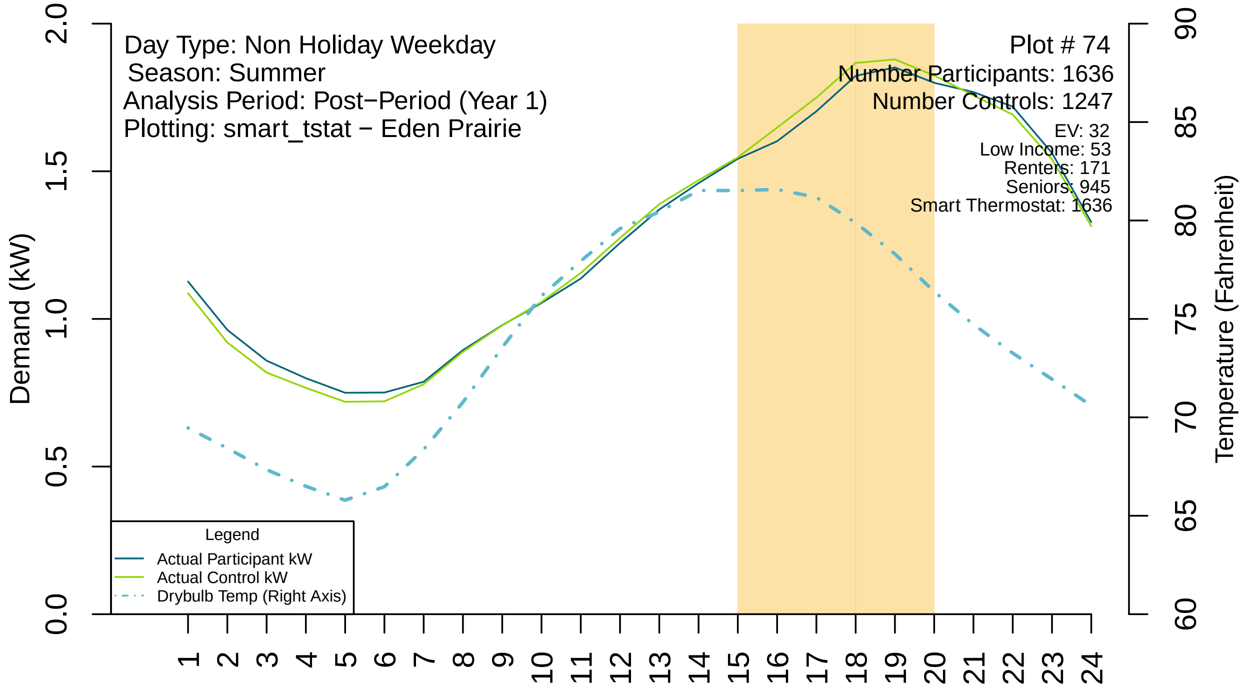

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: seniors − Eden Prairie
Plot # 69
Number Participants: 1677
Number Controls: 1283
EV: 10
Low Income: 55
Renters: 119
Seniors: 1677
Smart Thermostat: 945
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

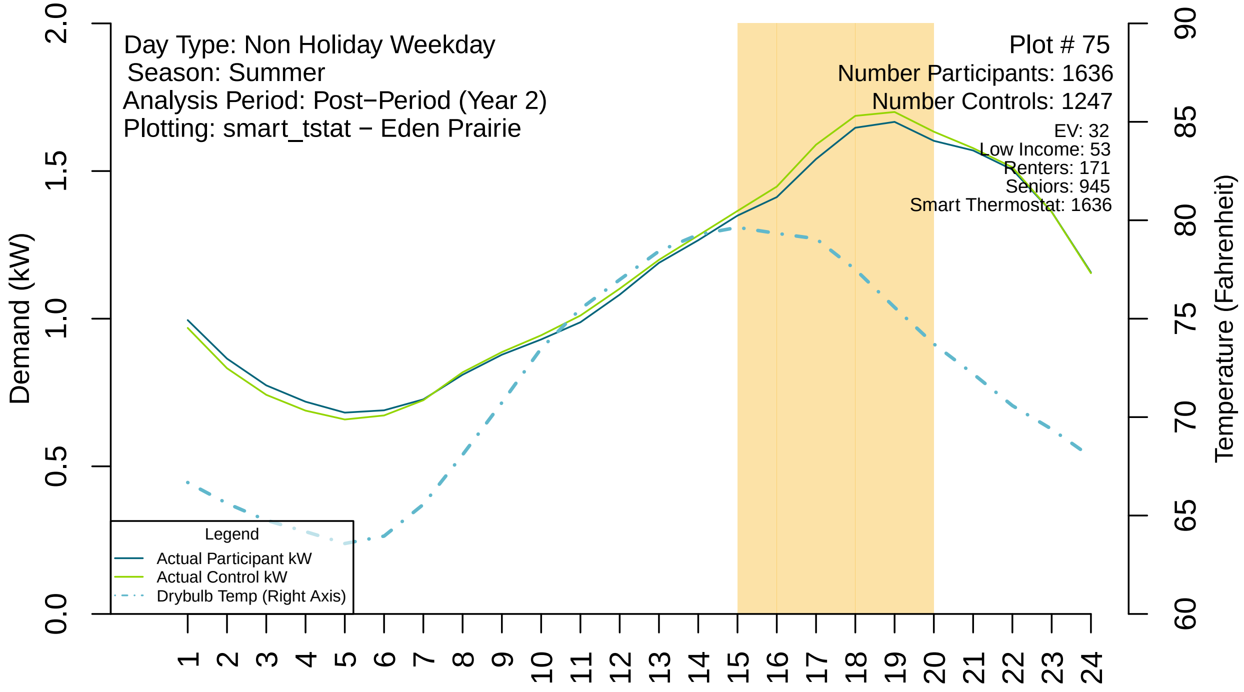

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Pre−Period
Plotting: seniors − Eden Prairie
Plot # 70
Number Participants: 1677
Number Controls: 1283
EV: 10
Low Income: 55
Renters: 119
Seniors: 1677
Smart Thermostat: 945
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

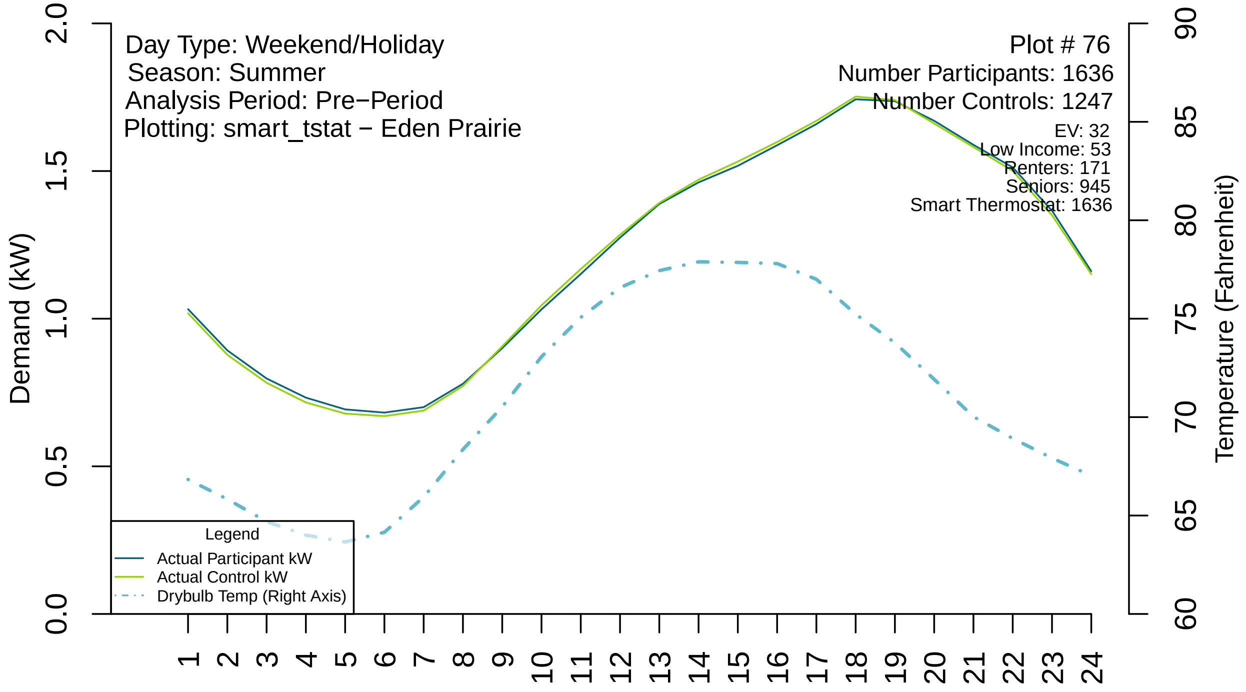

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: seniors − Eden Prairie
Plot # 71
Number Participants: 1677
Number Controls: 1283
EV: 10
Low Income: 55
Renters: 119
Seniors: 1677
Smart Thermostat: 945
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

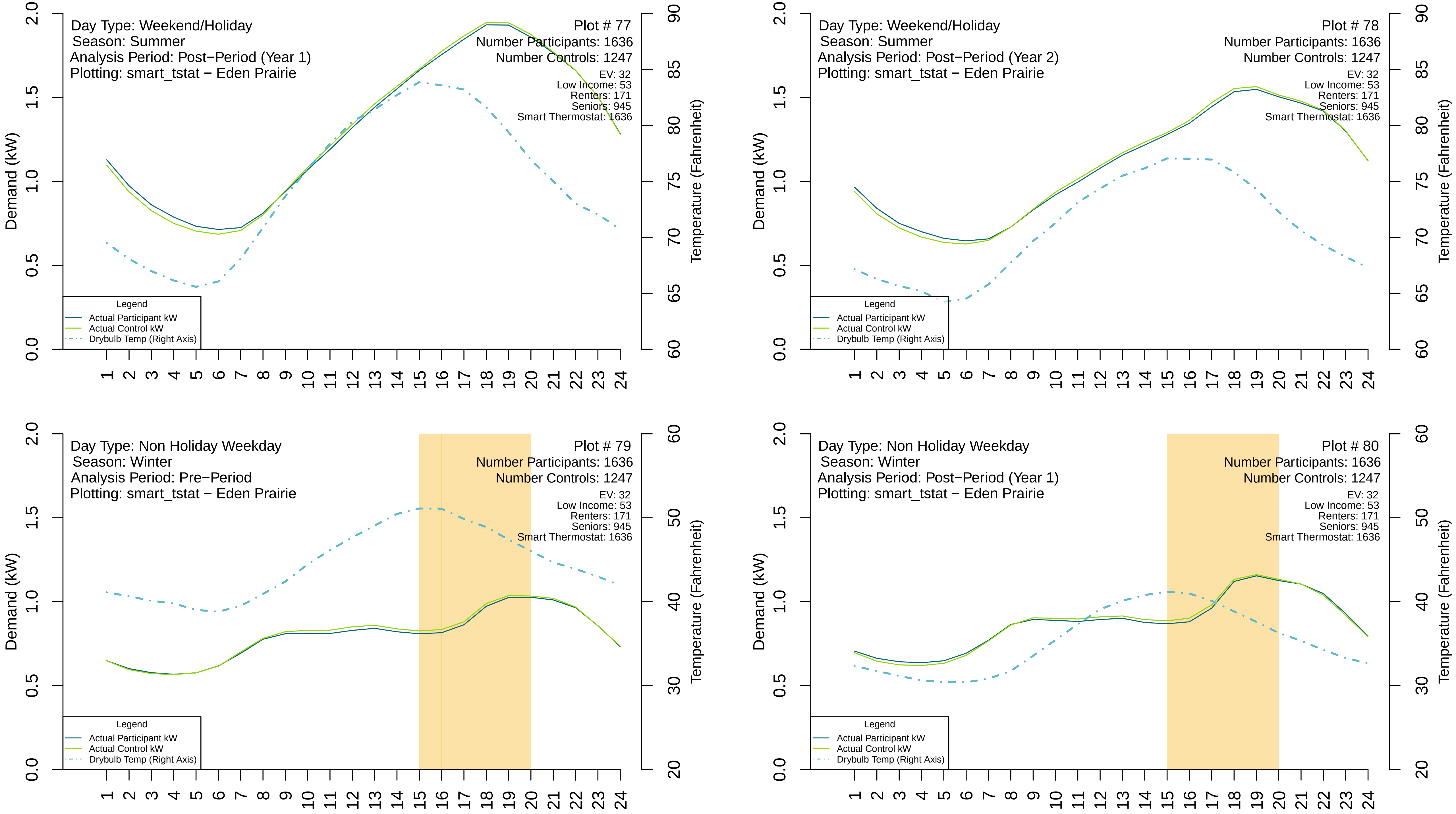

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: seniors − Eden Prairie
Plot # 72
Number Participants: 1677
Number Controls: 1283
EV: 10
Low Income: 55
Renters: 119
Seniors: 1677
Smart Thermostat: 945
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

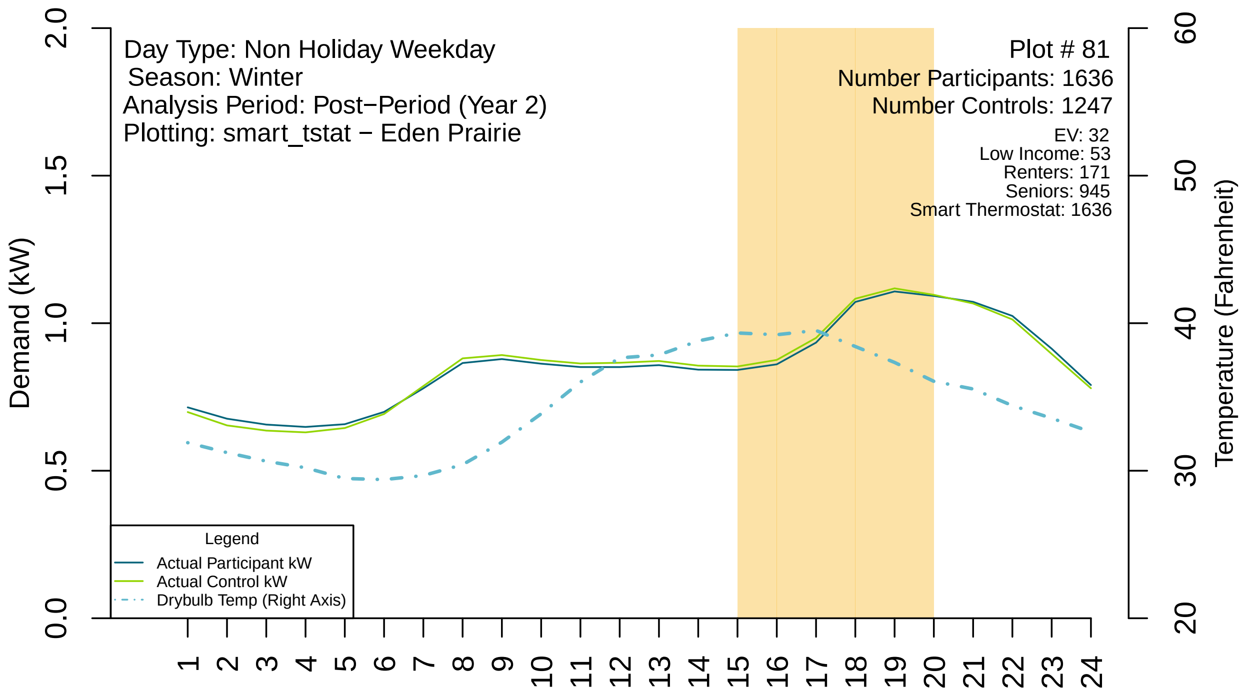

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Pre−Period
Plotting: smart_tstat − Eden Prairie
Plot # 73
Number Participants: 1636
Number Controls: 1247
EV: 32
Low Income: 53
Renters: 171
Seniors: 945
Smart Thermostat: 1636
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

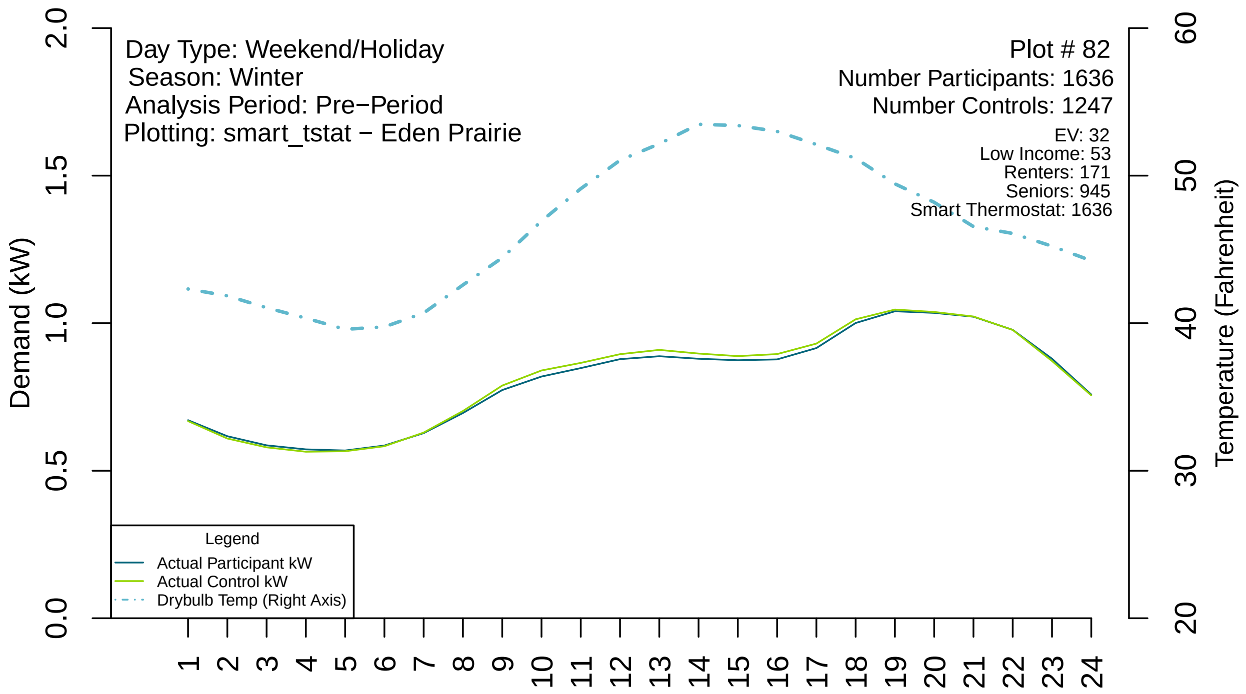

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: smart_tstat − Eden Prairie
Plot # 74
Number Participants: 1636
Number Controls: 1247
EV: 32
Low Income: 53
Renters: 171
Seniors: 945
Smart Thermostat: 1636
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

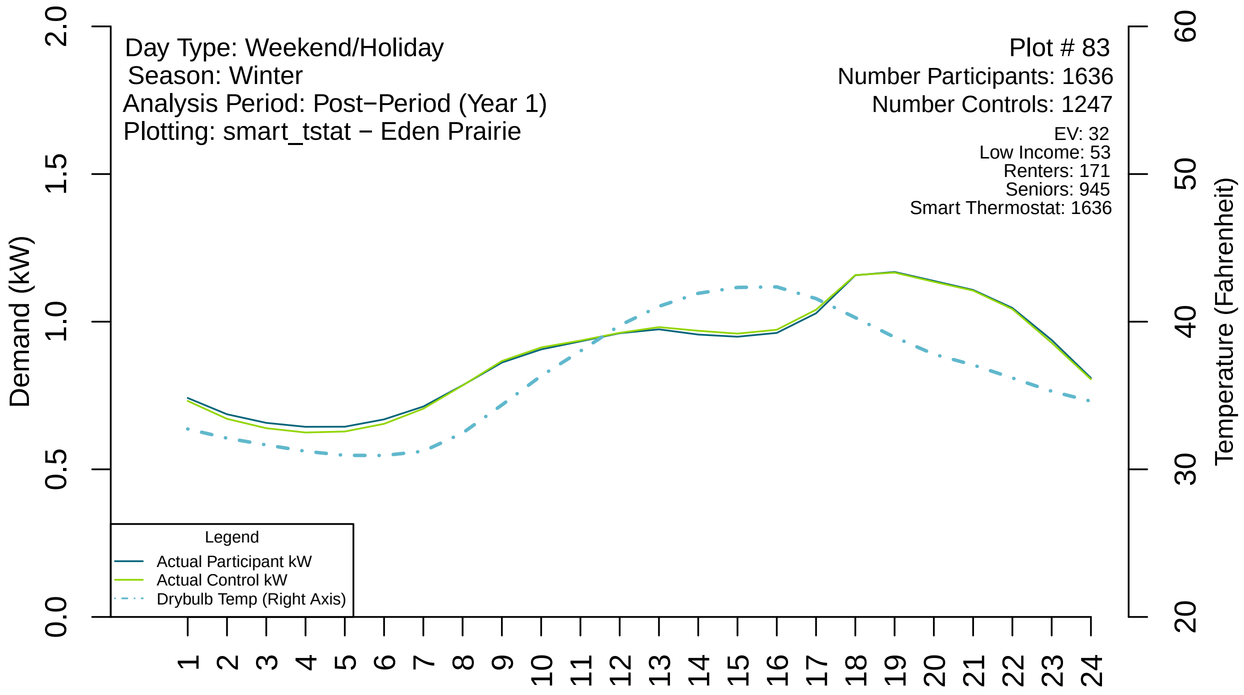

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: smart_tstat − Eden Prairie
Plot # 75
Number Participants: 1636
Number Controls: 1247
EV: 32
Low Income: 53
Renters: 171
Seniors: 945
Smart Thermostat: 1636
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

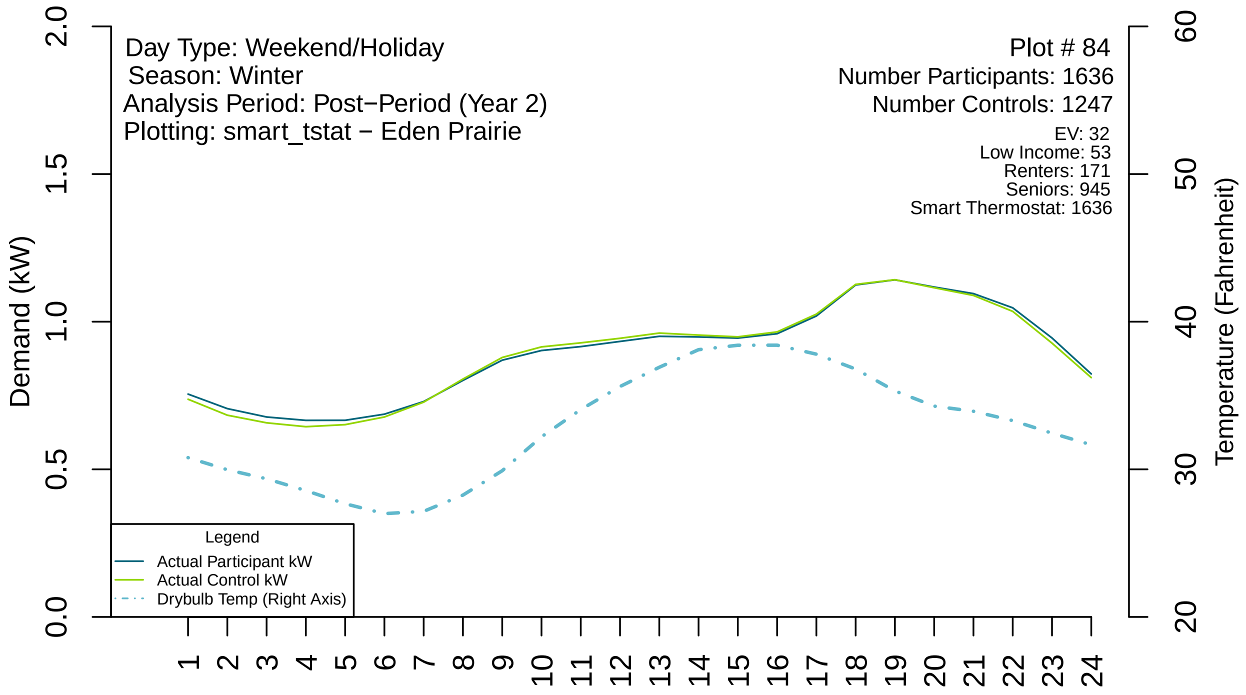

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Pre−Period
Plotting: smart_tstat − Eden Prairie
Plot # 76
Number Participants: 1636
Number Controls: 1247
EV: 32
Low Income: 53
Renters: 171
Seniors: 945
Smart Thermostat: 1636
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

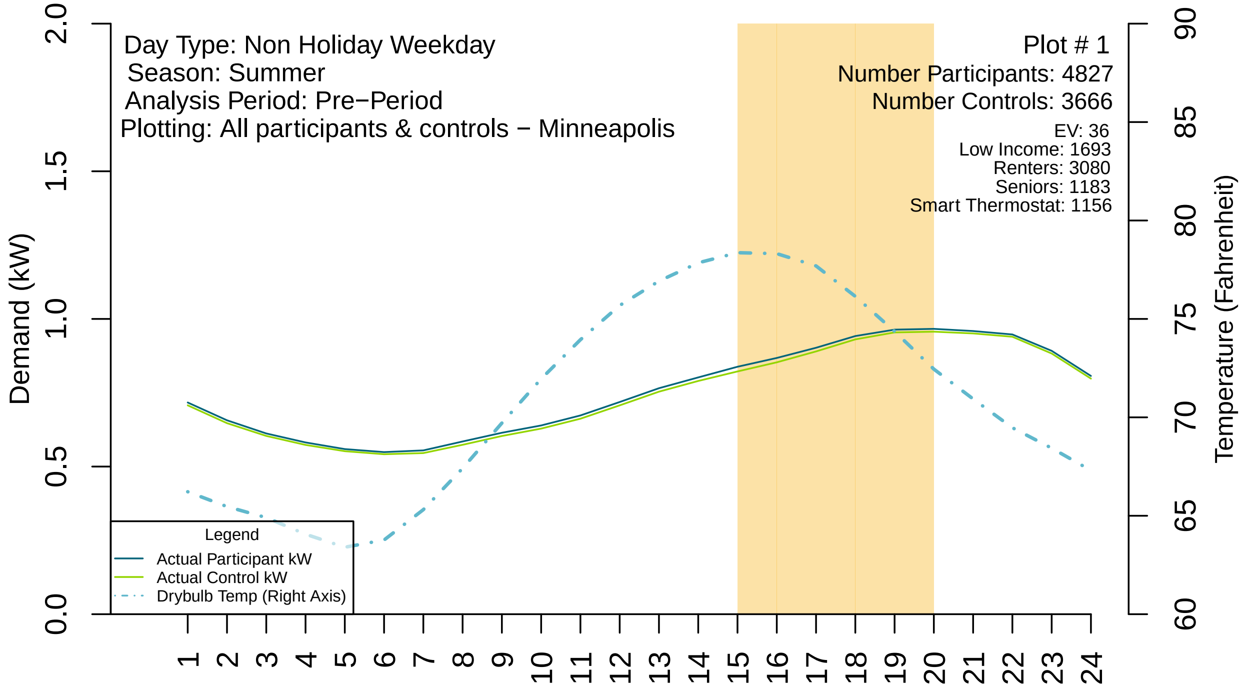

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: smart_tstat − Eden Prairie
Plot # 77
Number Participants: 1636
Number Controls: 1247
EV: 32
Low Income: 53
Renters: 171
Seniors: 945
Smart Thermostat: 1636
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)
Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: smart_tstat − Eden Prairie
Plot # 78
Number Participants: 1636
Number Controls: 1247
EV: 32
Low Income: 53
Renters: 171
Seniors: 945
Smart Thermostat: 1636
Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Pre−Period
Plotting: smart_tstat − Eden Prairie
Plot # 79
Number Participants: 1636
Number Controls: 1247
EV: 32
Low Income: 53
Renters: 171
Seniors: 945
Smart Thermostat: 1636
Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: smart_tstat − Eden Prairie
Plot # 80
Number Participants: 1636
Number Controls: 1247
EV: 32
Low Income: 53
Renters: 171
Seniors: 945
Smart Thermostat: 1636

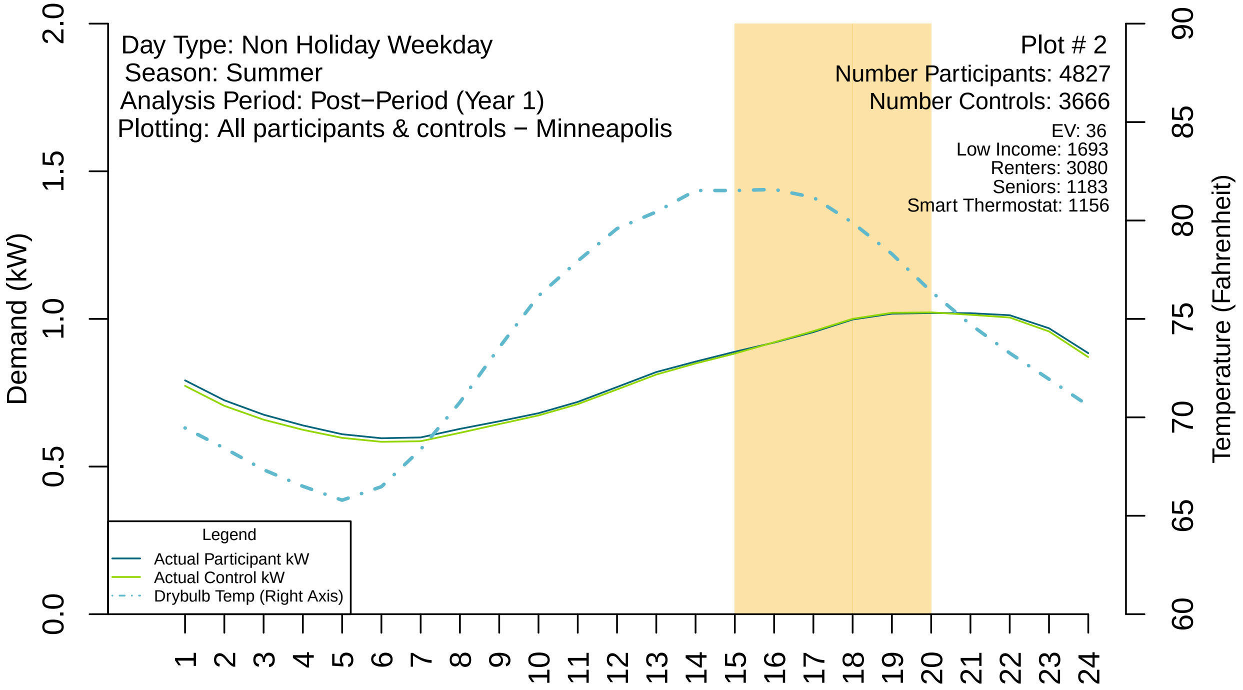

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: smart_tstat − Eden Prairie
Plot # 81
Number Participants: 1636
Number Controls: 1247
EV: 32
Low Income: 53
Renters: 171
Seniors: 945
Smart Thermostat: 1636
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

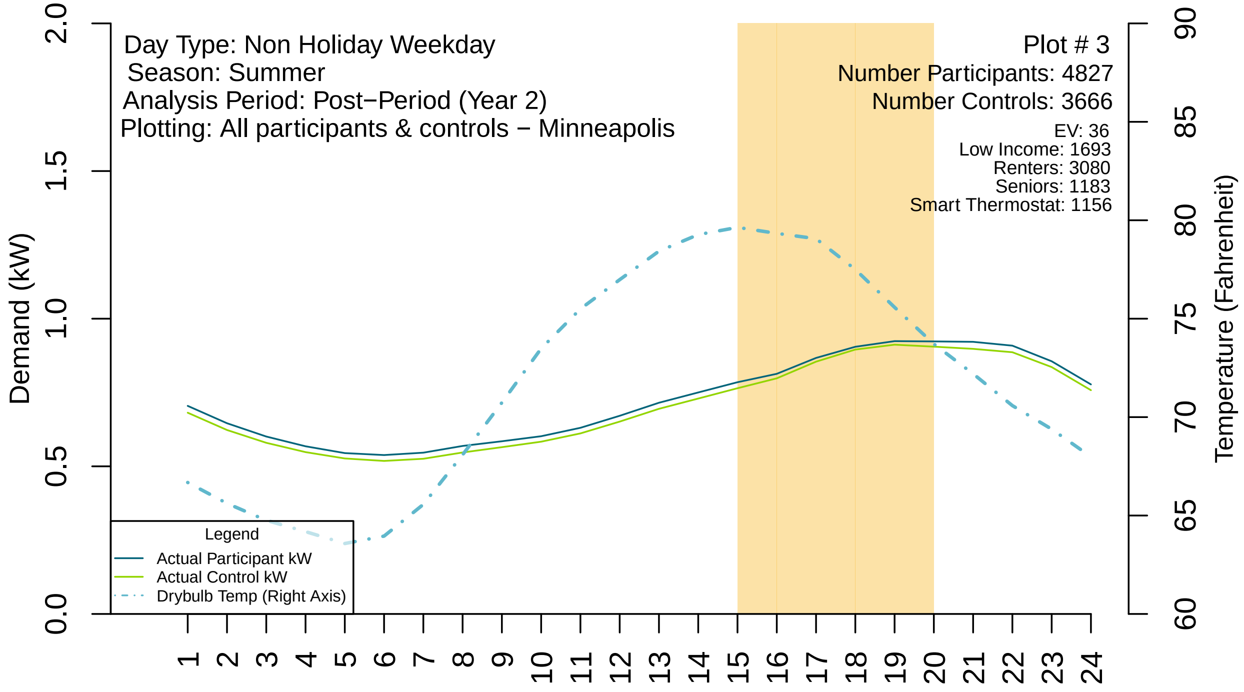

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Pre−Period
Plotting: smart_tstat − Eden Prairie
Plot # 82
Number Participants: 1636
Number Controls: 1247
EV: 32
Low Income: 53
Renters: 171
Seniors: 945
Smart Thermostat: 1636
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

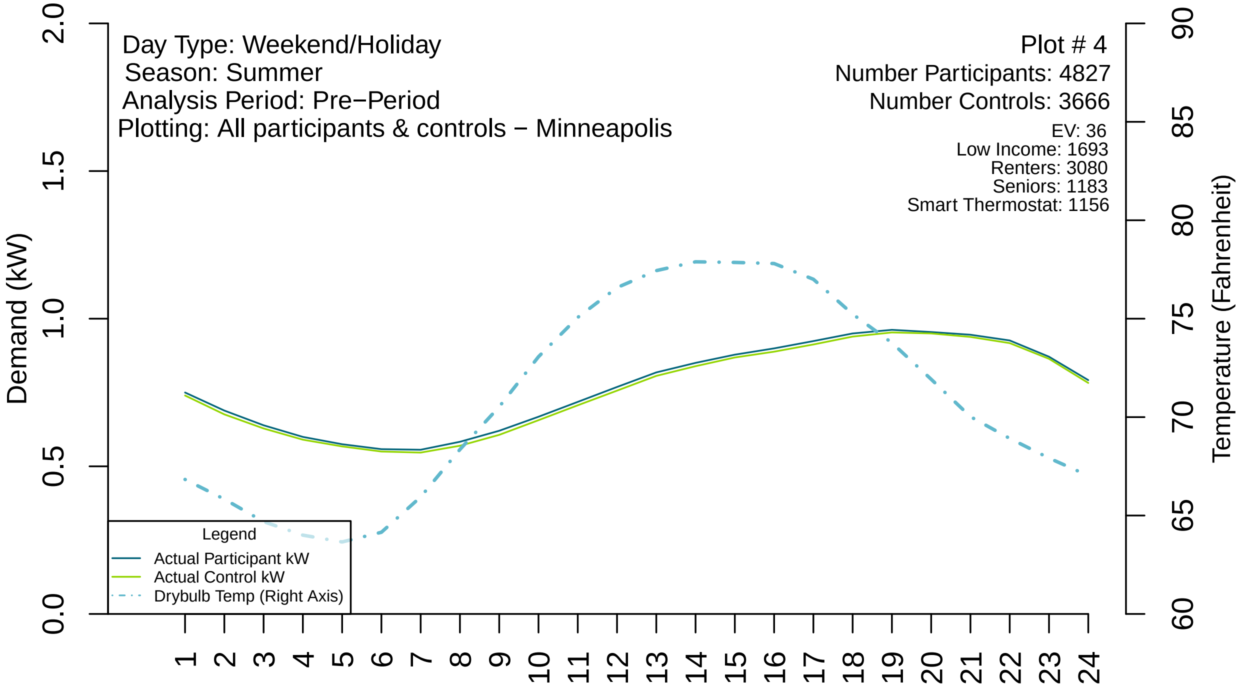

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: smart_tstat − Eden Prairie
Plot # 83
Number Participants: 1636
Number Controls: 1247
EV: 32
Low Income: 53
Renters: 171
Seniors: 945
Smart Thermostat: 1636
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

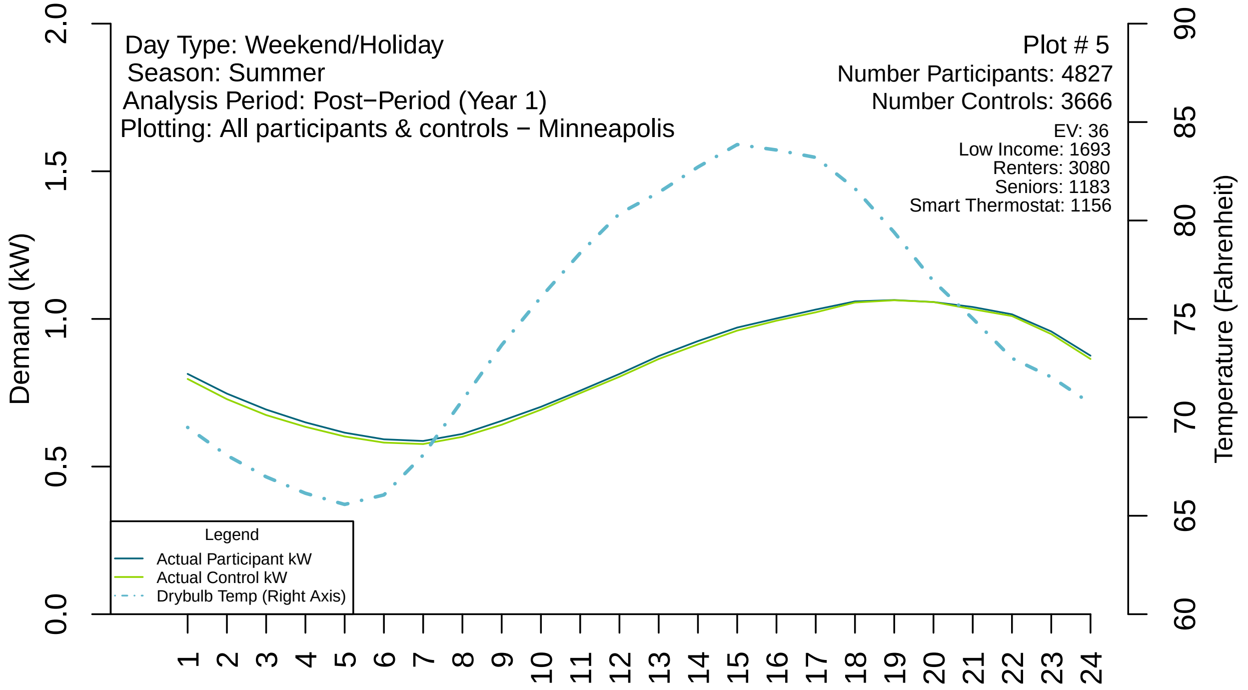

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: smart_tstat − Eden Prairie
Plot # 84
Number Participants: 1636
Number Controls: 1247
EV: 32
Low Income: 53
Renters: 171
Seniors: 945
Smart Thermostat: 1636
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

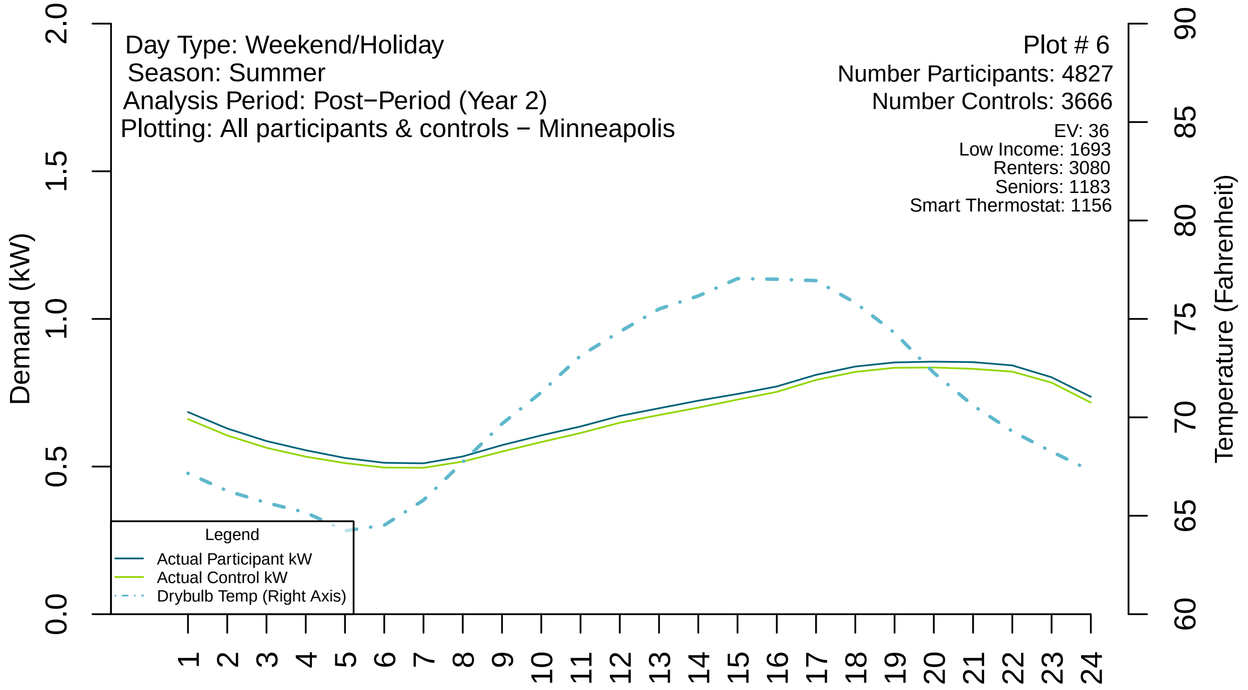

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Pre−Period
Plotting: All participants & controls − Minneapolis
Plot # 1
Number Participants: 4827
Number Controls: 3666
EV: 36
Low Income: 1693
Renters: 3080
Seniors: 1183
Smart Thermostat: 1156
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

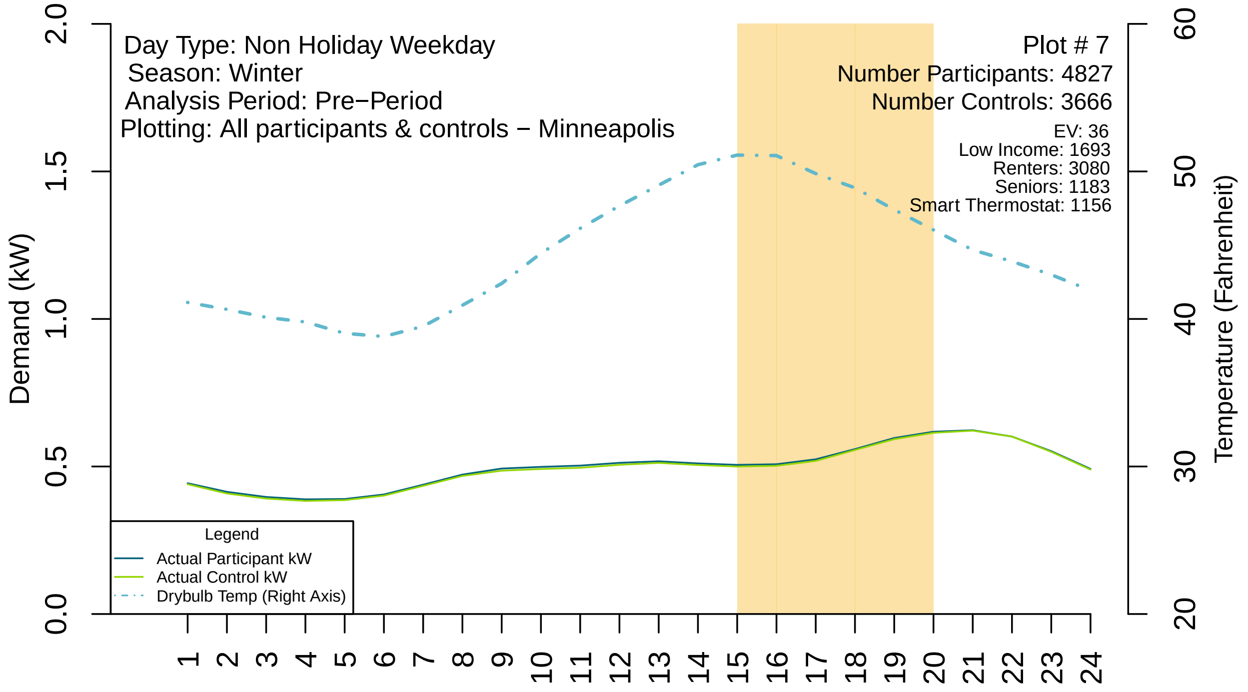

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: All participants & controls − Minneapolis
Plot # 2
Number Participants: 4827
Number Controls: 3666
EV: 36
Low Income: 1693
Renters: 3080
Seniors: 1183
Smart Thermostat: 1156
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

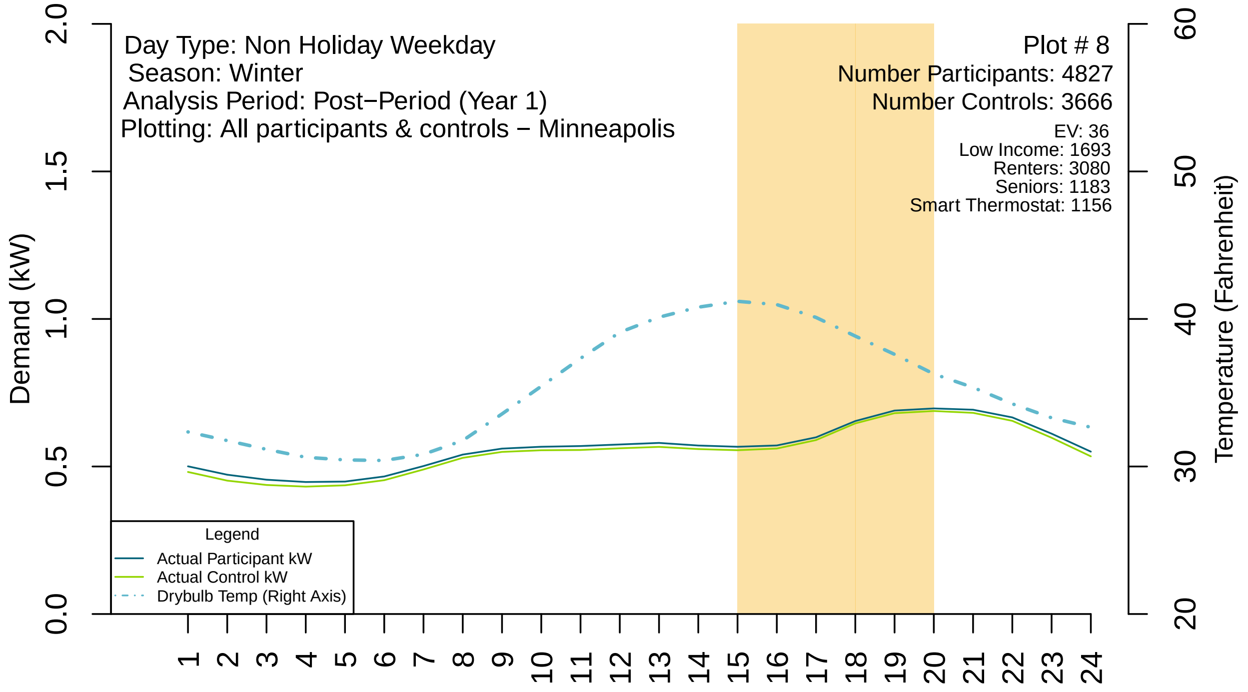

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: All participants & controls − Minneapolis
Plot # 3
Number Participants: 4827
Number Controls: 3666
EV: 36
Low Income: 1693
Renters: 3080
Seniors: 1183
Smart Thermostat: 1156
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

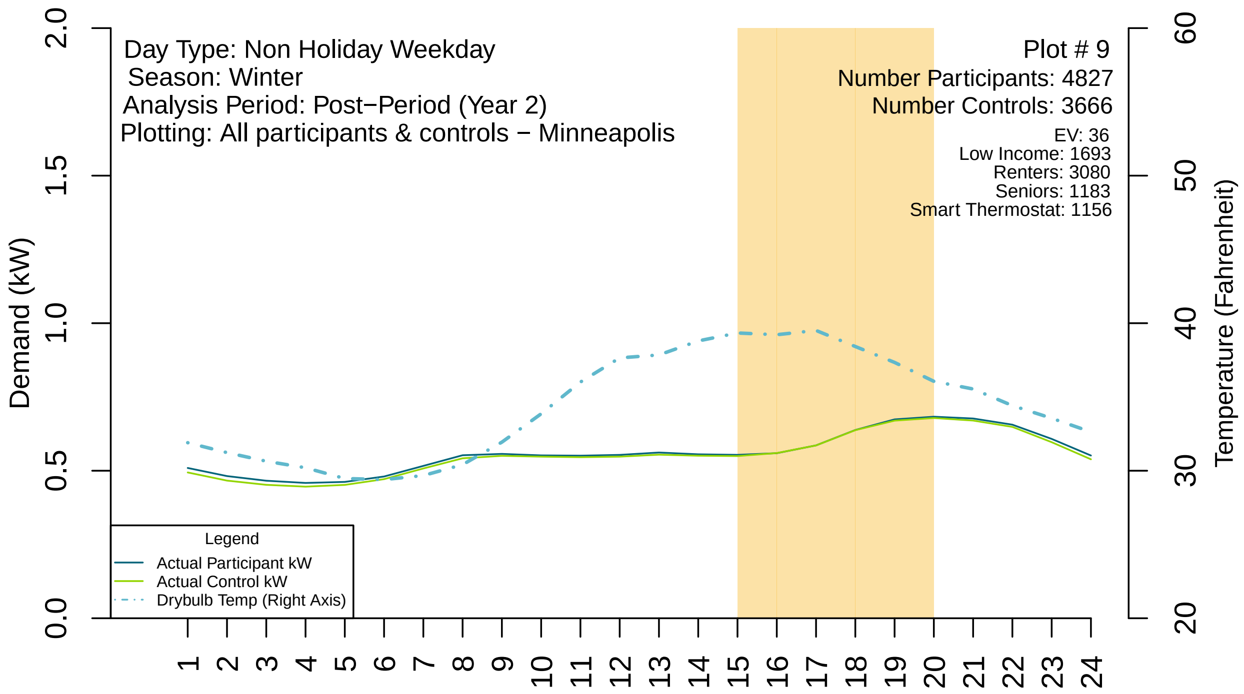

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Pre−Period
Plotting: All participants & controls − Minneapolis
Plot # 4
Number Participants: 4827
Number Controls: 3666
EV: 36
Low Income: 1693
Renters: 3080
Seniors: 1183
Smart Thermostat: 1156
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

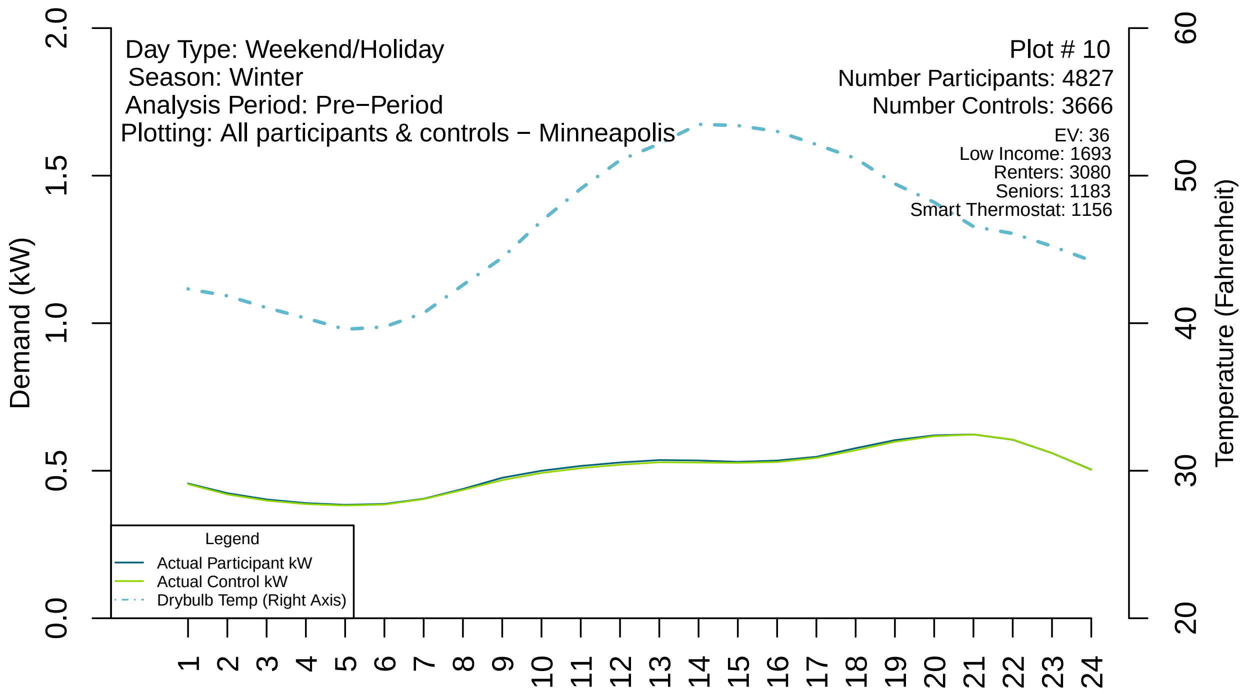

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: All participants & controls − Minneapolis
Plot # 5
Number Participants: 4827
Number Controls: 3666
EV: 36
Low Income: 1693
Renters: 3080
Seniors: 1183
Smart Thermostat: 1156
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

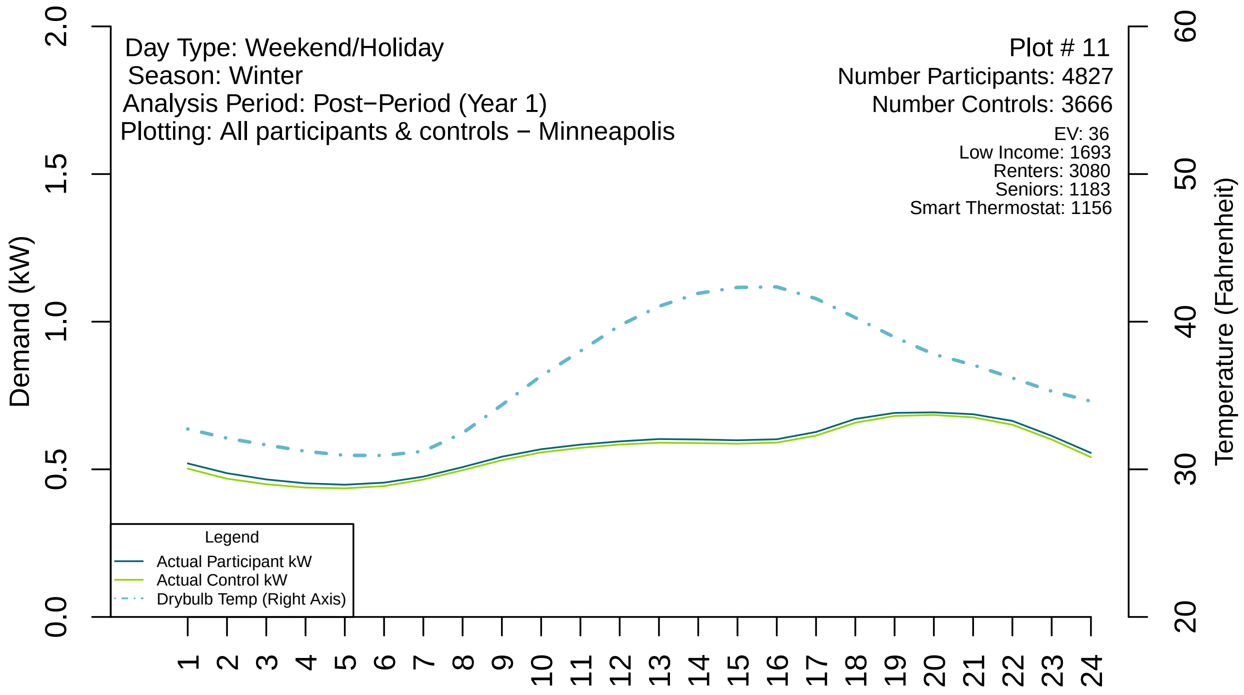

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: All participants & controls − Minneapolis
Plot # 6
Number Participants: 4827
Number Controls: 3666
EV: 36
Low Income: 1693
Renters: 3080
Seniors: 1183
Smart Thermostat: 1156
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

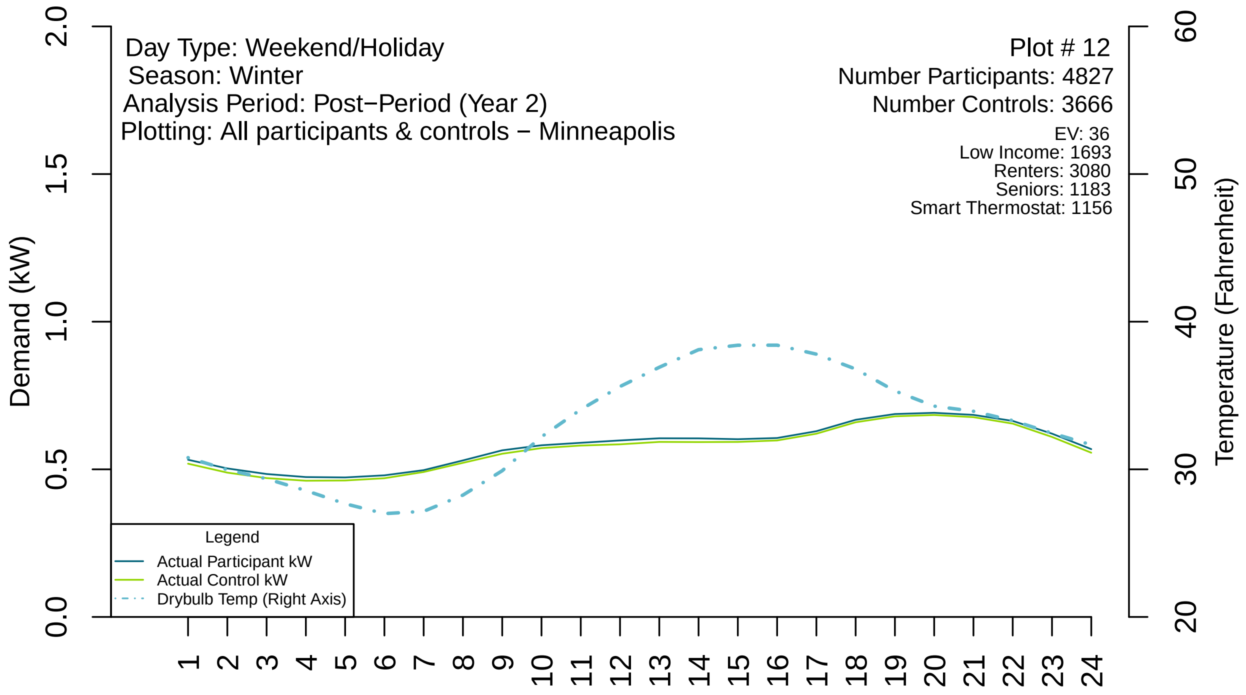

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Pre−Period
Plotting: All participants & controls − Minneapolis
Plot # 7
Number Participants: 4827
Number Controls: 3666
EV: 36
Low Income: 1693
Renters: 3080
Seniors: 1183
Smart Thermostat: 1156
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

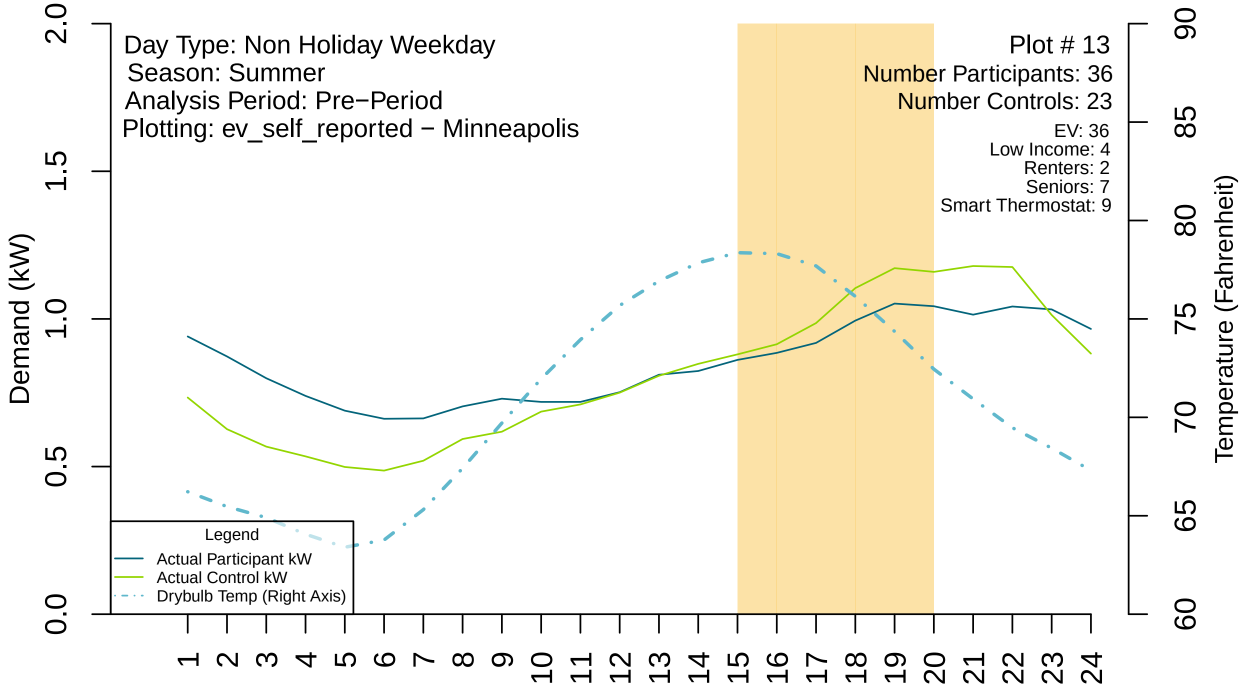

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: All participants & controls − Minneapolis
Plot # 8
Number Participants: 4827
Number Controls: 3666
EV: 36
Low Income: 1693
Renters: 3080
Seniors: 1183
Smart Thermostat: 1156
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

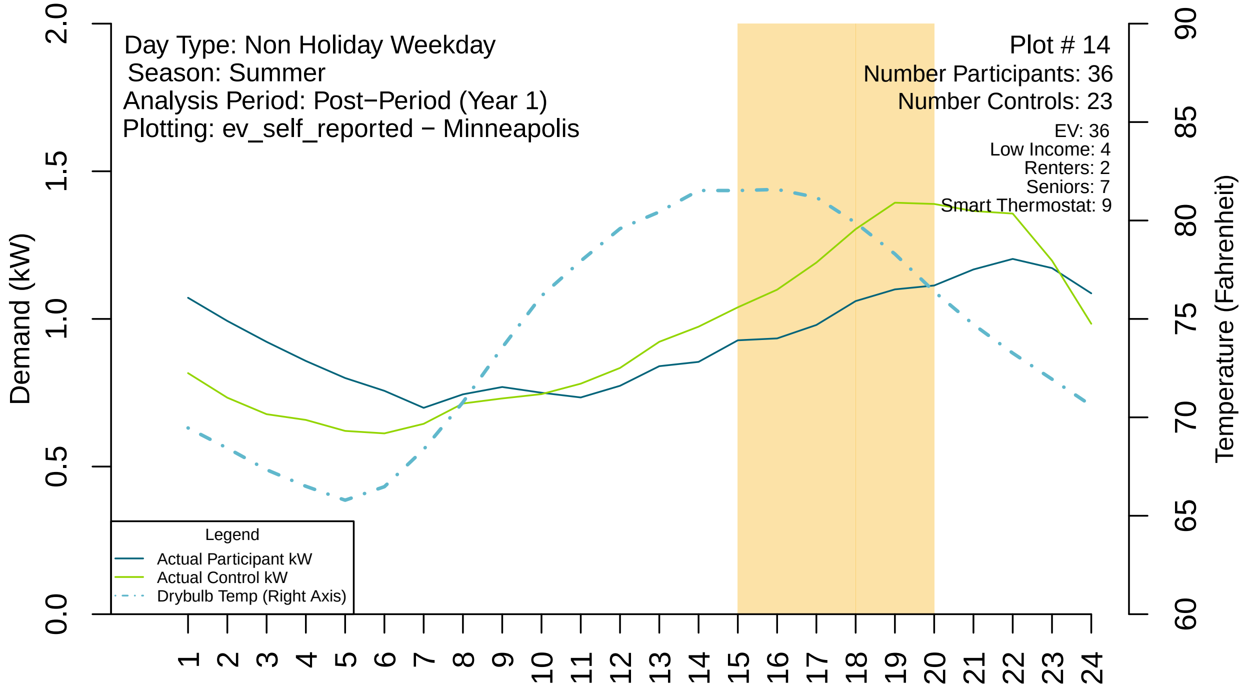

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: All participants & controls − Minneapolis
Plot # 9
Number Participants: 4827
Number Controls: 3666
EV: 36
Low Income: 1693
Renters: 3080
Seniors: 1183
Smart Thermostat: 1156
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

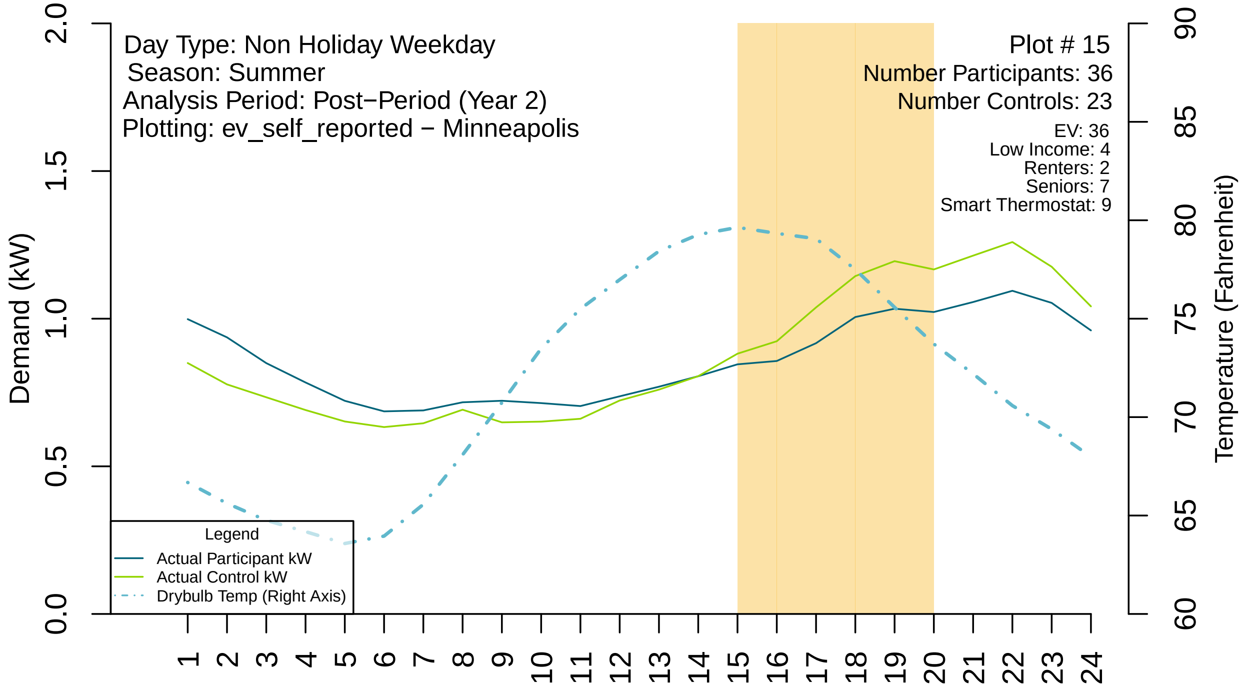

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Pre−Period
Plotting: All participants & controls − Minneapolis
Plot # 10
Number Participants: 4827
Number Controls: 3666
EV: 36
Low Income: 1693
Renters: 3080
Seniors: 1183
Smart Thermostat: 1156
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

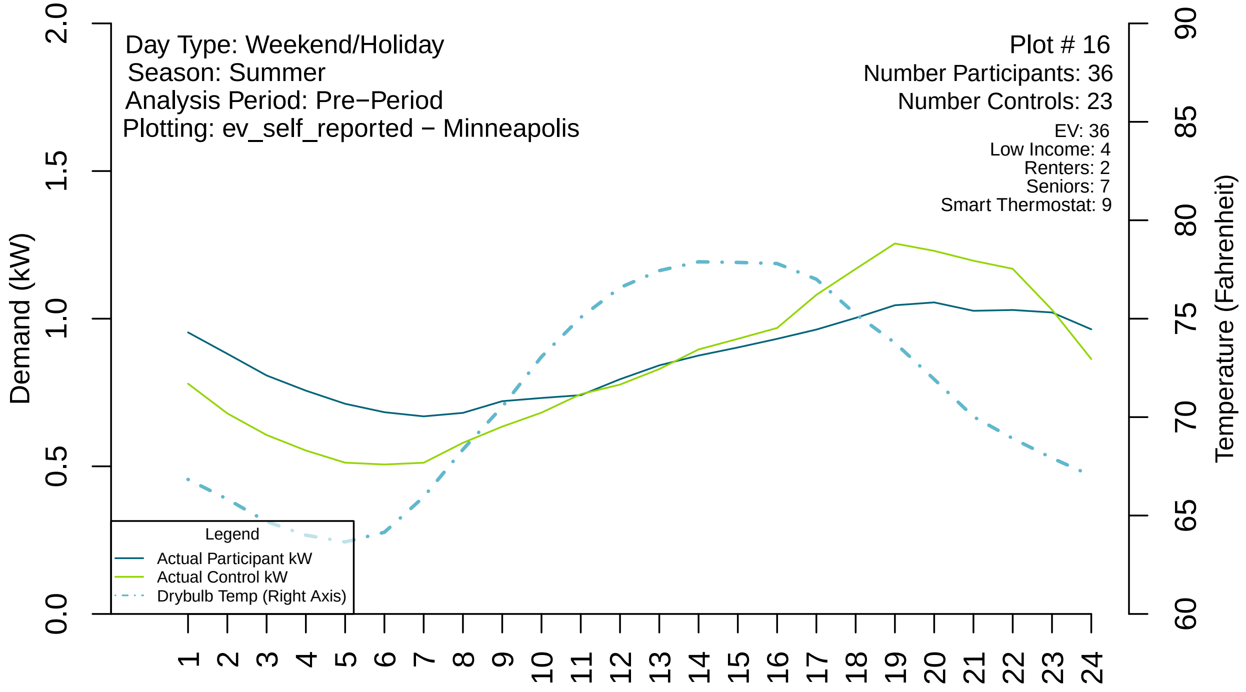

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: All participants & controls − Minneapolis
Plot # 11
Number Participants: 4827
Number Controls: 3666
EV: 36
Low Income: 1693
Renters: 3080
Seniors: 1183
Smart Thermostat: 1156
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

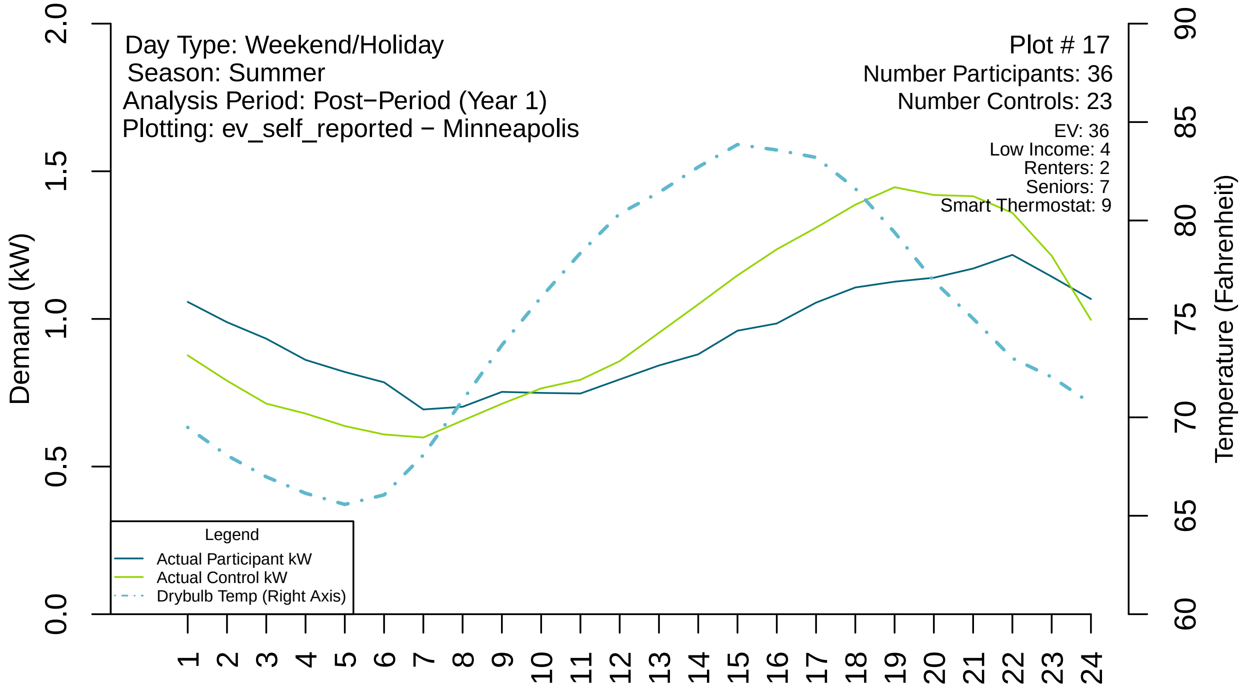

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: All participants & controls − Minneapolis
Plot # 12
Number Participants: 4827
Number Controls: 3666
EV: 36
Low Income: 1693
Renters: 3080
Seniors: 1183
Smart Thermostat: 1156
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

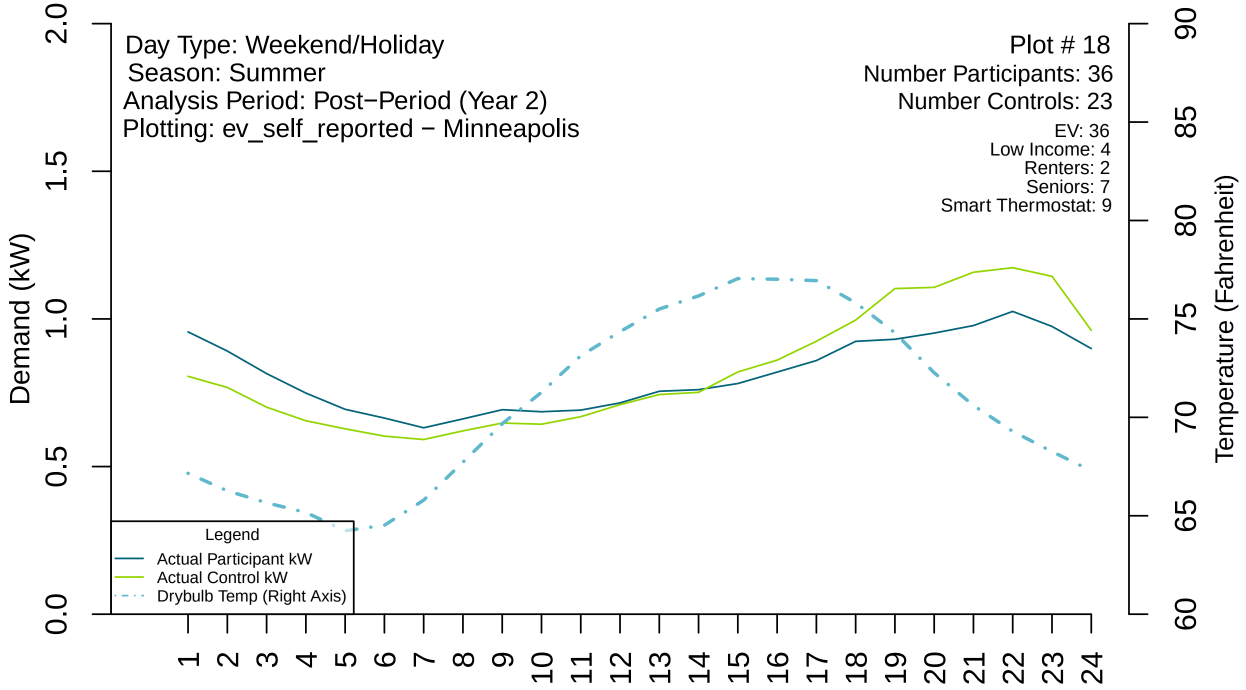

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Pre−Period
Plotting: ev_self_reported − Minneapolis
Plot # 13
Number Participants: 36
Number Controls: 23
EV: 36
Low Income: 4
Renters: 2
Seniors: 7
Smart Thermostat: 9
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

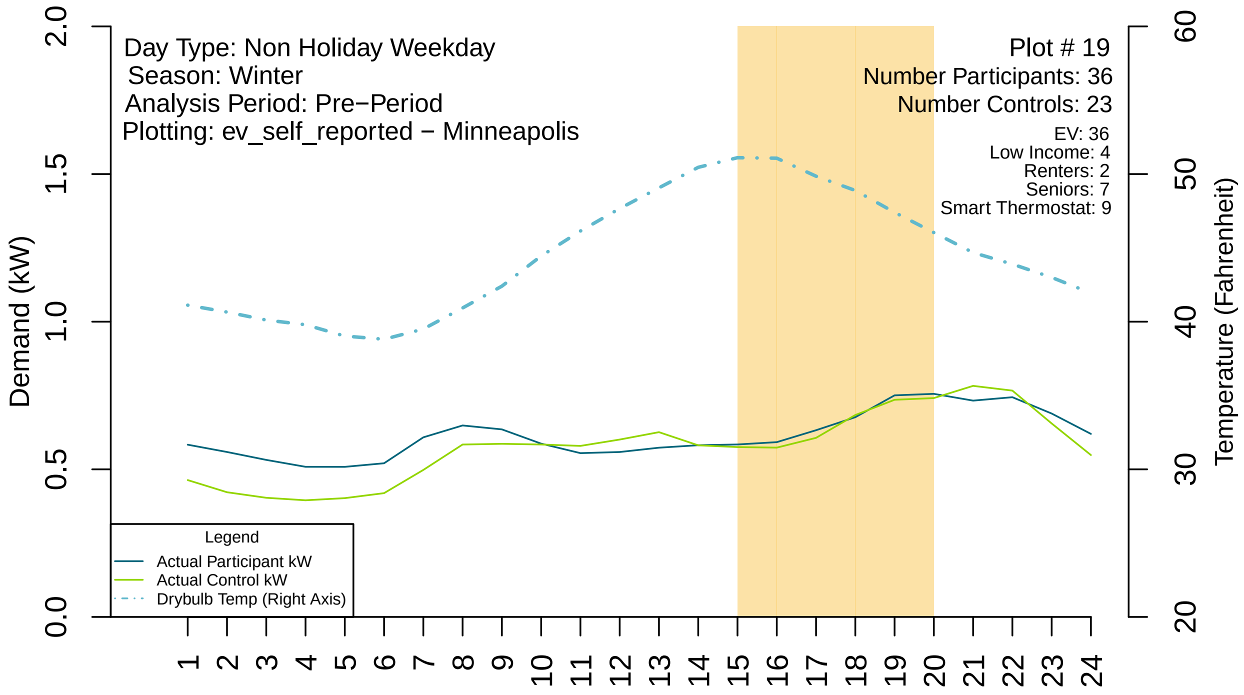

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: ev_self_reported − Minneapolis
Plot # 14
Number Participants: 36
Number Controls: 23
EV: 36
Low Income: 4
Renters: 2
Seniors: 7
Smart Thermostat: 9
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

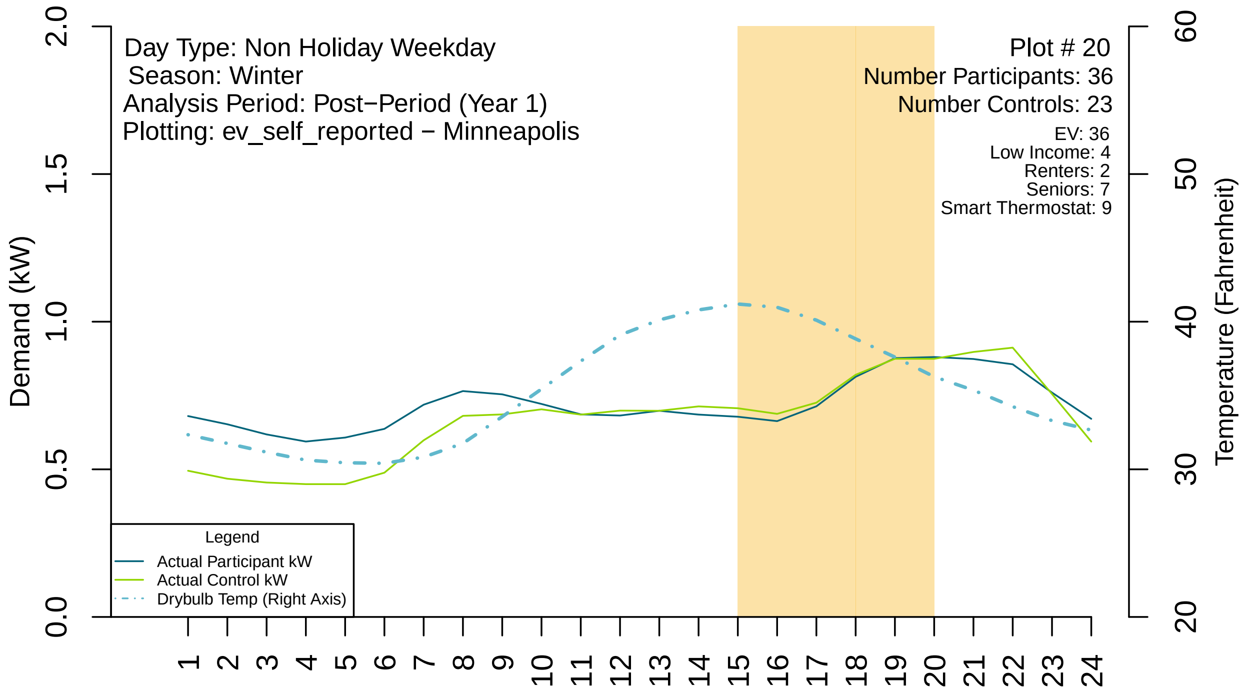

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: ev_self_reported − Minneapolis
Plot # 15
Number Participants: 36
Number Controls: 23
EV: 36
Low Income: 4
Renters: 2
Seniors: 7
Smart Thermostat: 9
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

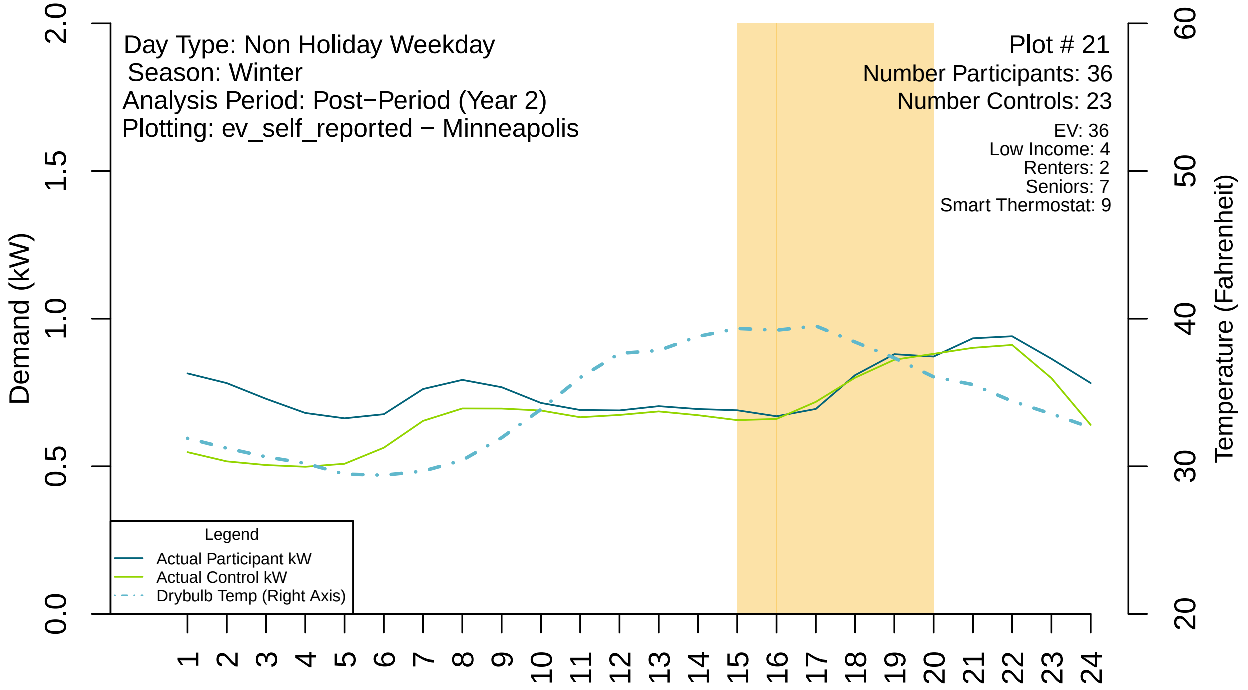

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Pre−Period
Plotting: ev_self_reported − Minneapolis
Plot # 16
Number Participants: 36
Number Controls: 23
EV: 36
Low Income: 4
Renters: 2
Seniors: 7
Smart Thermostat: 9
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

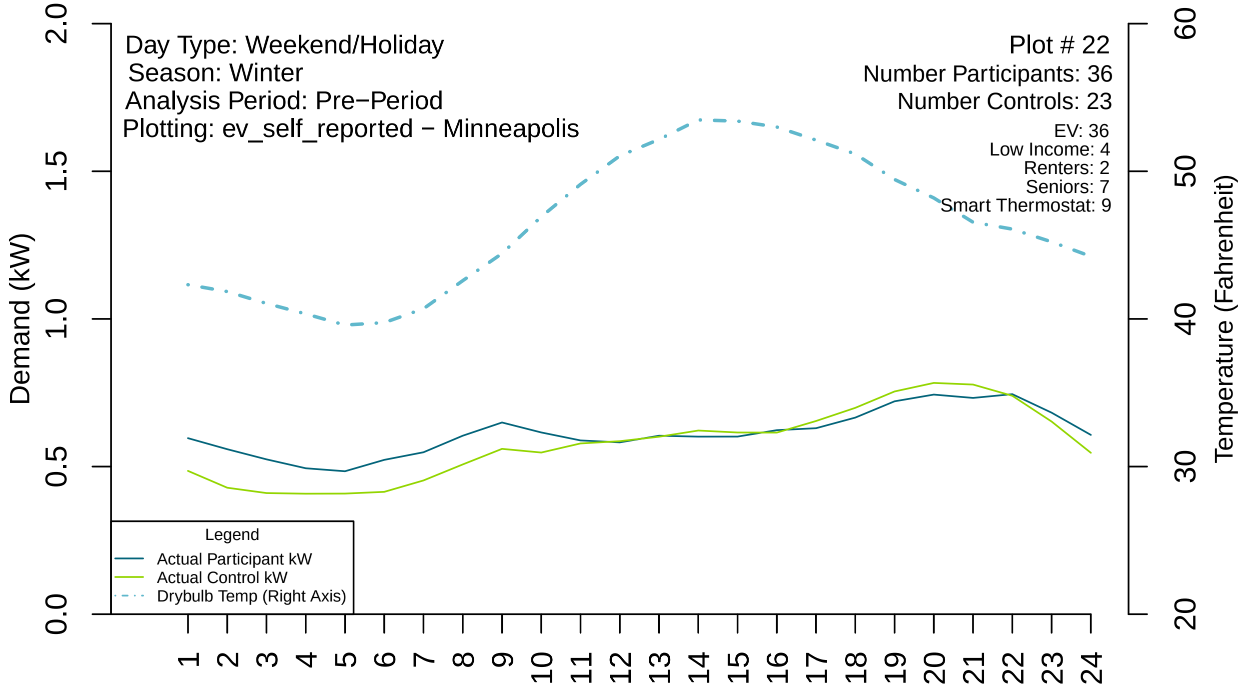

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: ev_self_reported − Minneapolis
Plot # 17
Number Participants: 36
Number Controls: 23
EV: 36
Low Income: 4
Renters: 2
Seniors: 7
Smart Thermostat: 9
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

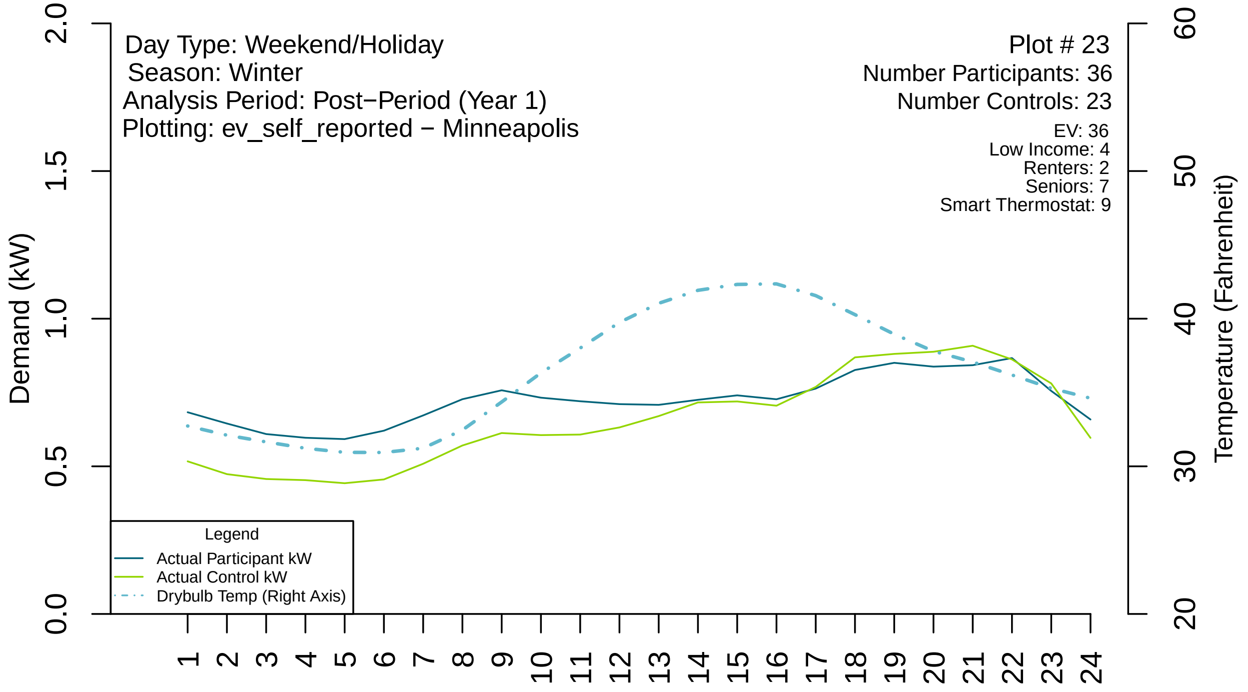

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: ev_self_reported − Minneapolis
Plot # 18
Number Participants: 36
Number Controls: 23
EV: 36
Low Income: 4
Renters: 2
Seniors: 7
Smart Thermostat: 9
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

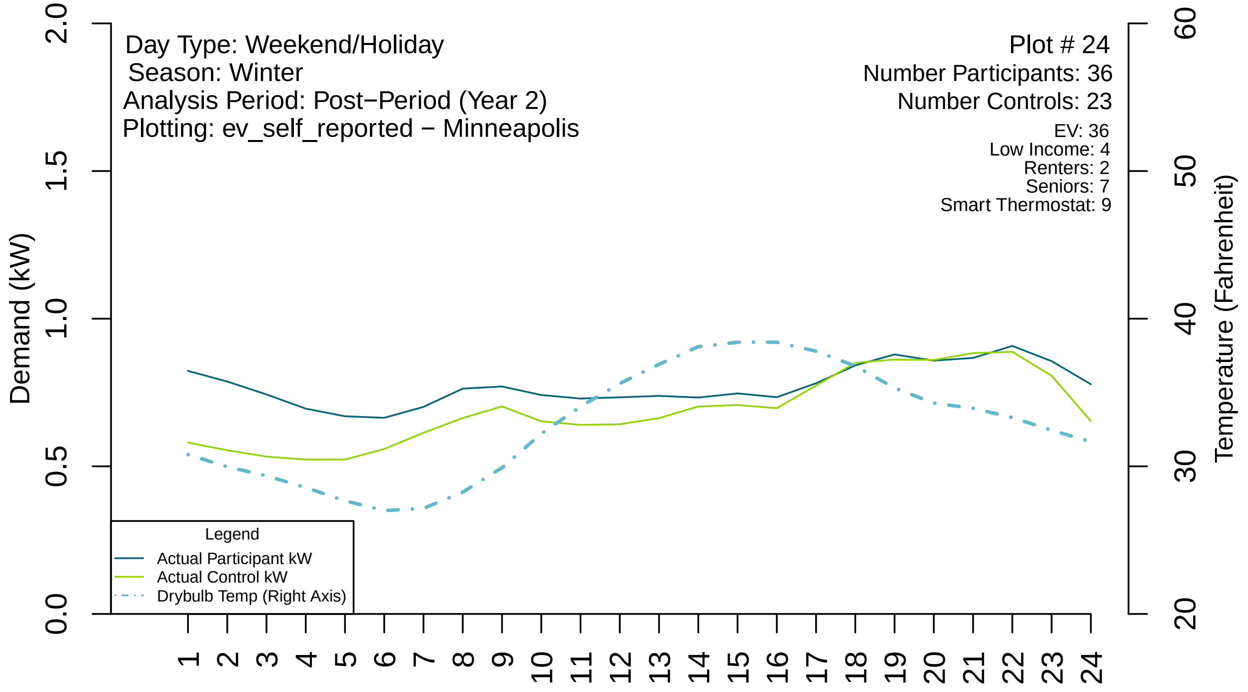

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Pre−Period
Plotting: ev_self_reported − Minneapolis
Plot # 19
Number Participants: 36
Number Controls: 23
EV: 36
Low Income: 4
Renters: 2
Seniors: 7
Smart Thermostat: 9
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

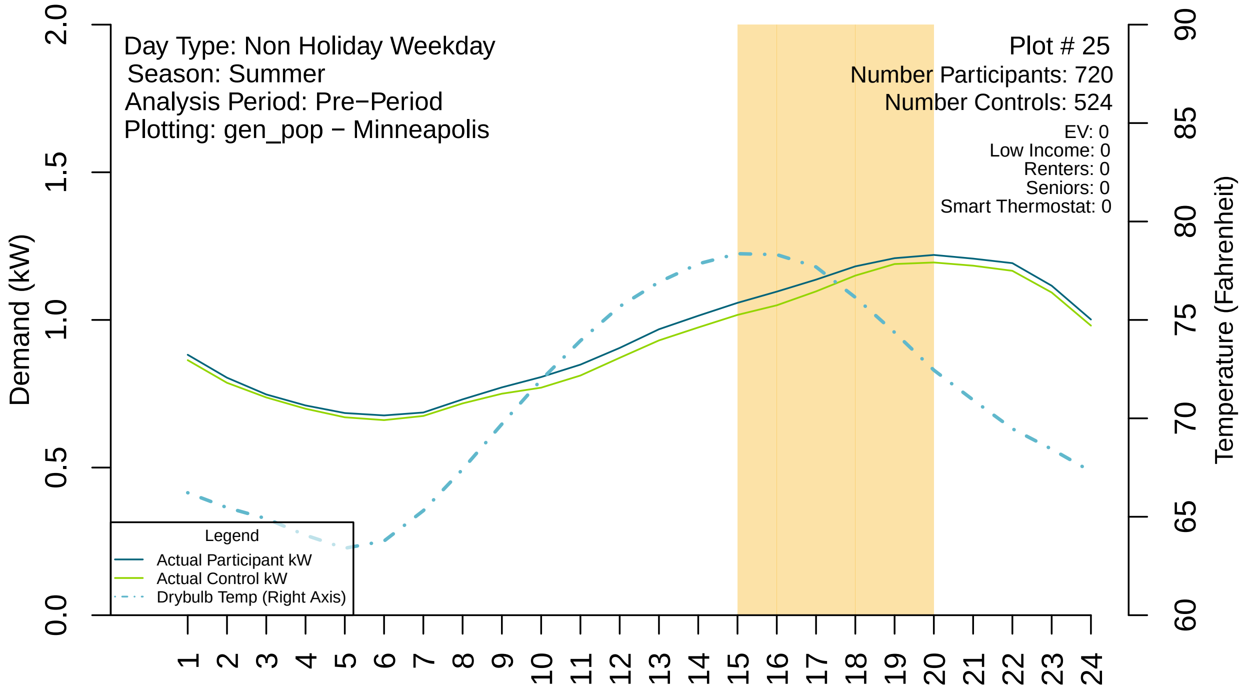

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: ev_self_reported − Minneapolis
Plot # 20
Number Participants: 36
Number Controls: 23
EV: 36
Low Income: 4
Renters: 2
Seniors: 7
Smart Thermostat: 9
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

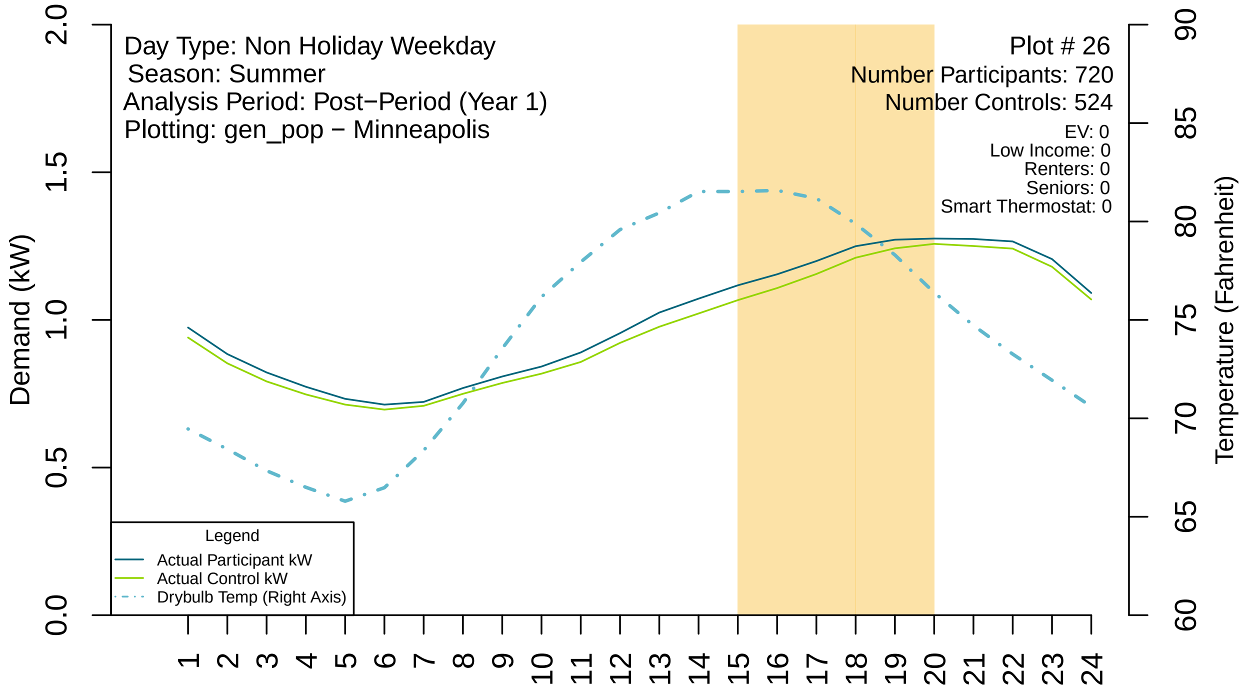

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: ev_self_reported − Minneapolis
Plot # 21
Number Participants: 36
Number Controls: 23
EV: 36
Low Income: 4
Renters: 2
Seniors: 7
Smart Thermostat: 9
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

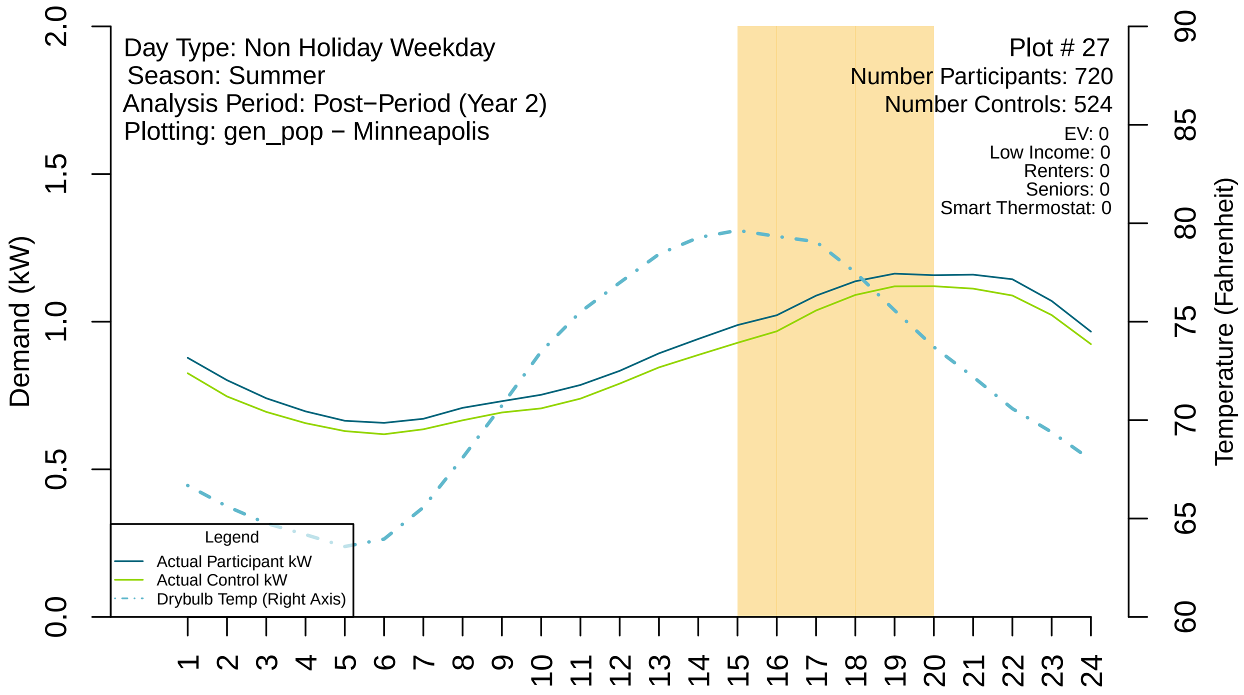

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Pre−Period
Plotting: ev_self_reported − Minneapolis
Plot # 22
Number Participants: 36
Number Controls: 23
EV: 36
Low Income: 4
Renters: 2
Seniors: 7
Smart Thermostat: 9
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

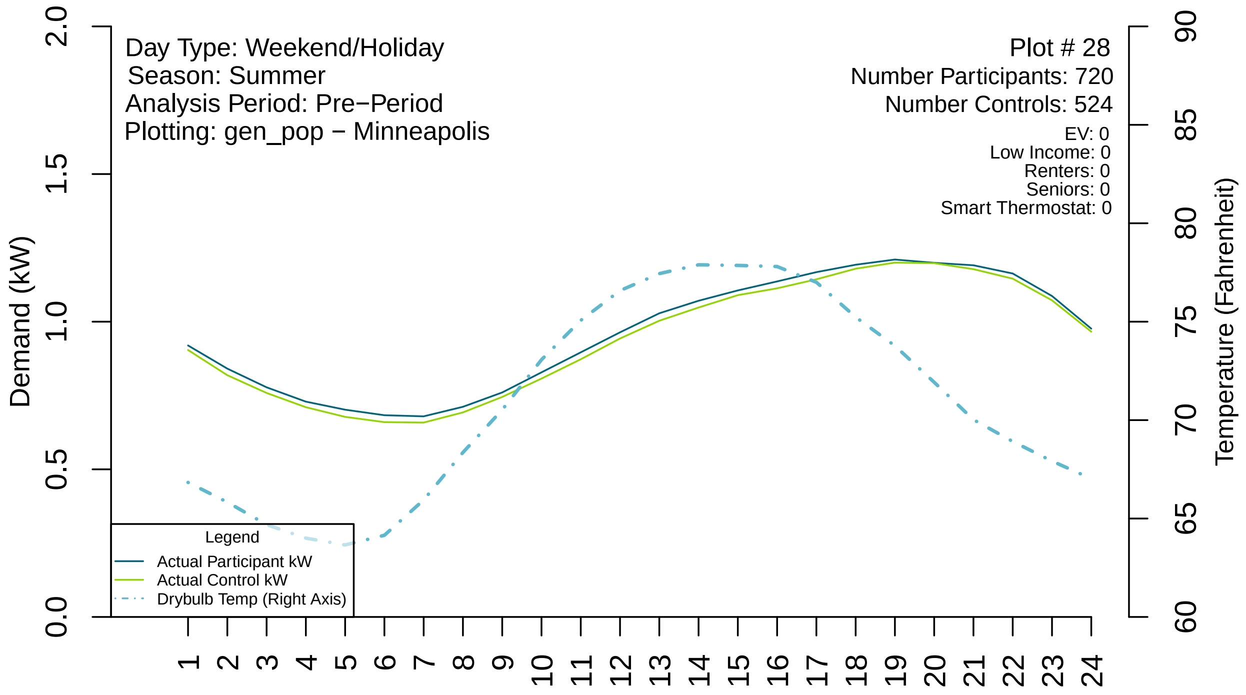

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: ev_self_reported − Minneapolis
Plot # 23
Number Participants: 36
Number Controls: 23
EV: 36
Low Income: 4
Renters: 2
Seniors: 7
Smart Thermostat: 9
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

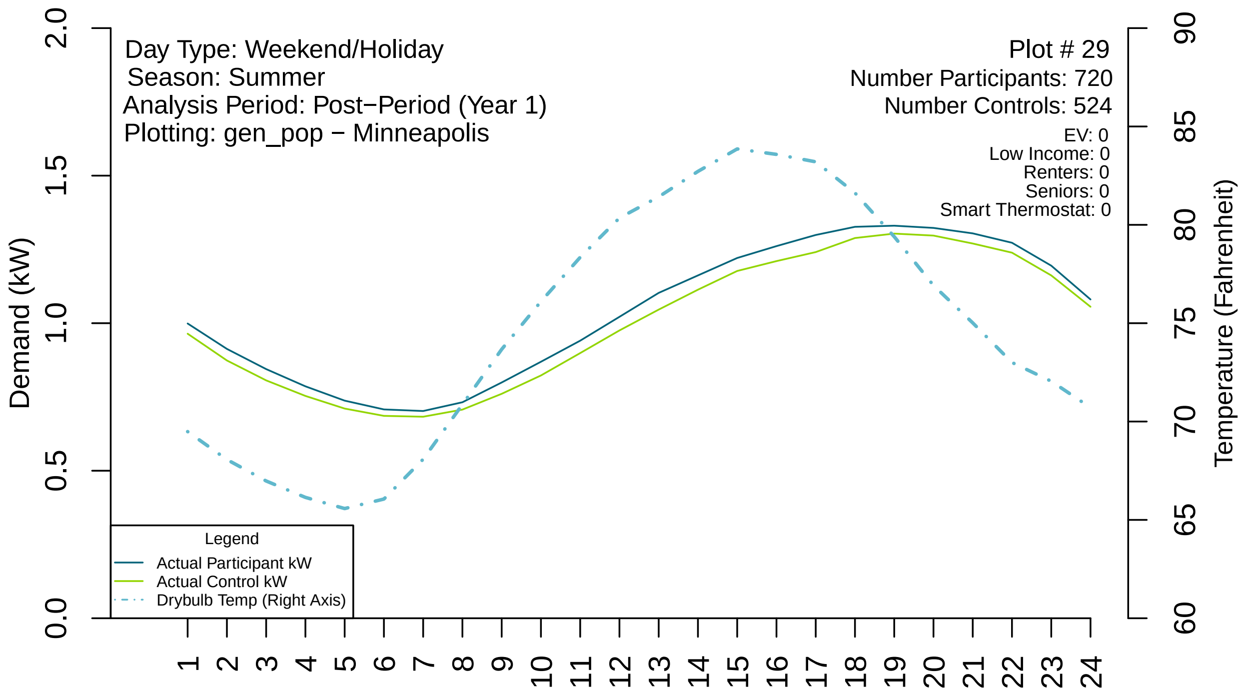

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: ev_self_reported − Minneapolis
Plot # 24
Number Participants: 36
Number Controls: 23
EV: 36
Low Income: 4
Renters: 2
Seniors: 7
Smart Thermostat: 9
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

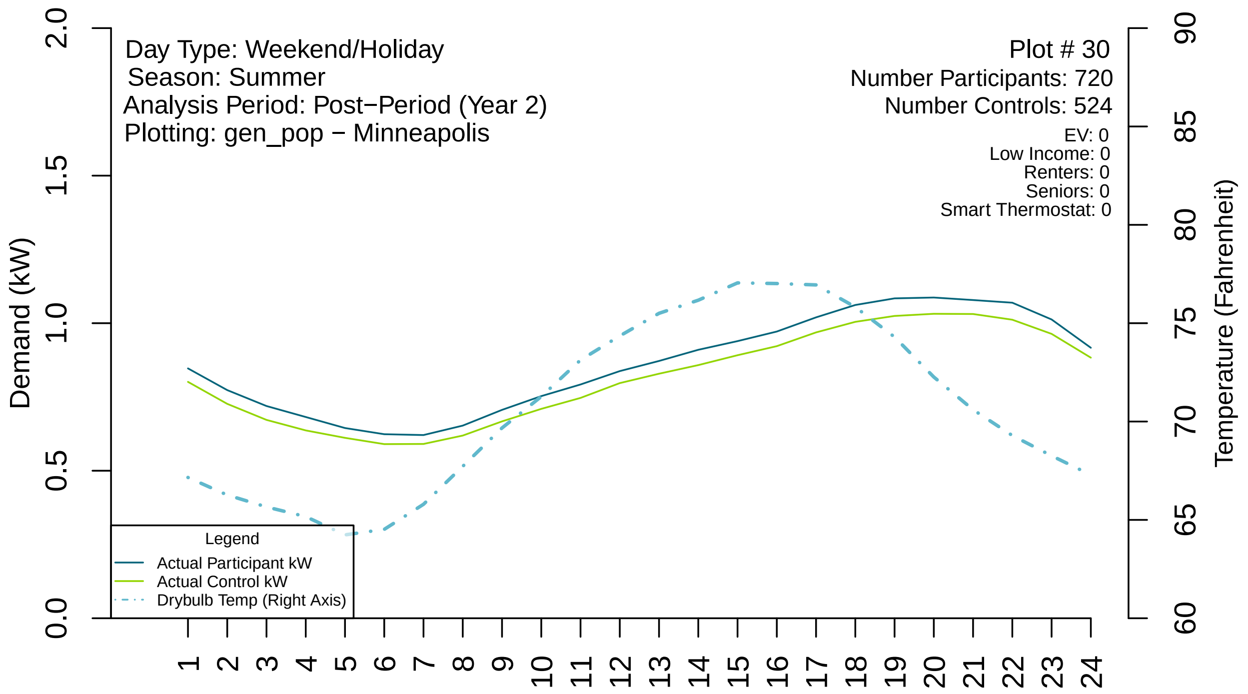

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Pre−Period
Plotting: gen_pop − Minneapolis
Plot # 25
Number Participants: 720
Number Controls: 524
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

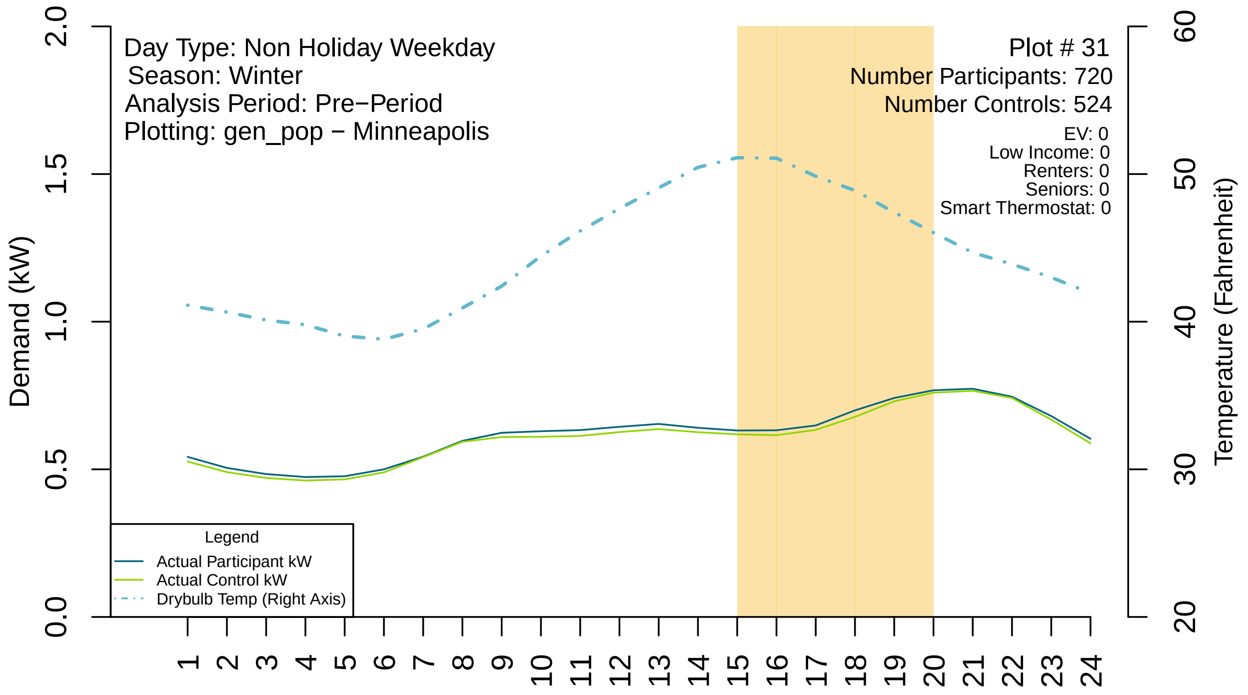

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: gen_pop − Minneapolis
Plot # 26
Number Participants: 720
Number Controls: 524
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

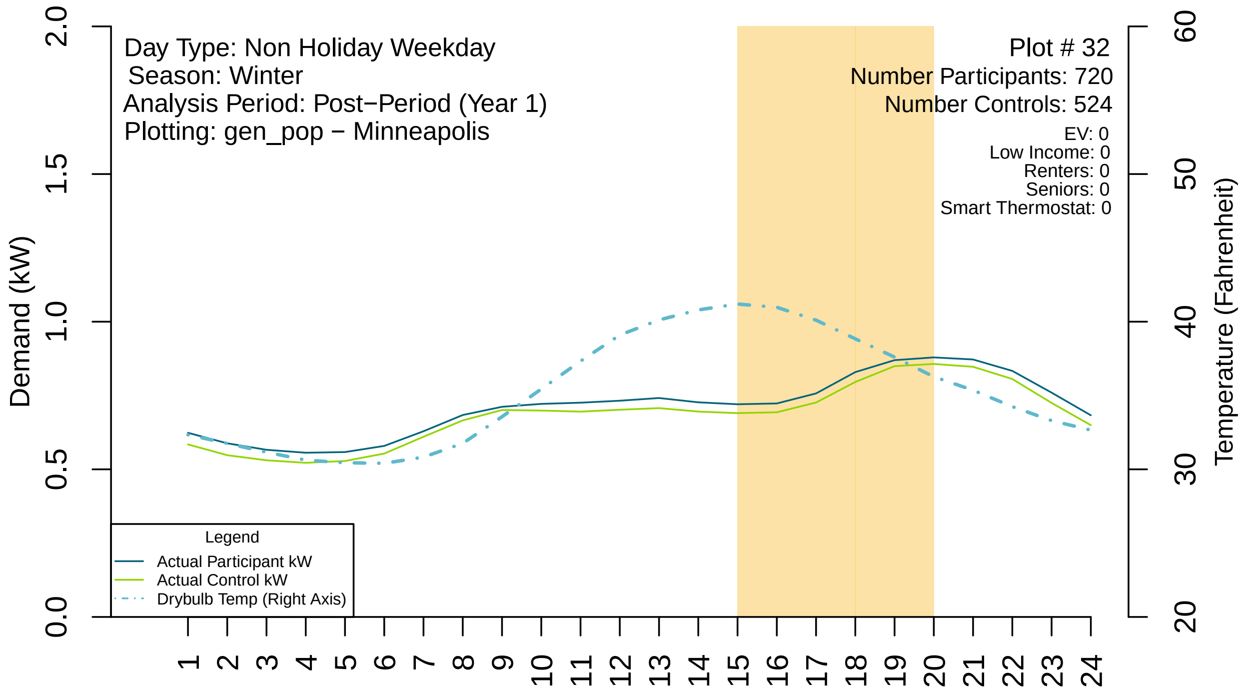

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: gen_pop − Minneapolis
Plot # 27
Number Participants: 720
Number Controls: 524
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

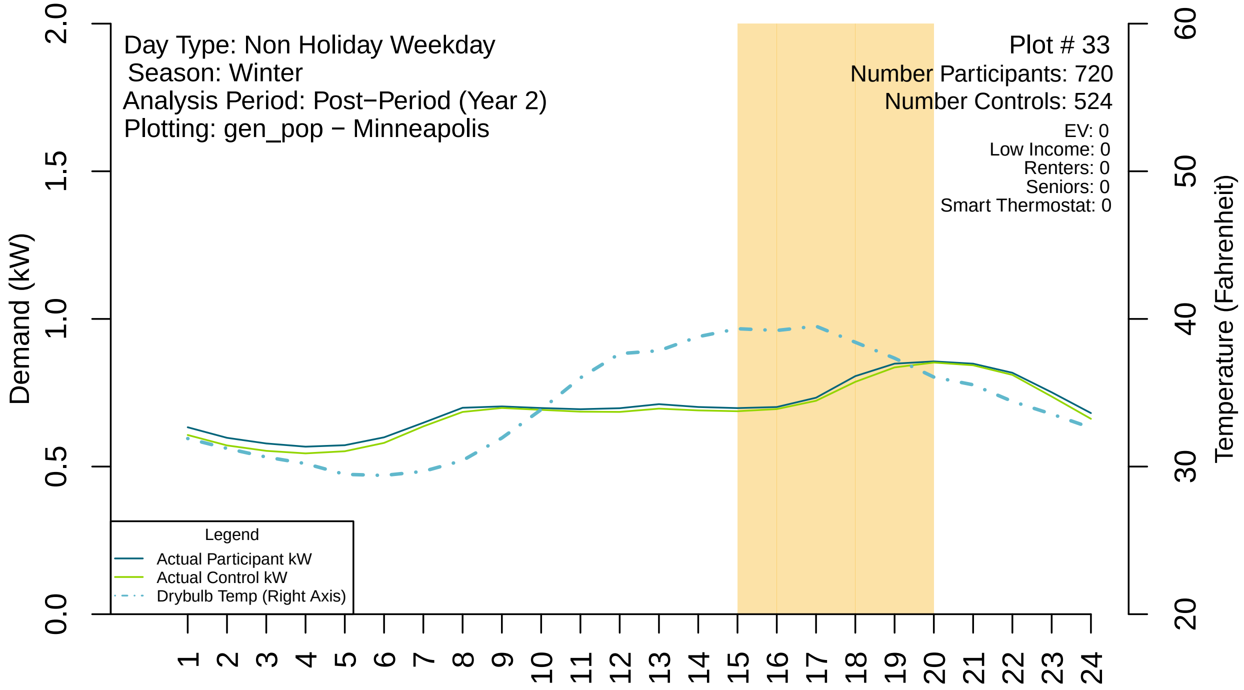

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Pre−Period
Plotting: gen_pop − Minneapolis
Plot # 28
Number Participants: 720
Number Controls: 524
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

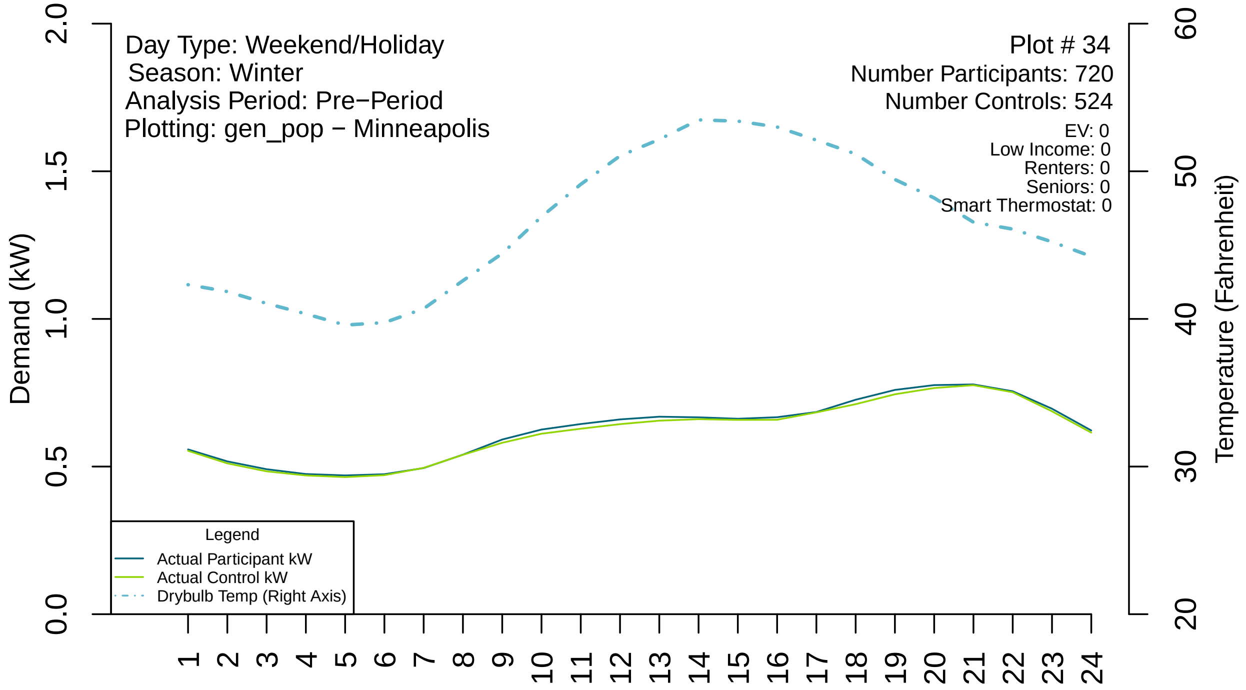

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: gen_pop − Minneapolis
Plot # 29
Number Participants: 720
Number Controls: 524
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

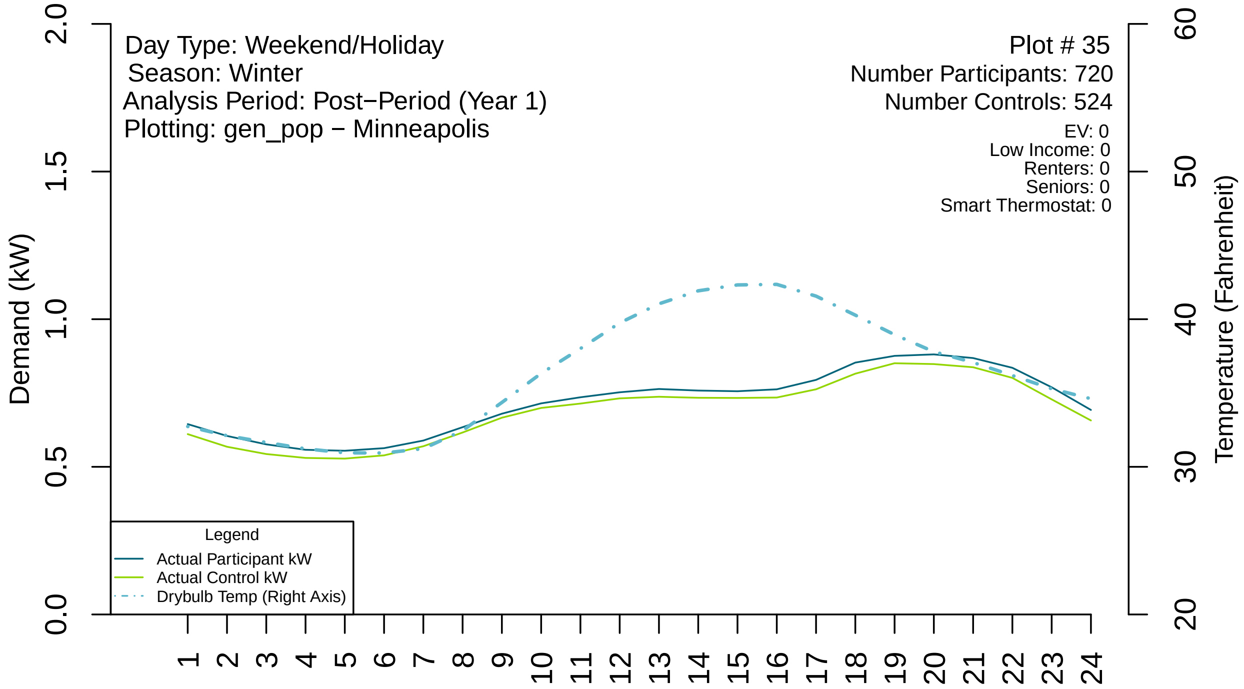

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: gen_pop − Minneapolis
Plot # 30
Number Participants: 720
Number Controls: 524
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

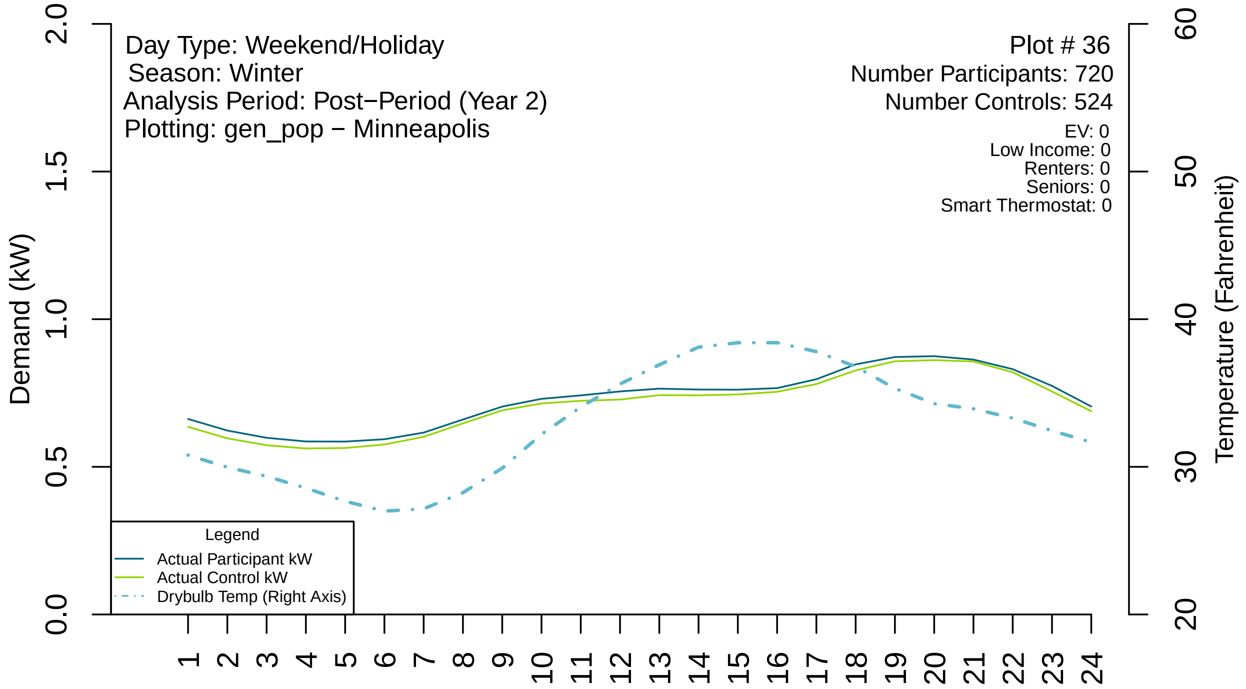

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Pre−Period
Plotting: gen_pop − Minneapolis
Plot # 31
Number Participants: 720
Number Controls: 524
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

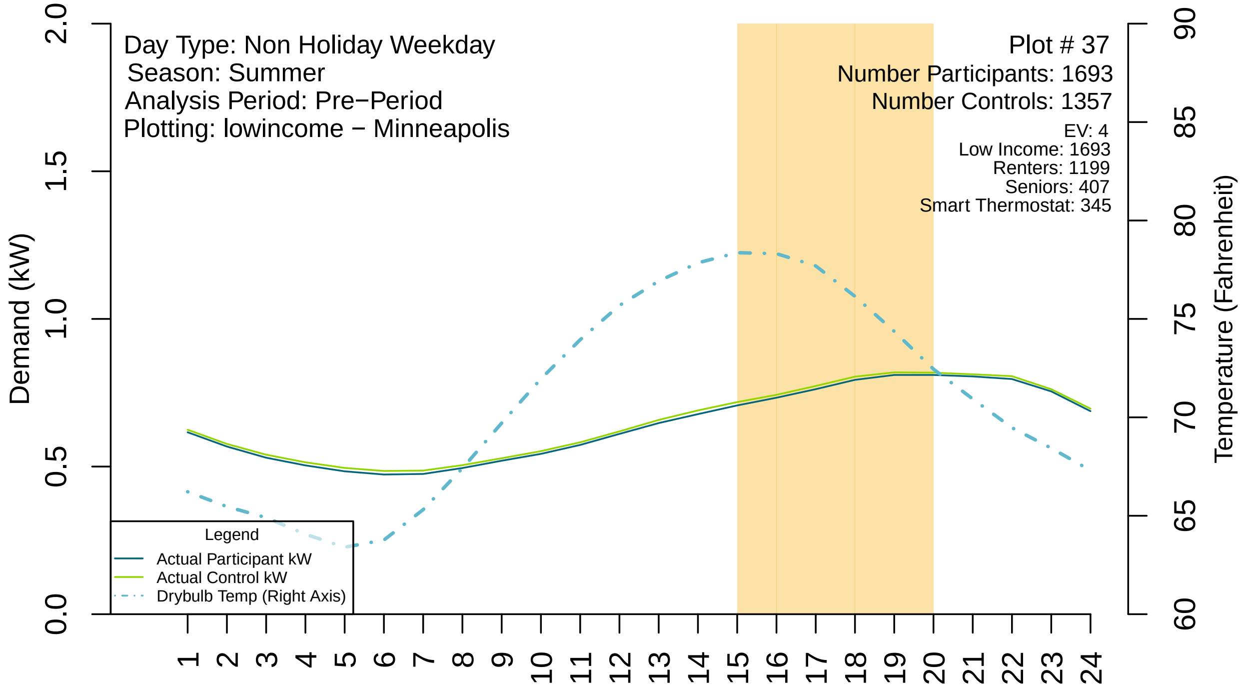

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: gen_pop − Minneapolis
Plot # 32
Number Participants: 720
Number Controls: 524
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

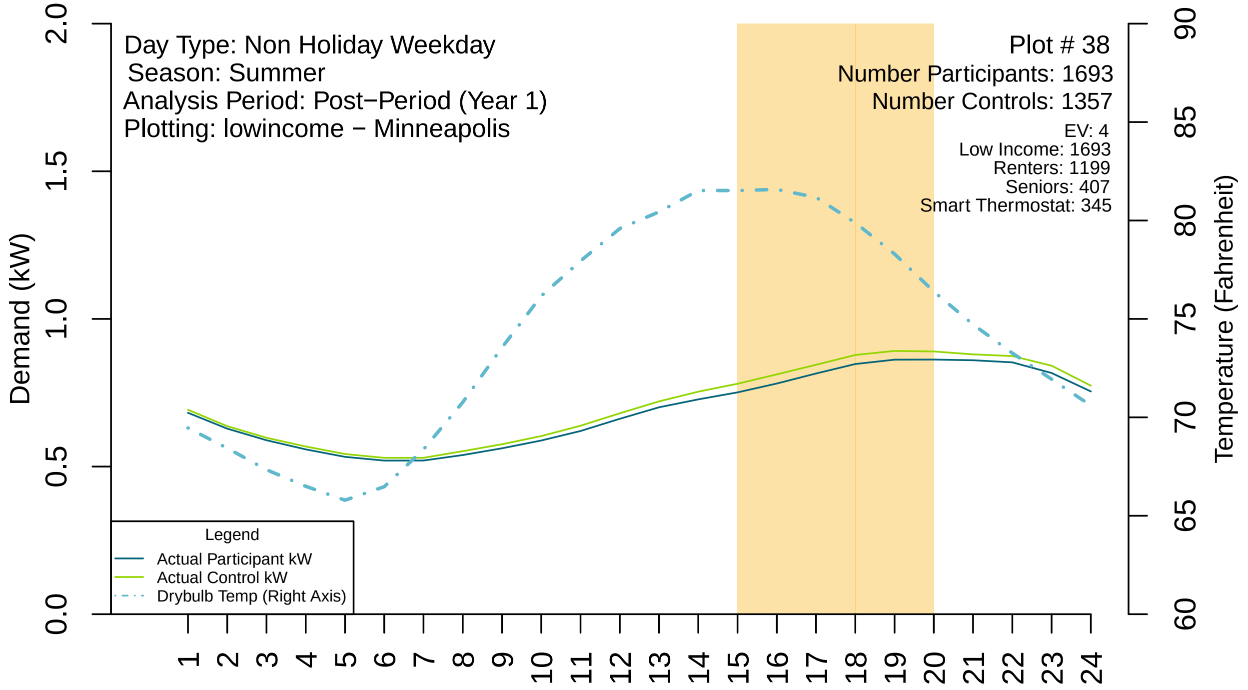

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: gen_pop − Minneapolis
Plot # 33
Number Participants: 720
Number Controls: 524
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

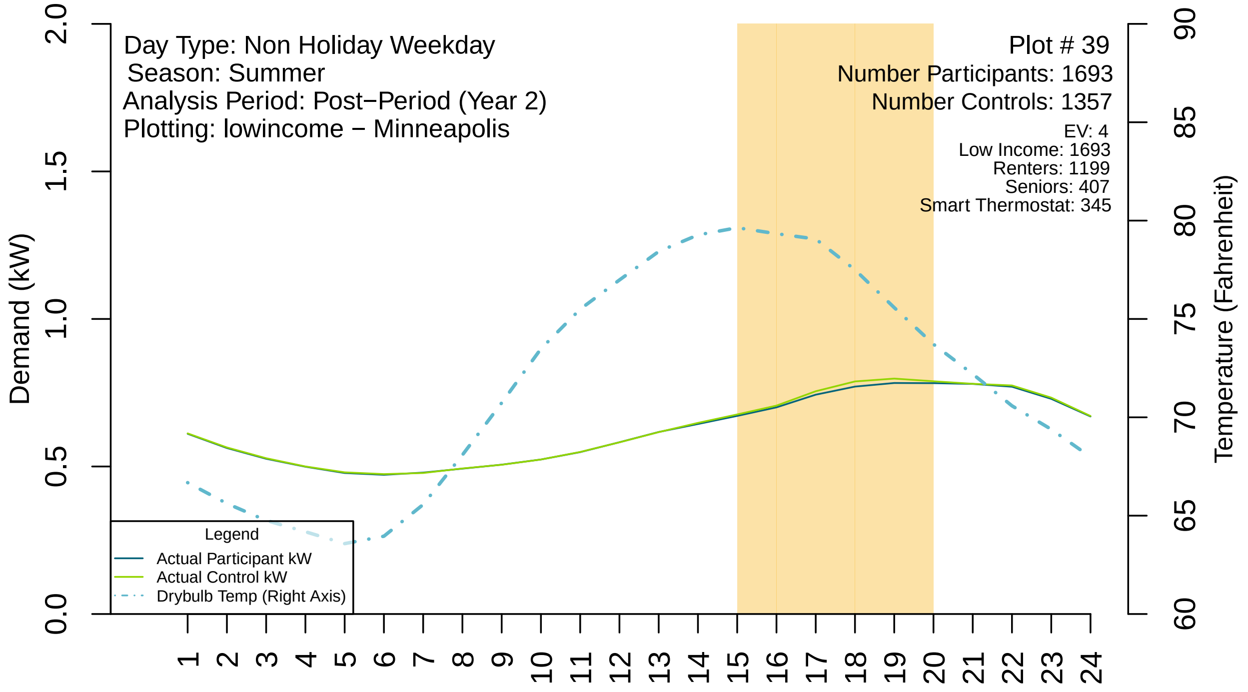

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Pre−Period
Plotting: gen_pop − Minneapolis
Plot # 34
Number Participants: 720
Number Controls: 524
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

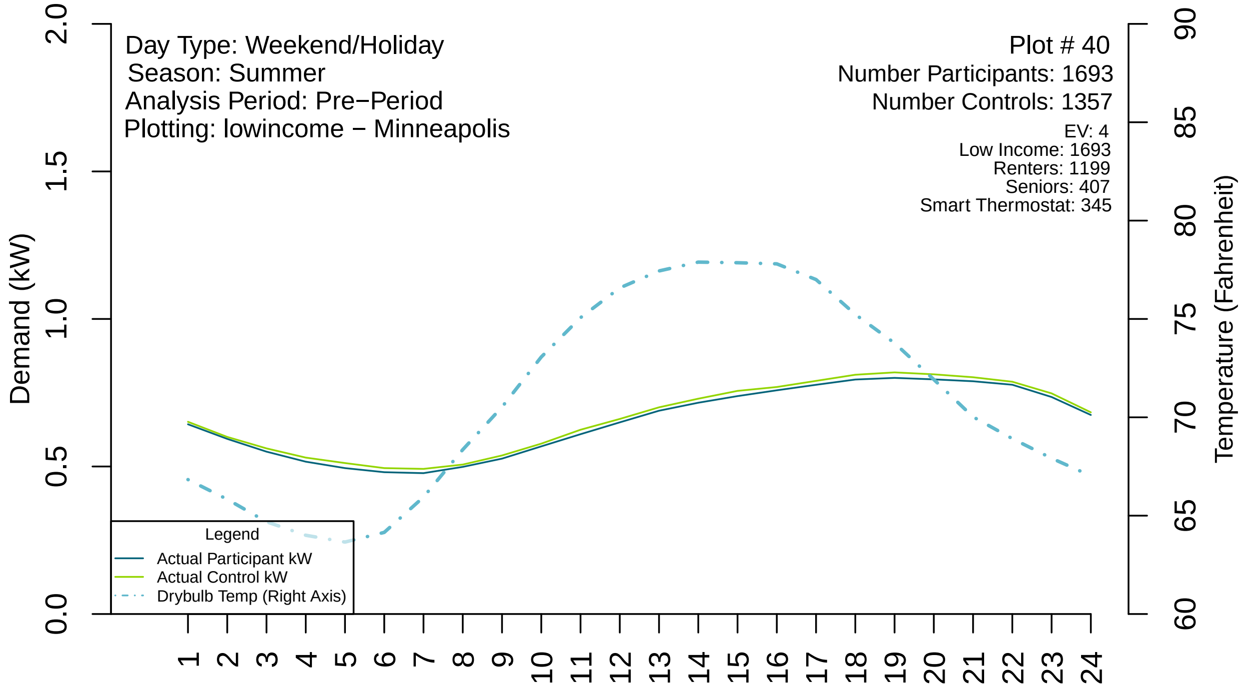

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: gen_pop − Minneapolis
Plot # 35
Number Participants: 720
Number Controls: 524
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

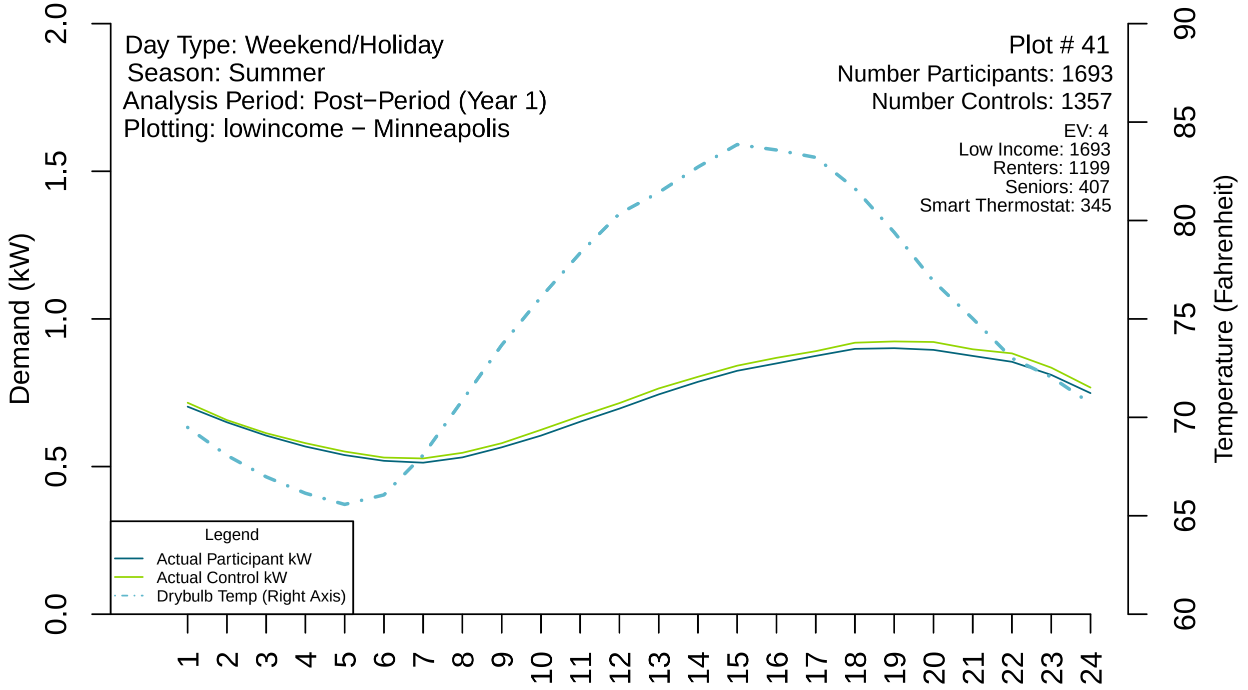

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: gen_pop − Minneapolis
Plot # 36
Number Participants: 720
Number Controls: 524
EV: 0
Low Income: 0
Renters: 0
Seniors: 0
Smart Thermostat: 0
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

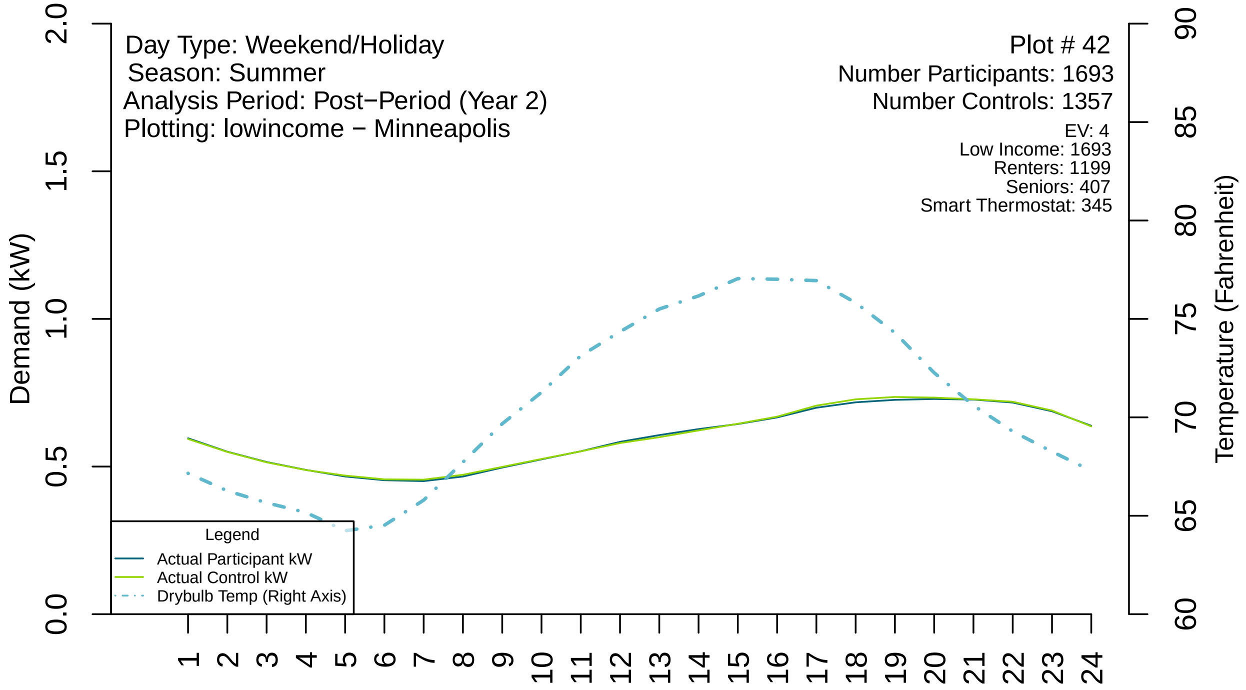

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Pre−Period
Plotting: lowincome − Minneapolis
Plot # 37
Number Participants: 1693
Number Controls: 1357
EV: 4
Low Income: 1693
Renters: 1199
Seniors: 407
Smart Thermostat: 345
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

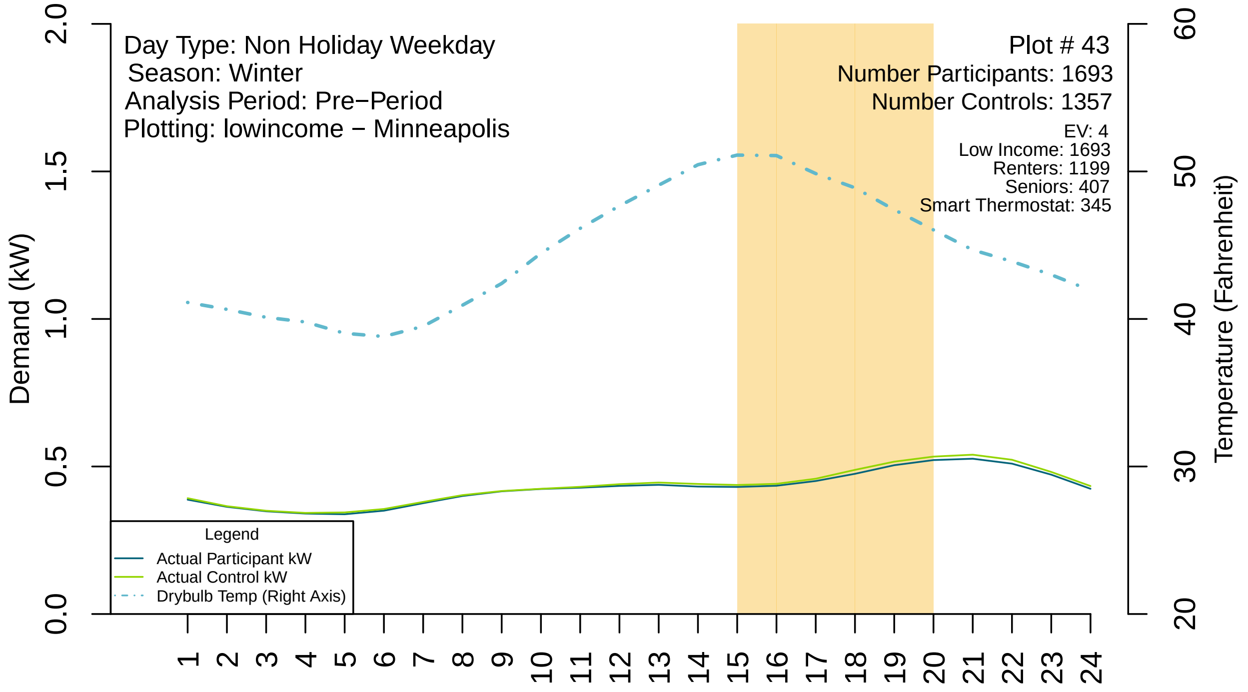

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: lowincome − Minneapolis
Plot # 38
Number Participants: 1693
Number Controls: 1357
EV: 4
Low Income: 1693
Renters: 1199
Seniors: 407
Smart Thermostat: 345
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

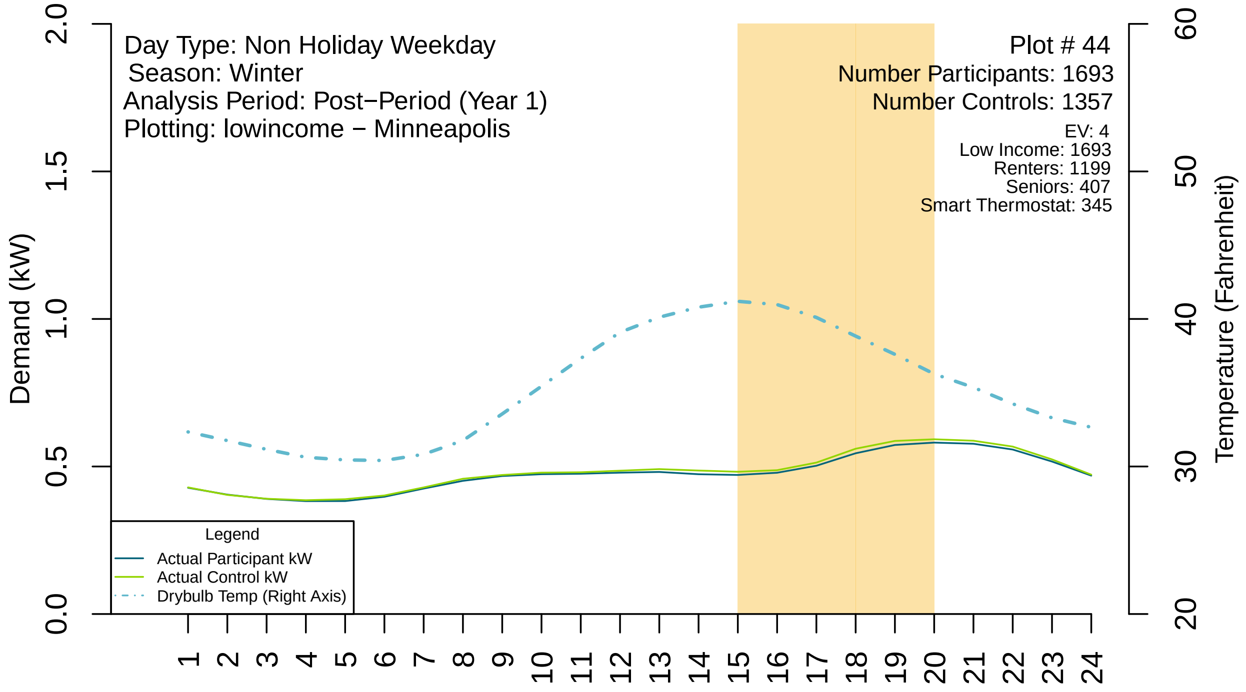

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: lowincome − Minneapolis
Plot # 39
Number Participants: 1693
Number Controls: 1357
EV: 4
Low Income: 1693
Renters: 1199
Seniors: 407
Smart Thermostat: 345
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

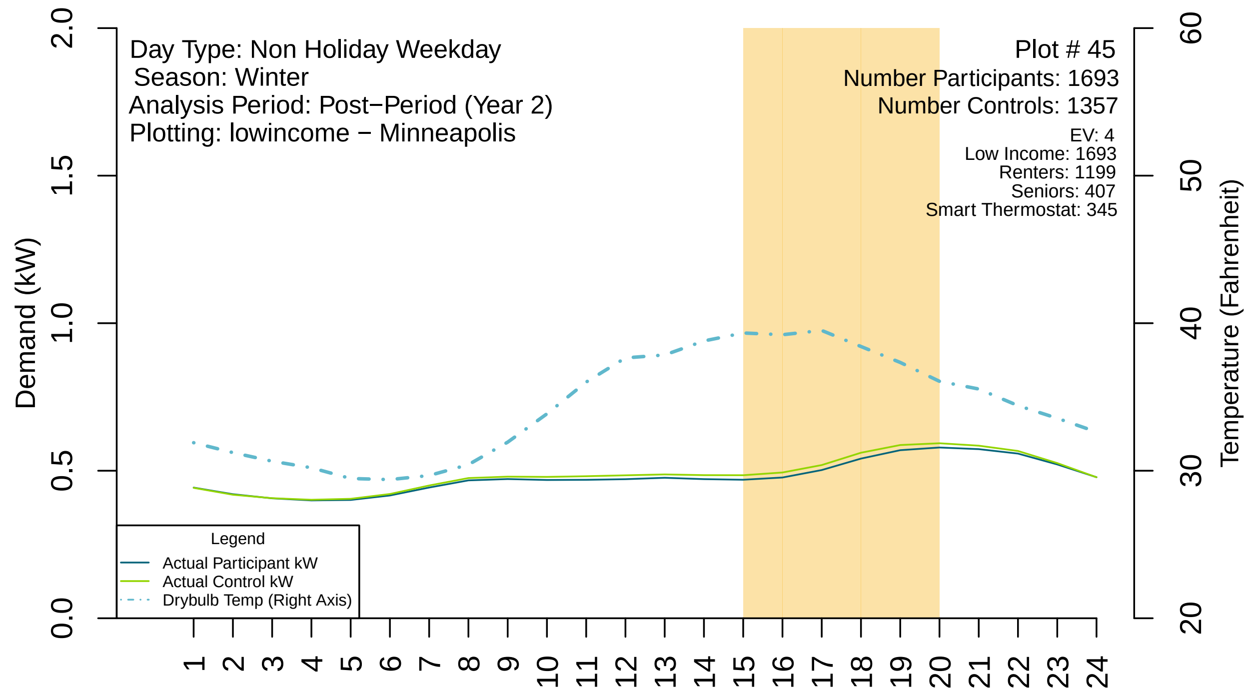

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Pre−Period
Plotting: lowincome − Minneapolis
Plot # 40
Number Participants: 1693
Number Controls: 1357
EV: 4
Low Income: 1693
Renters: 1199
Seniors: 407
Smart Thermostat: 345
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

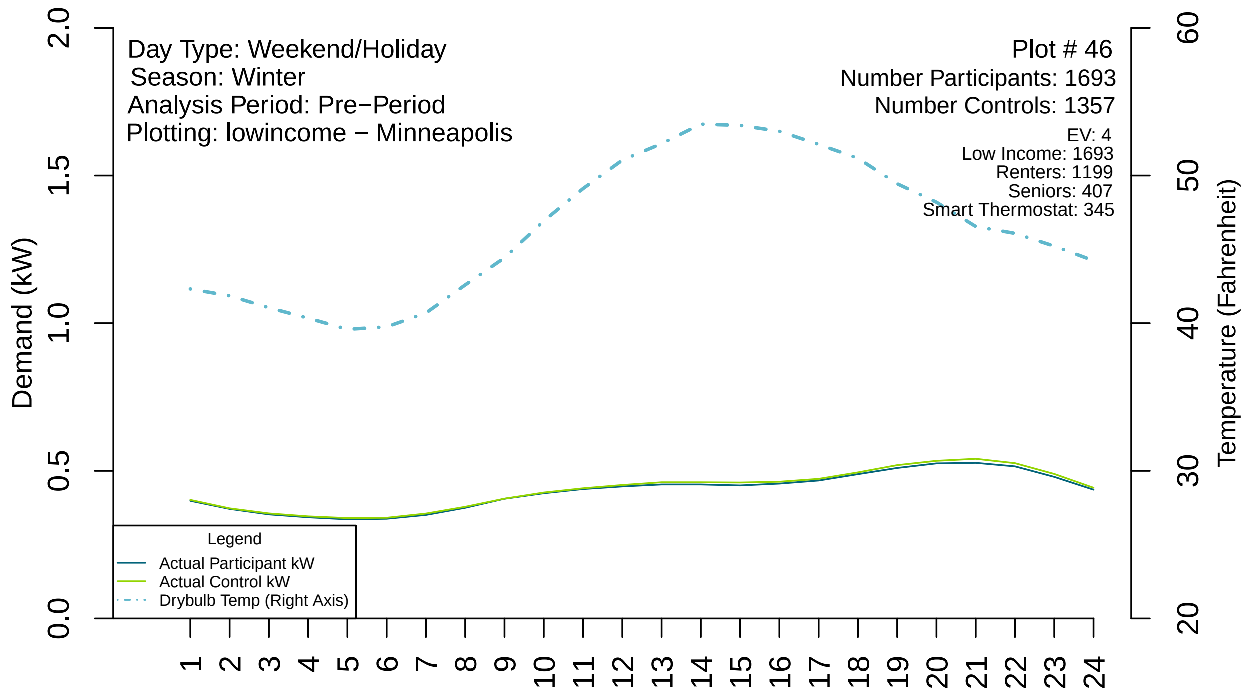

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: lowincome − Minneapolis
Plot # 41
Number Participants: 1693
Number Controls: 1357
EV: 4
Low Income: 1693
Renters: 1199
Seniors: 407
Smart Thermostat: 345
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

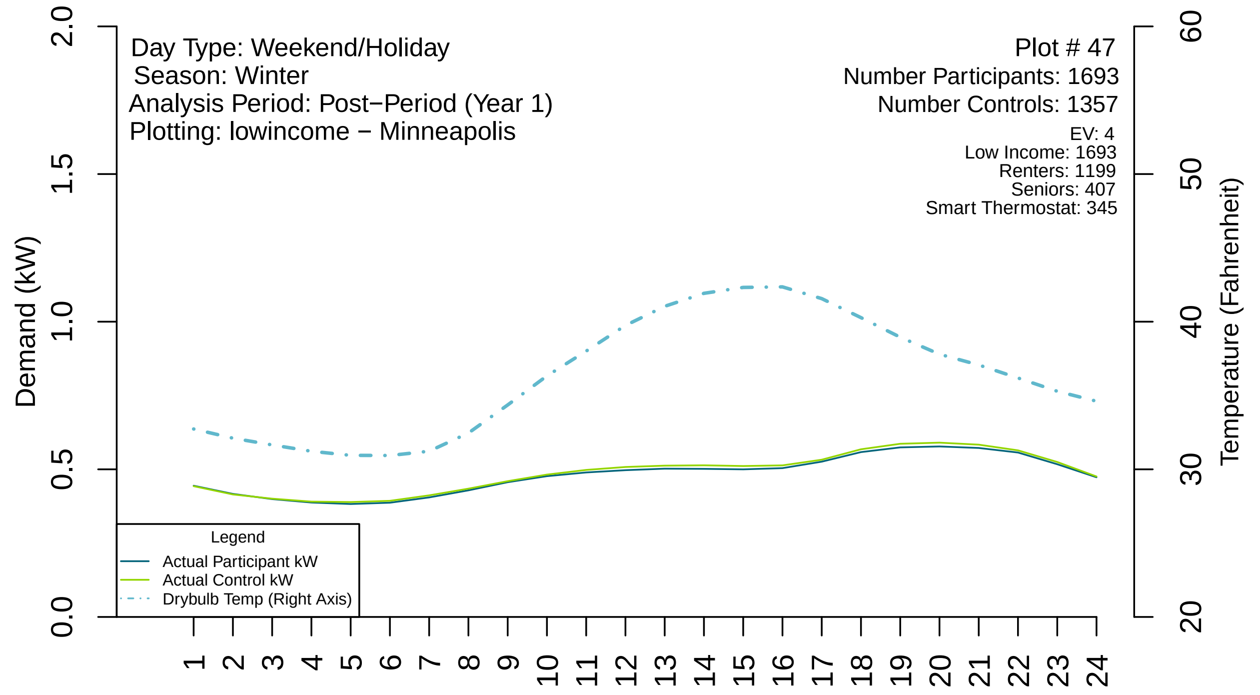

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: lowincome − Minneapolis
Plot # 42
Number Participants: 1693
Number Controls: 1357
EV: 4
Low Income: 1693
Renters: 1199
Seniors: 407
Smart Thermostat: 345
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

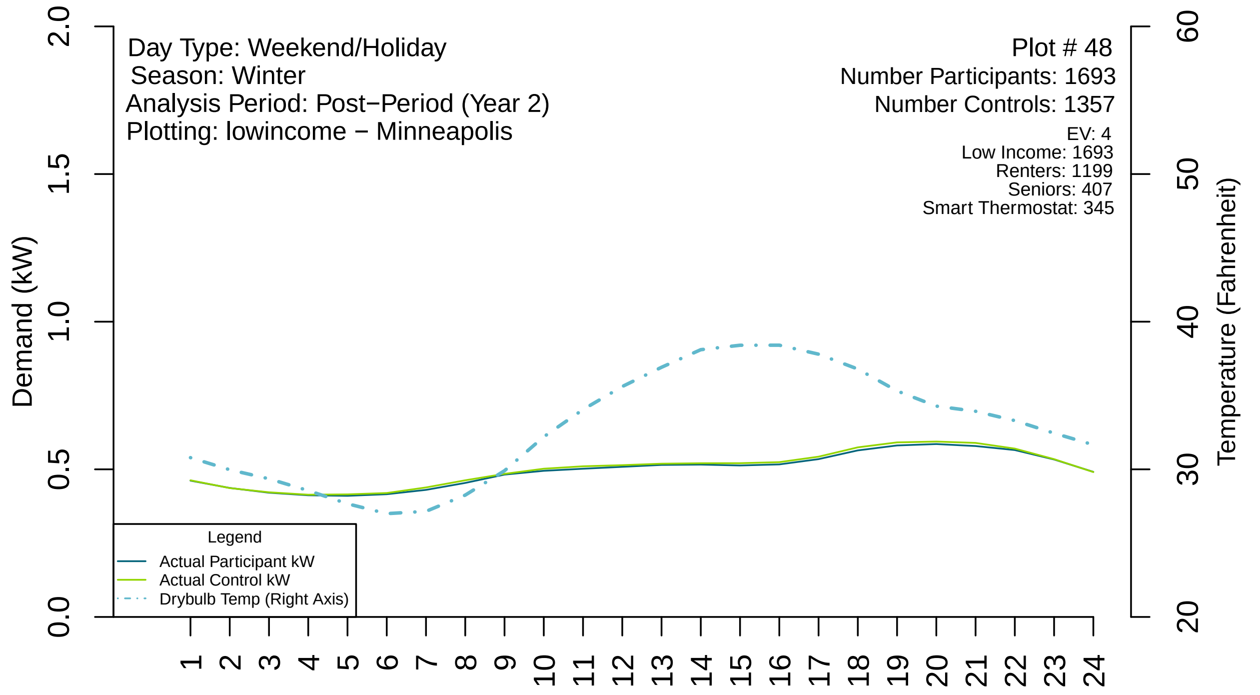

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Pre−Period
Plotting: lowincome − Minneapolis
Plot # 43
Number Participants: 1693
Number Controls: 1357
EV: 4
Low Income: 1693
Renters: 1199
Seniors: 407
Smart Thermostat: 345
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

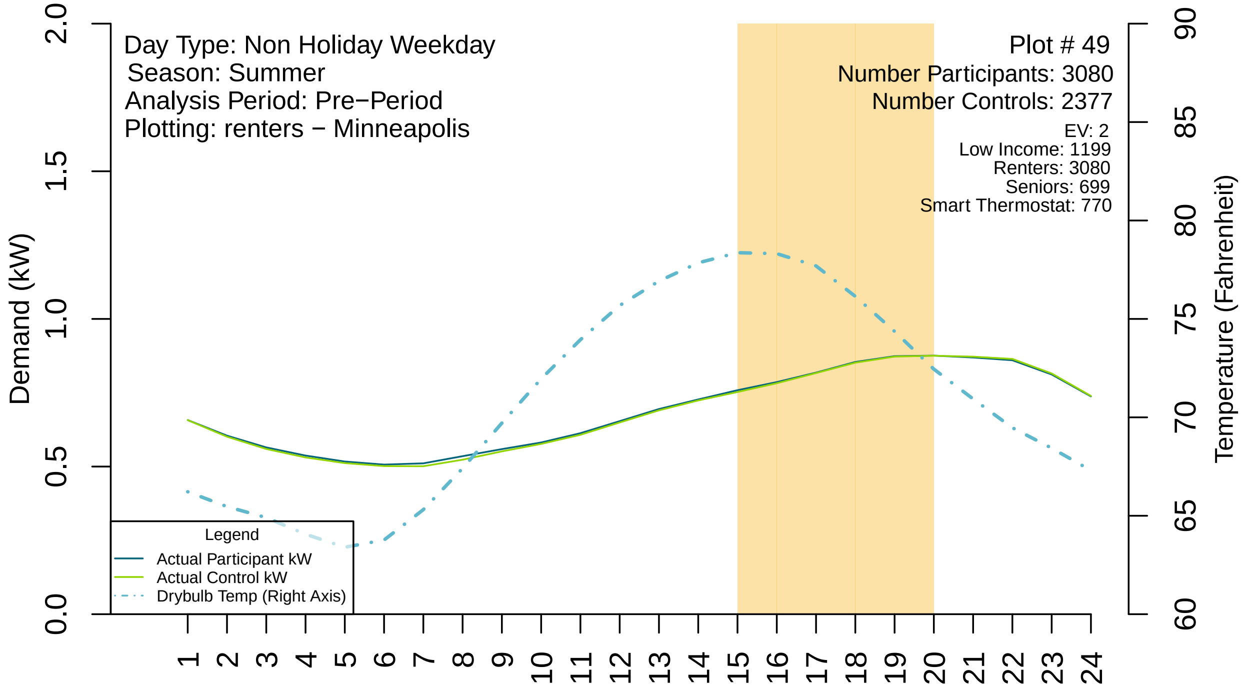

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: lowincome − Minneapolis
Plot # 44
Number Participants: 1693
Number Controls: 1357
EV: 4
Low Income: 1693
Renters: 1199
Seniors: 407
Smart Thermostat: 345
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

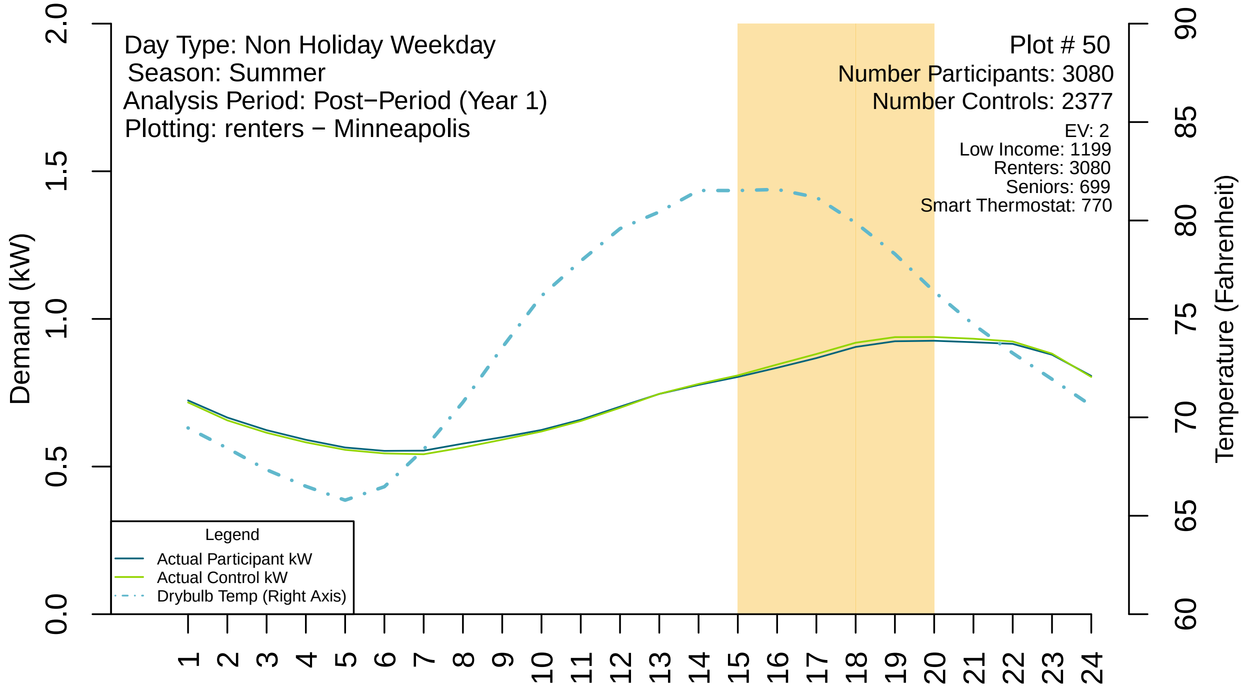

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: lowincome − Minneapolis
Plot # 45
Number Participants: 1693
Number Controls: 1357
EV: 4
Low Income: 1693
Renters: 1199
Seniors: 407
Smart Thermostat: 345
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

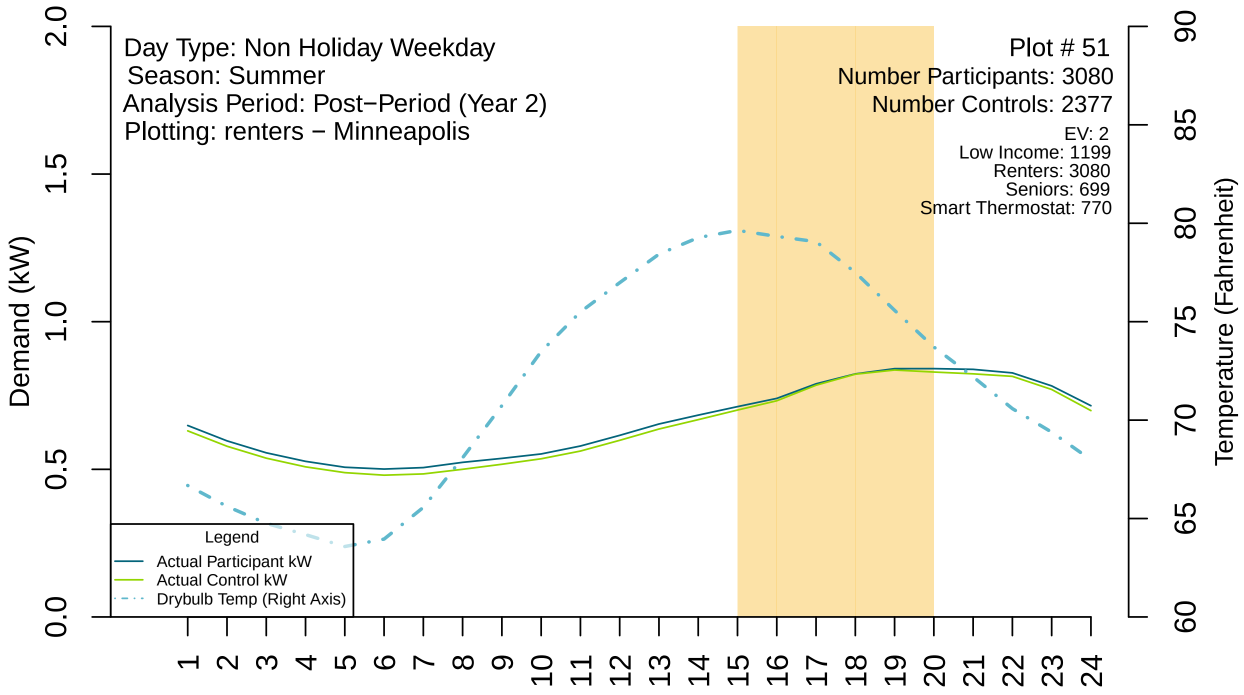

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Pre−Period
Plotting: lowincome − Minneapolis
Plot # 46
Number Participants: 1693
Number Controls: 1357
EV: 4
Low Income: 1693
Renters: 1199
Seniors: 407
Smart Thermostat: 345
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

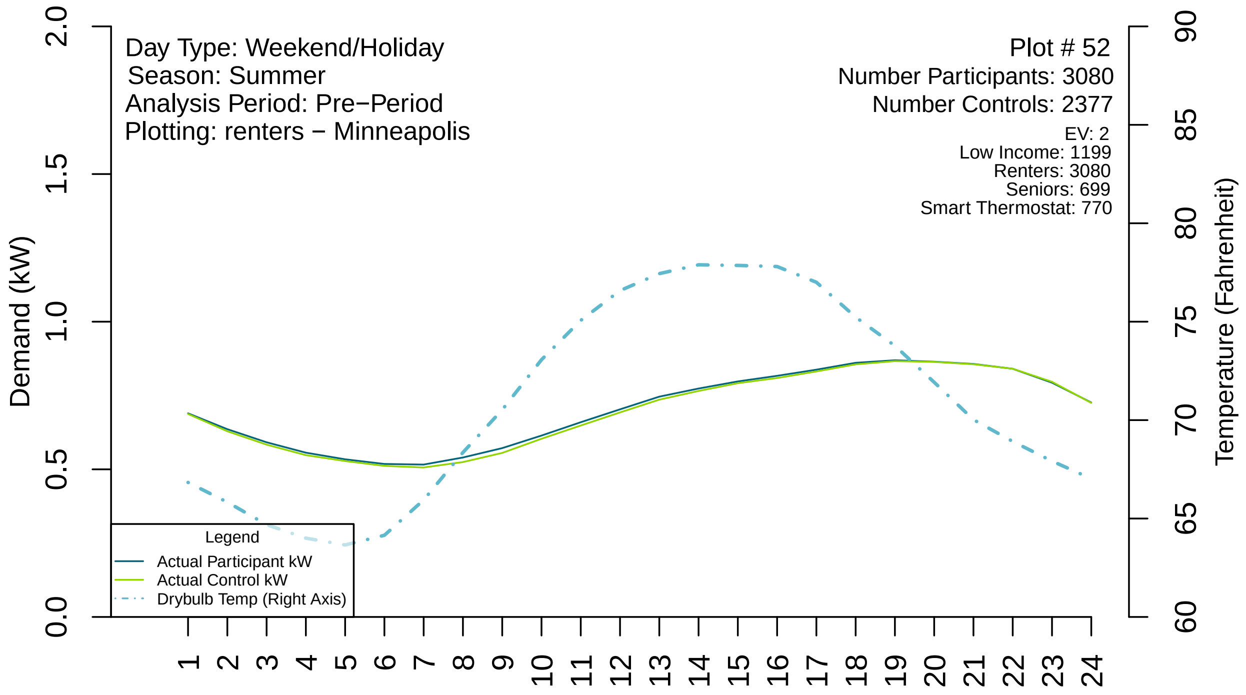

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: lowincome − Minneapolis
Plot # 47
Number Participants: 1693
Number Controls: 1357
EV: 4
Low Income: 1693
Renters: 1199
Seniors: 407
Smart Thermostat: 345
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

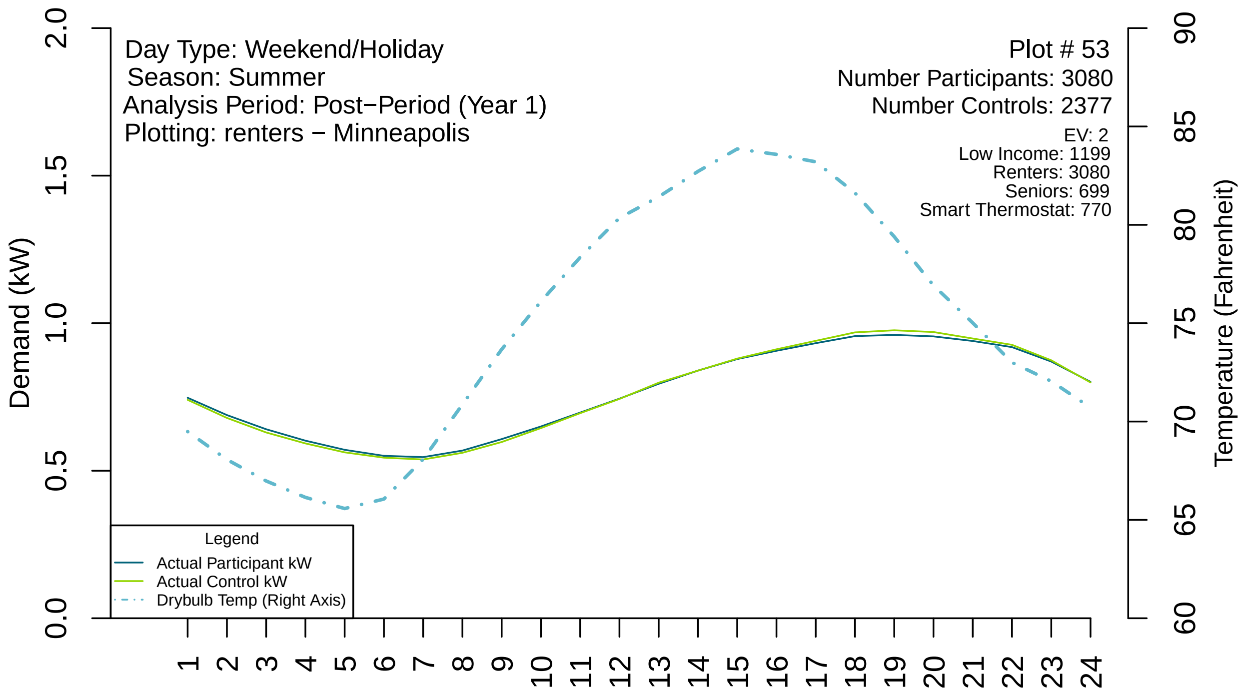

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: lowincome − Minneapolis
Plot # 48
Number Participants: 1693
Number Controls: 1357
EV: 4
Low Income: 1693
Renters: 1199
Seniors: 407
Smart Thermostat: 345
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

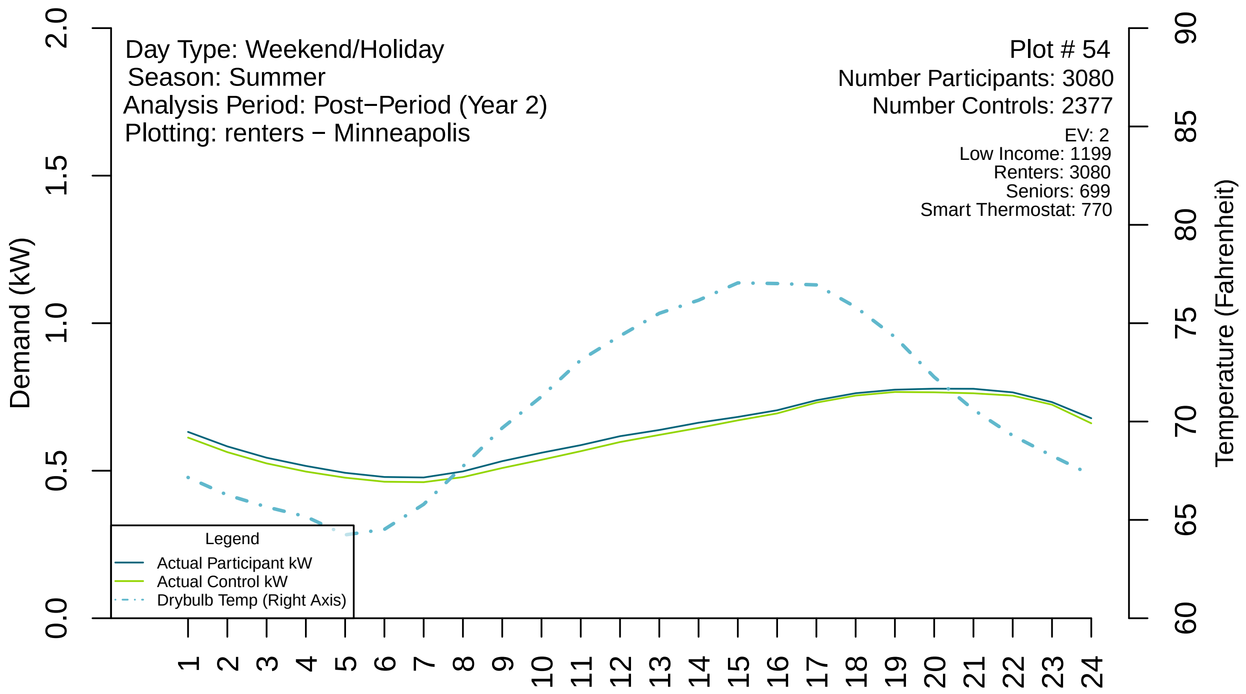

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Pre−Period
Plotting: renters − Minneapolis
Plot # 49
Number Participants: 3080
Number Controls: 2377
EV: 2
Low Income: 1199
Renters: 3080
Seniors: 699
Smart Thermostat: 770
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

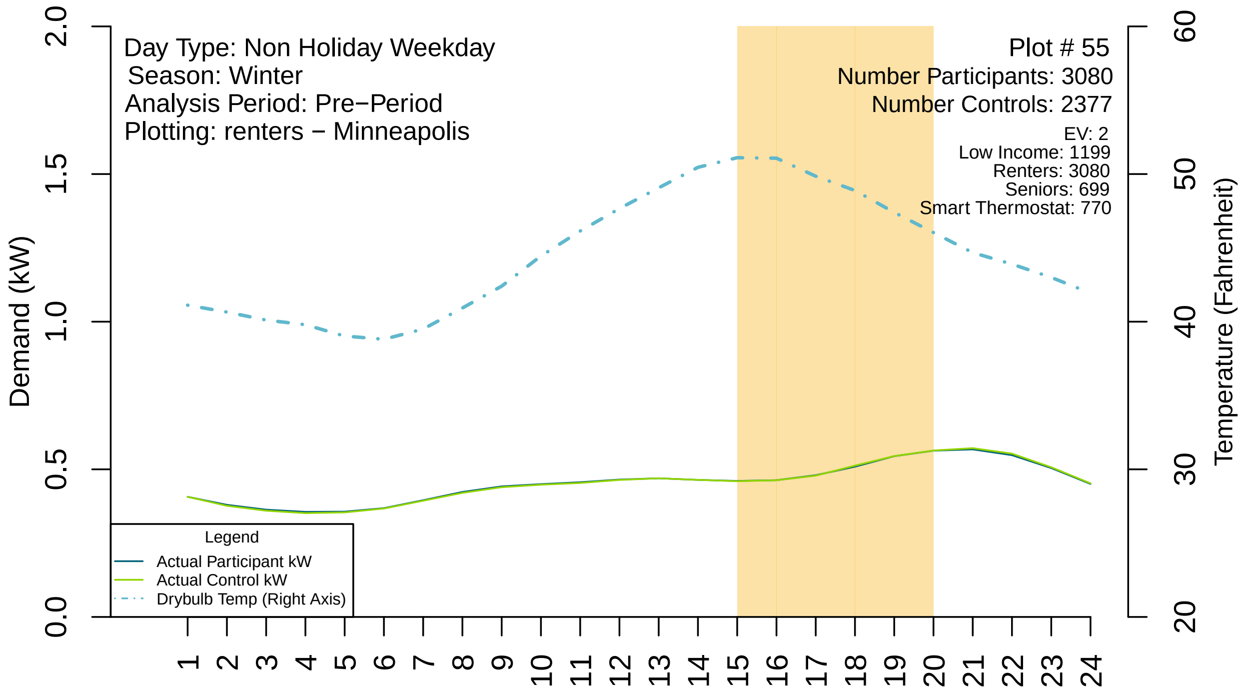

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: renters − Minneapolis
Plot # 50
Number Participants: 3080
Number Controls: 2377
EV: 2
Low Income: 1199
Renters: 3080
Seniors: 699
Smart Thermostat: 770
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

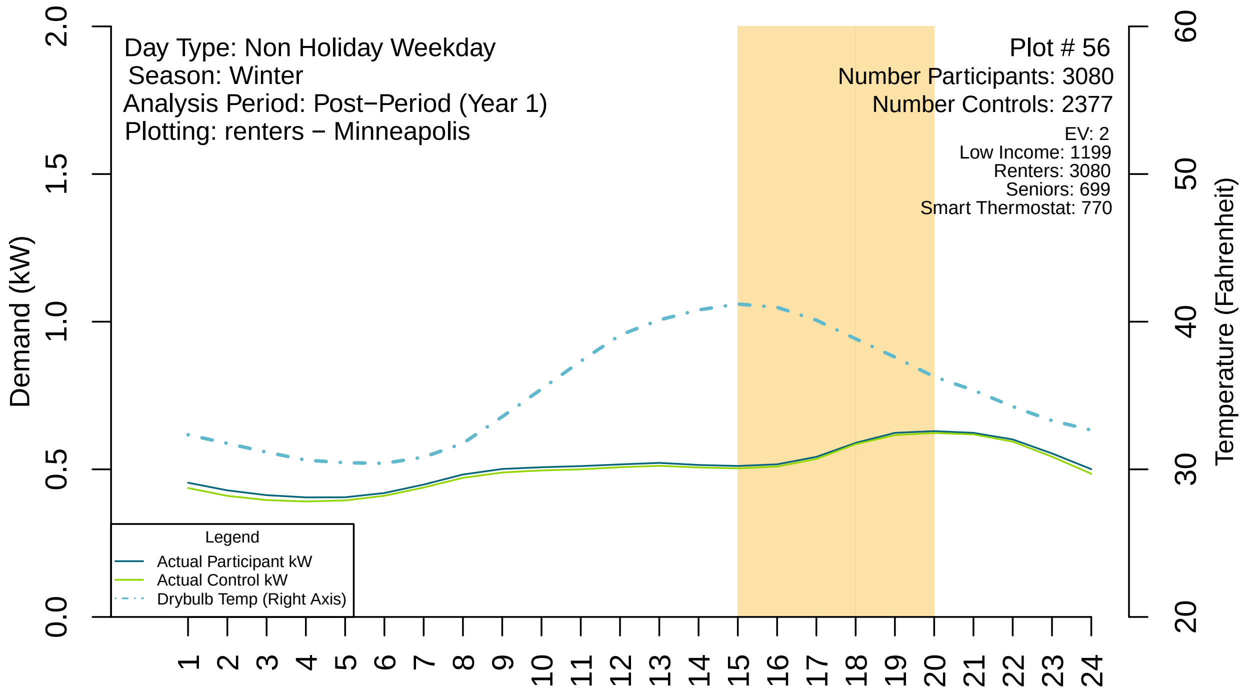

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: renters − Minneapolis
Plot # 51
Number Participants: 3080
Number Controls: 2377
EV: 2
Low Income: 1199
Renters: 3080
Seniors: 699
Smart Thermostat: 770
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

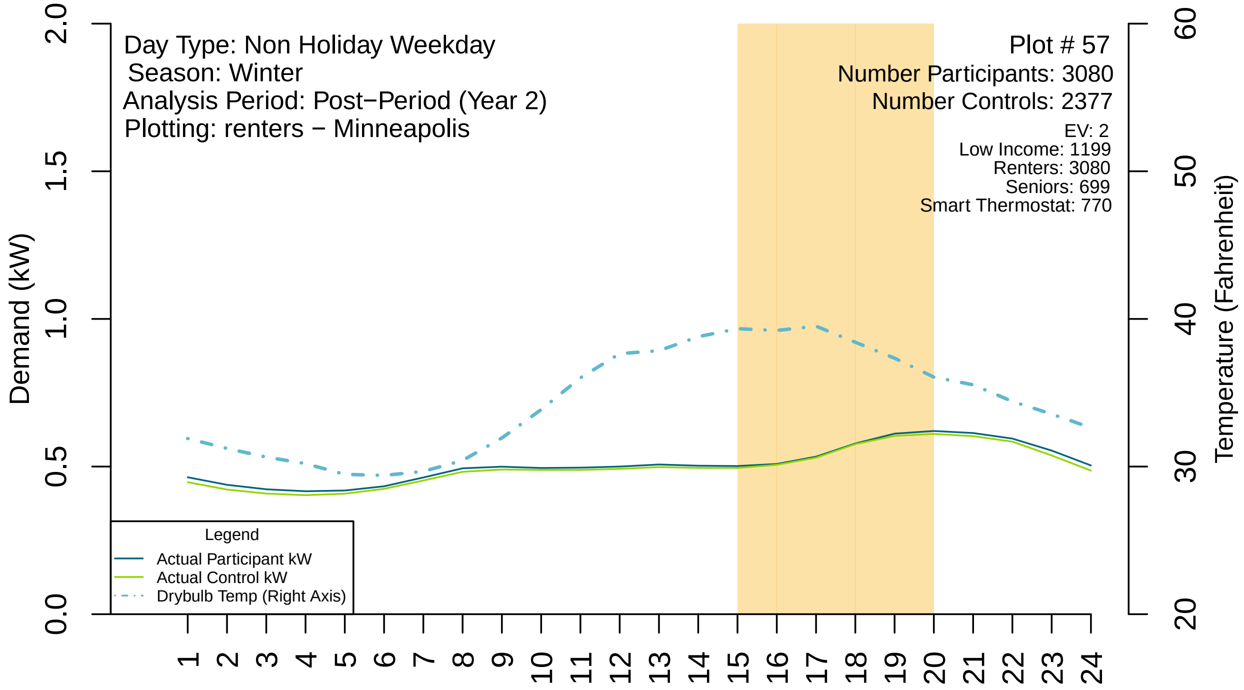

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Pre−Period
Plotting: renters − Minneapolis
Plot # 52
Number Participants: 3080
Number Controls: 2377
EV: 2
Low Income: 1199
Renters: 3080
Seniors: 699
Smart Thermostat: 770
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

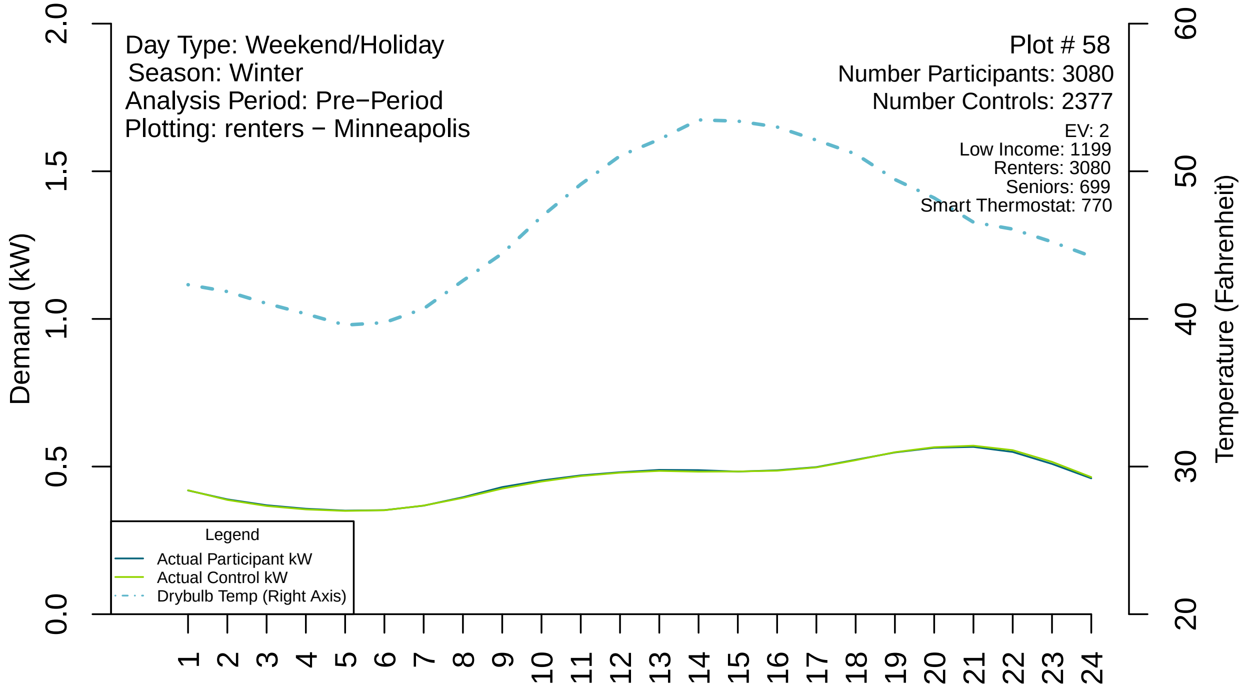

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: renters − Minneapolis
Plot # 53
Number Participants: 3080
Number Controls: 2377
EV: 2
Low Income: 1199
Renters: 3080
Seniors: 699
Smart Thermostat: 770
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

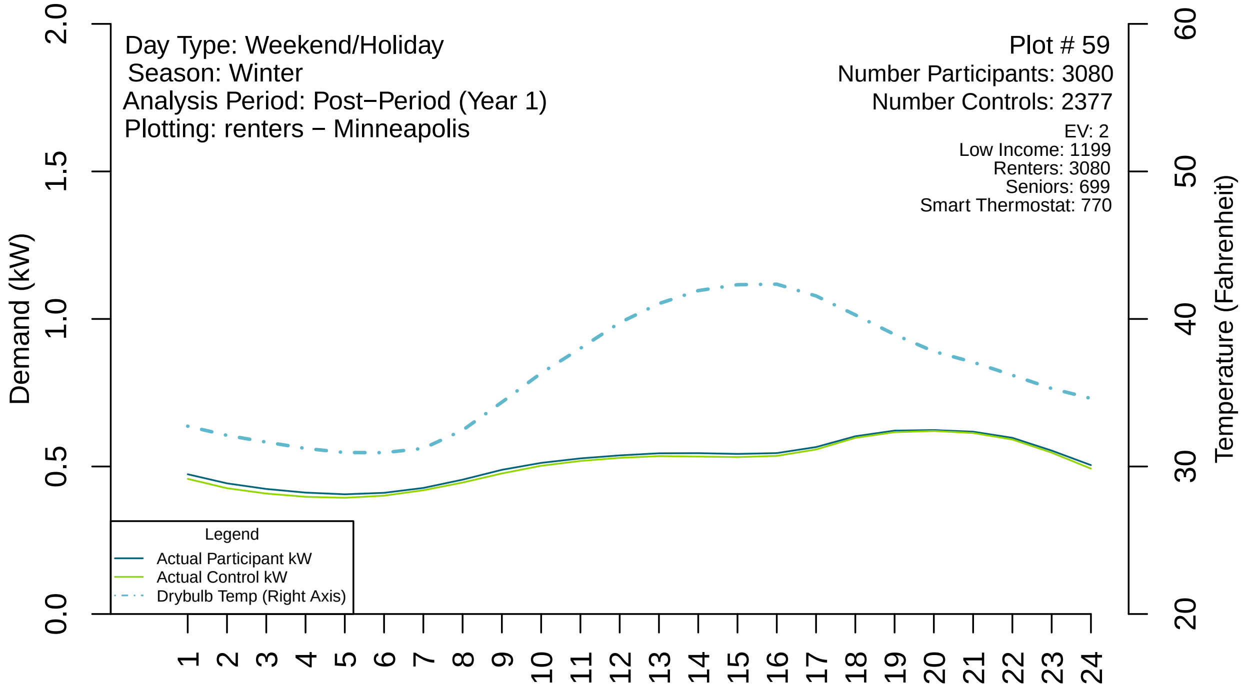

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: renters − Minneapolis
Plot # 54
Number Participants: 3080
Number Controls: 2377
EV: 2
Low Income: 1199
Renters: 3080
Seniors: 699
Smart Thermostat: 770
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

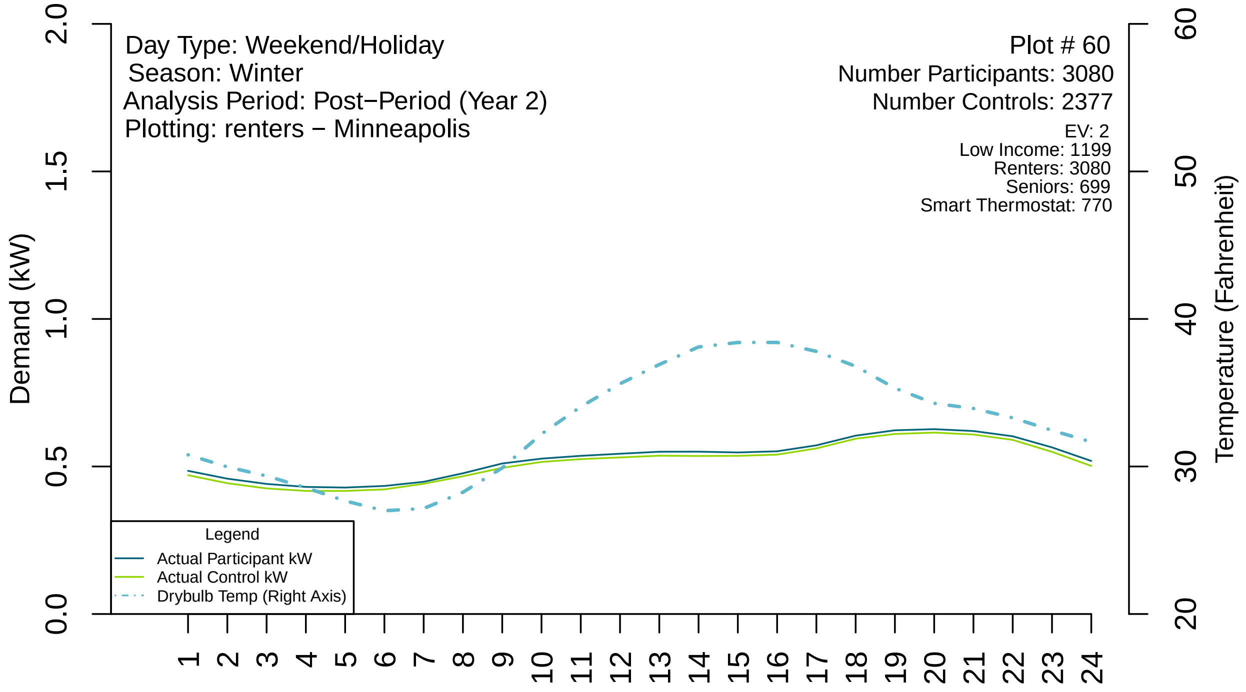

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Pre−Period
Plotting: renters − Minneapolis
Plot # 55
Number Participants: 3080
Number Controls: 2377
EV: 2
Low Income: 1199
Renters: 3080
Seniors: 699
Smart Thermostat: 770
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

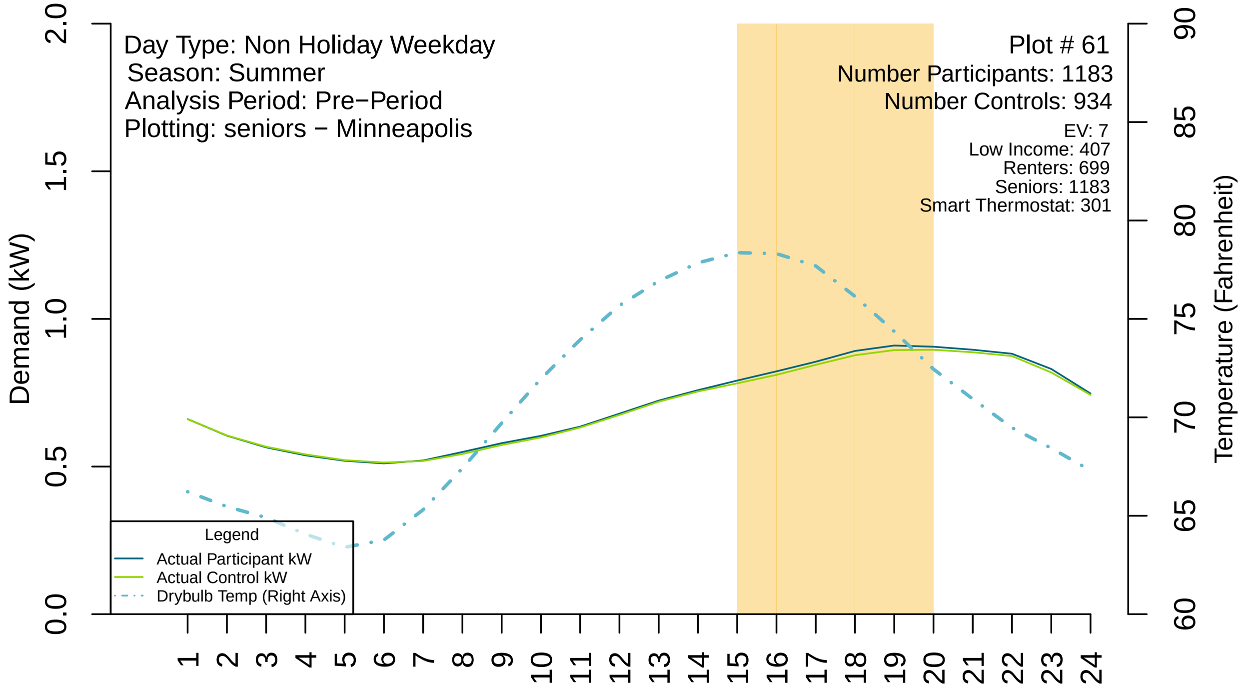

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: renters − Minneapolis
Plot # 56
Number Participants: 3080
Number Controls: 2377
EV: 2
Low Income: 1199
Renters: 3080
Seniors: 699
Smart Thermostat: 770
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

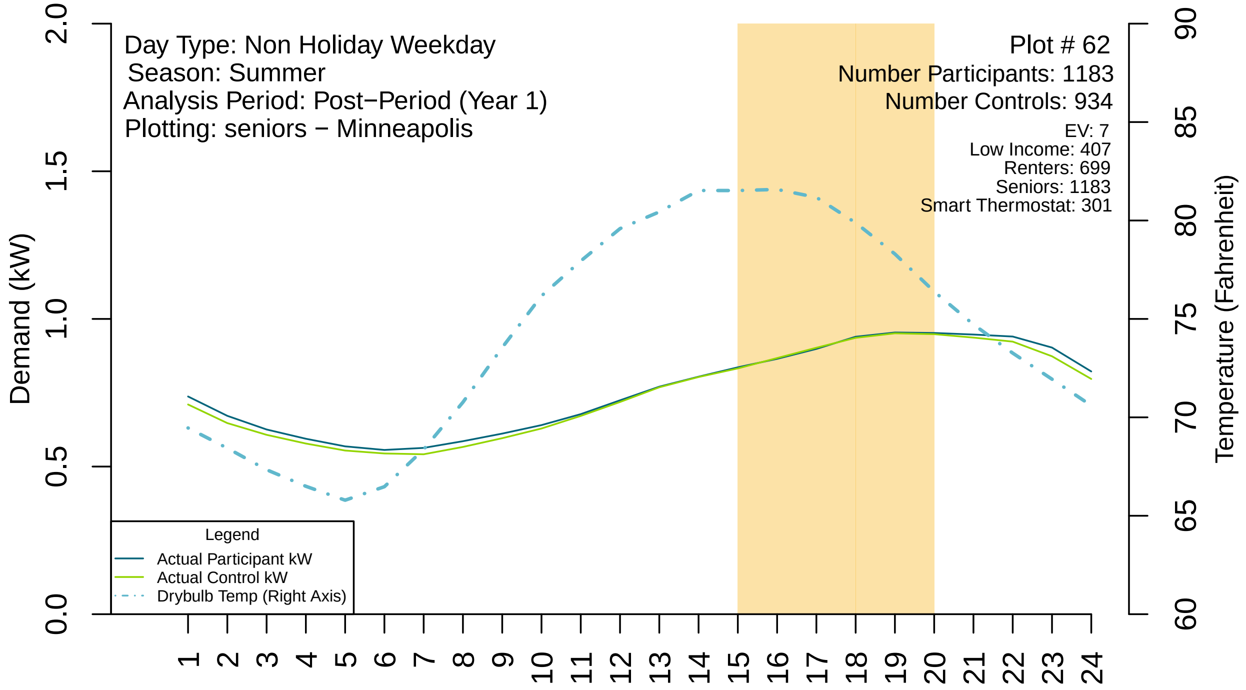

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: renters − Minneapolis
Plot # 57
Number Participants: 3080
Number Controls: 2377
EV: 2
Low Income: 1199
Renters: 3080
Seniors: 699
Smart Thermostat: 770
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

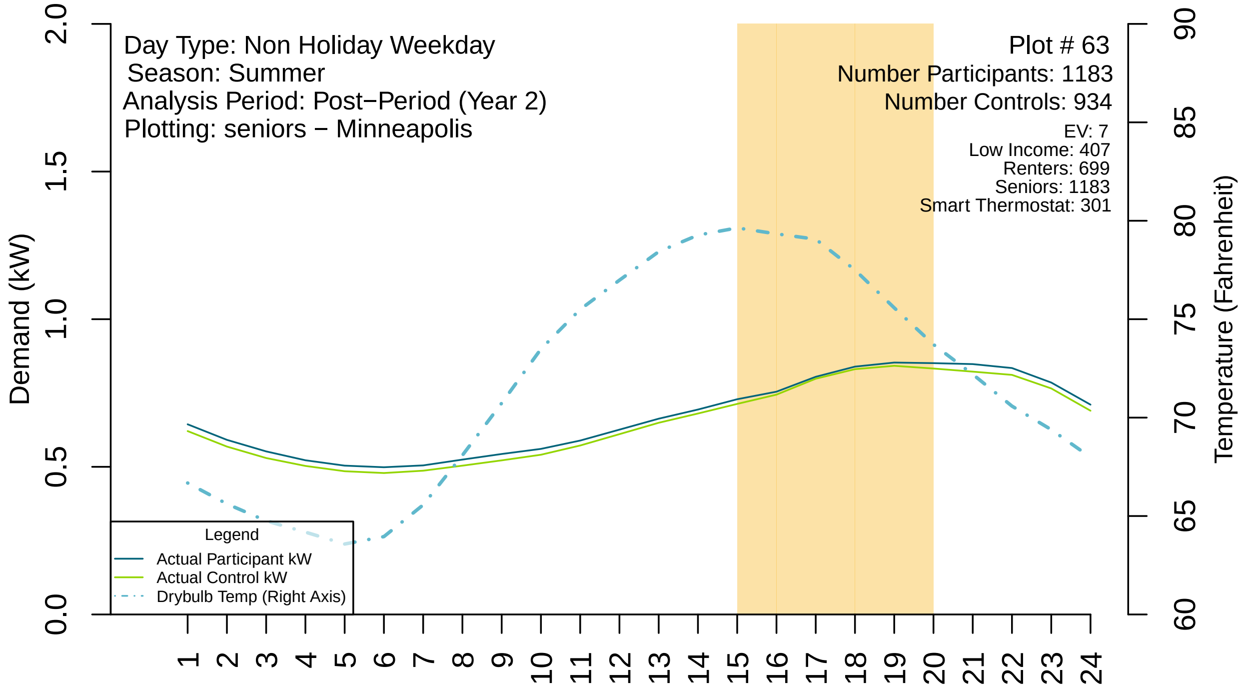

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Pre−Period
Plotting: renters − Minneapolis
Plot # 58
Number Participants: 3080
Number Controls: 2377
EV: 2
Low Income: 1199
Renters: 3080
Seniors: 699
Smart Thermostat: 770
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

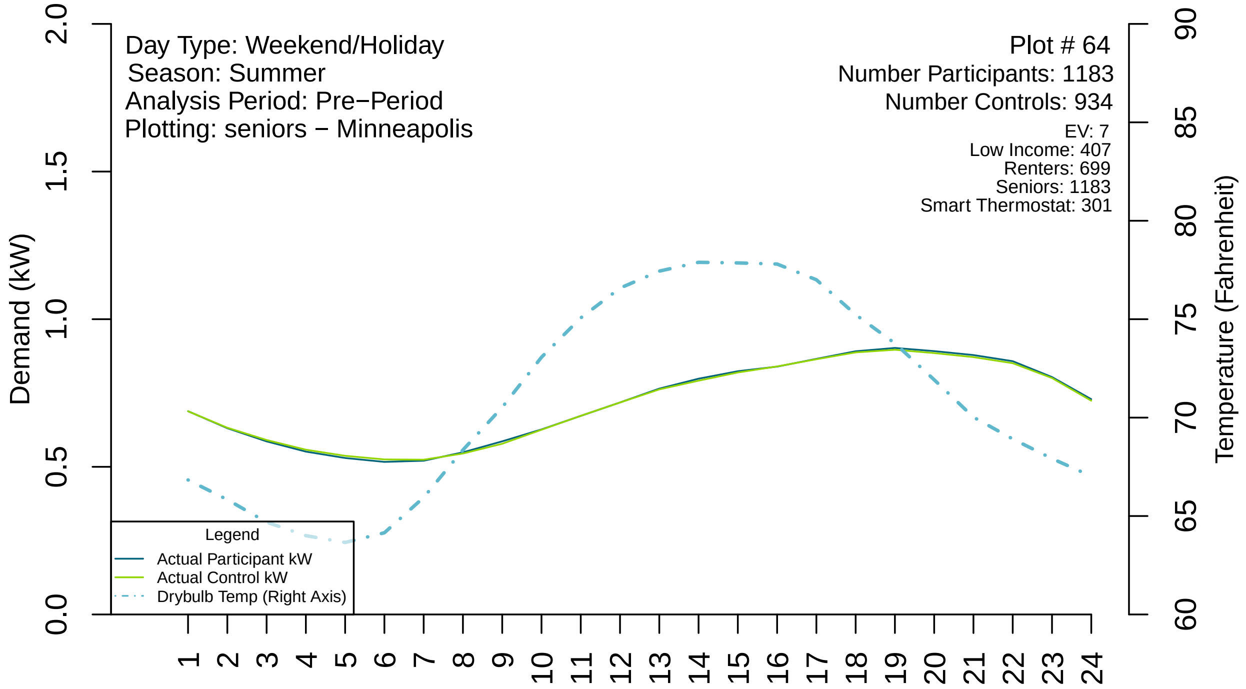

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: renters − Minneapolis
Plot # 59
Number Participants: 3080
Number Controls: 2377
EV: 2
Low Income: 1199
Renters: 3080
Seniors: 699
Smart Thermostat: 770
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

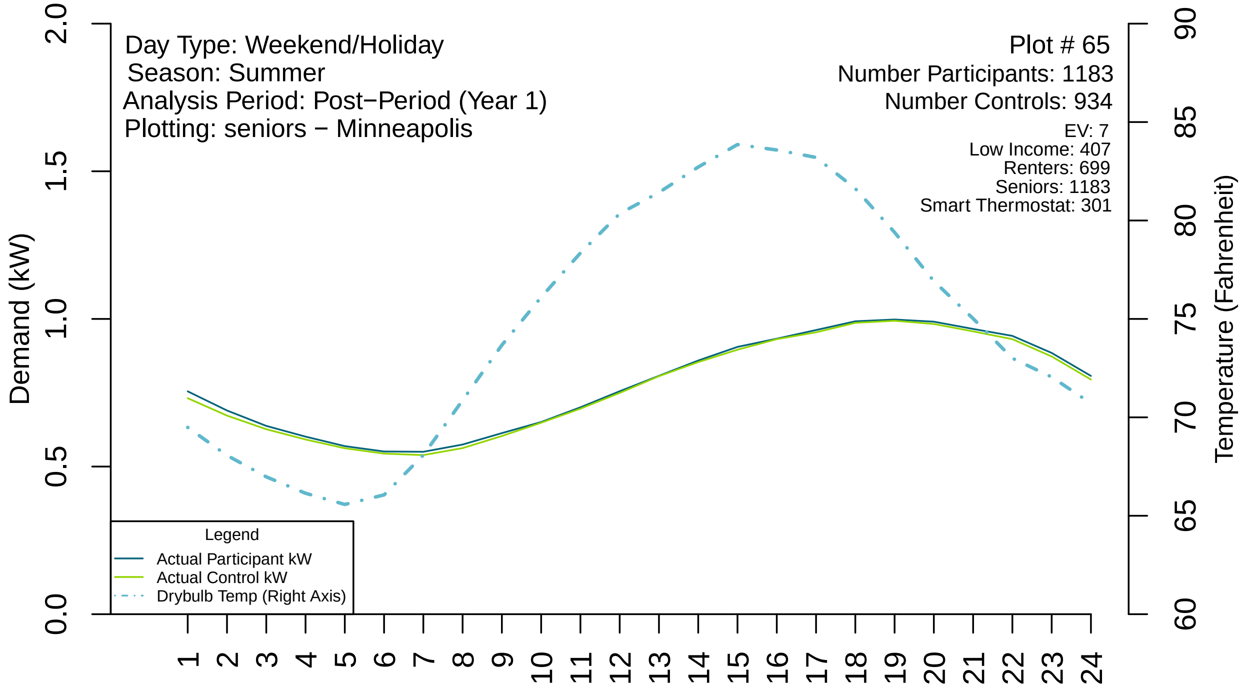

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: renters − Minneapolis
Plot # 60
Number Participants: 3080
Number Controls: 2377
EV: 2
Low Income: 1199
Renters: 3080
Seniors: 699
Smart Thermostat: 770
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

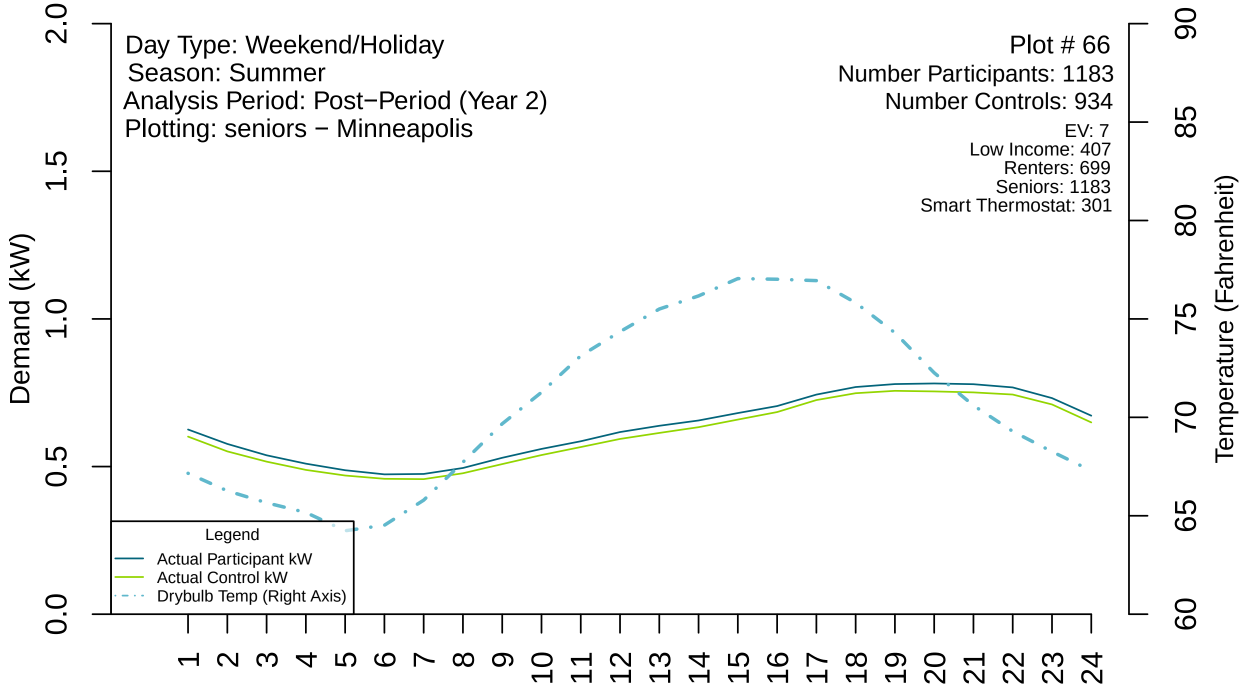

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Pre−Period
Plotting: seniors − Minneapolis
Plot # 61
Number Participants: 1183
Number Controls: 934
EV: 7
Low Income: 407
Renters: 699
Seniors: 1183
Smart Thermostat: 301
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

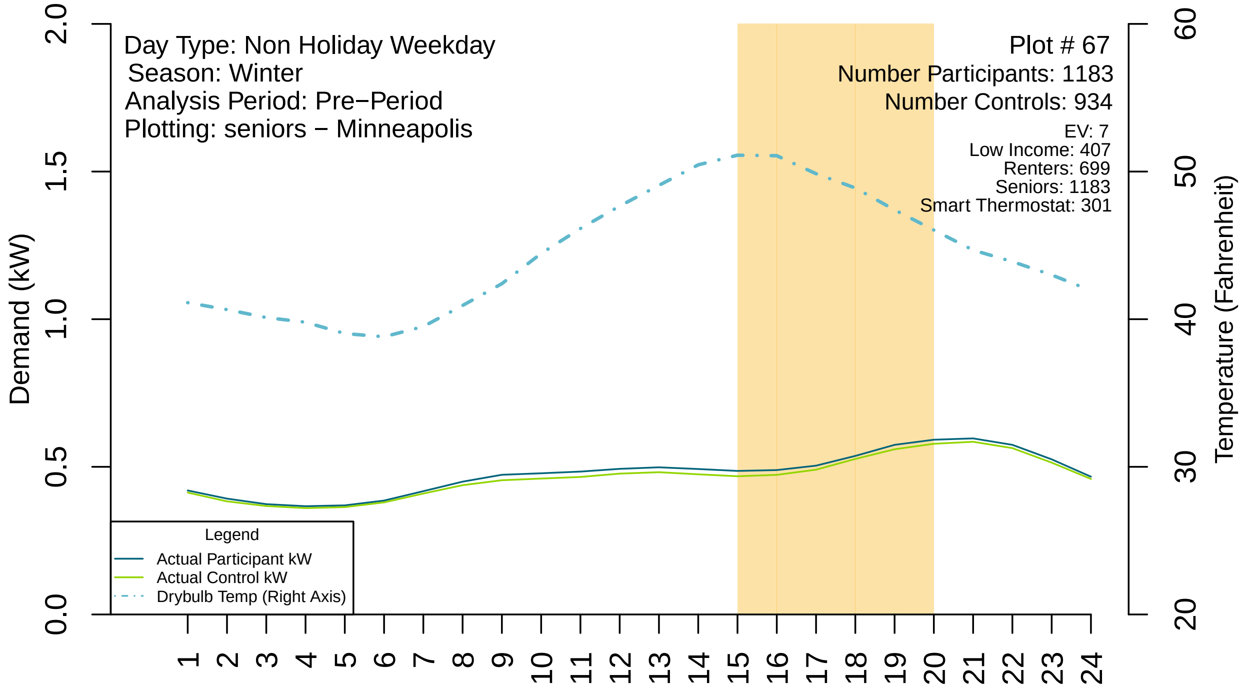

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: seniors − Minneapolis
Plot # 62
Number Participants: 1183
Number Controls: 934
EV: 7
Low Income: 407
Renters: 699
Seniors: 1183
Smart Thermostat: 301
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

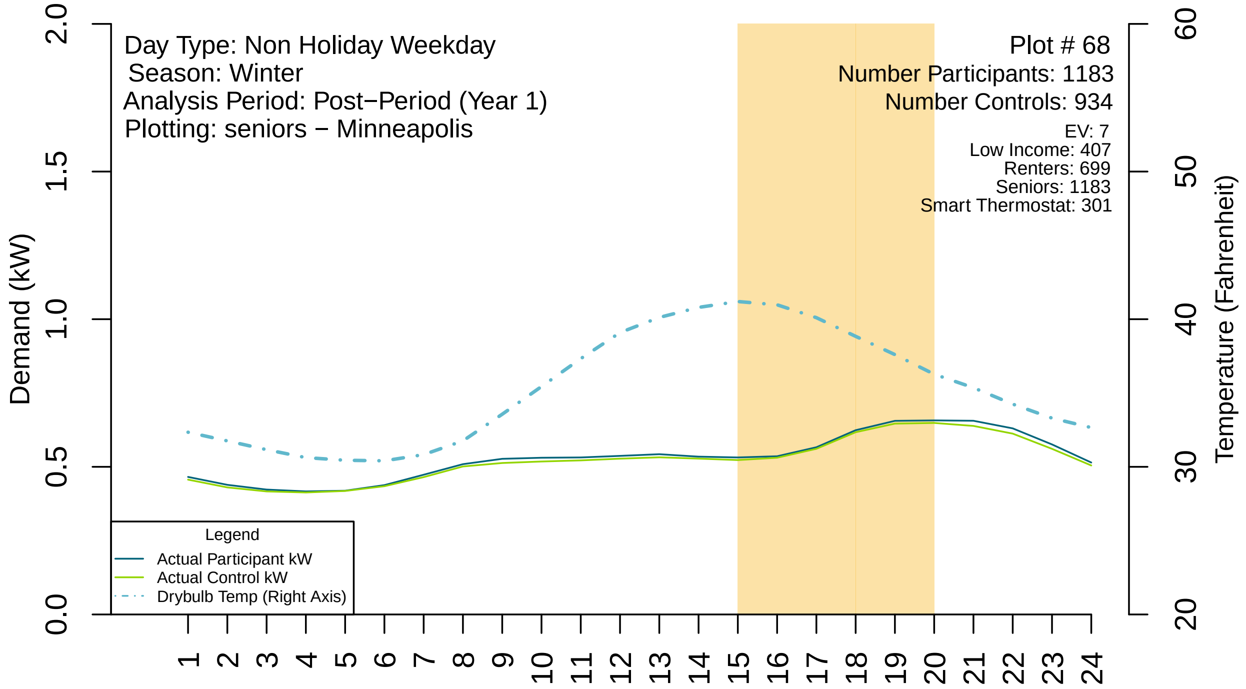

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: seniors − Minneapolis
Plot # 63
Number Participants: 1183
Number Controls: 934
EV: 7
Low Income: 407
Renters: 699
Seniors: 1183
Smart Thermostat: 301
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

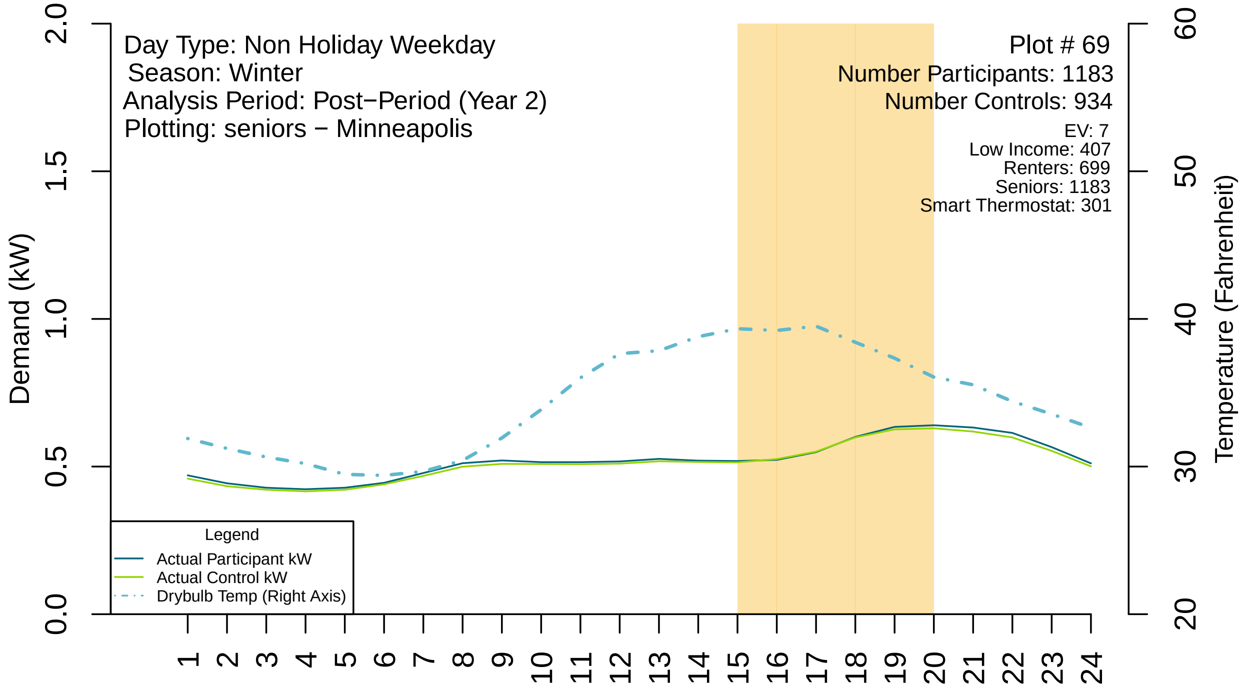

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Pre−Period
Plotting: seniors − Minneapolis
Plot # 64
Number Participants: 1183
Number Controls: 934
EV: 7
Low Income: 407
Renters: 699
Seniors: 1183
Smart Thermostat: 301
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

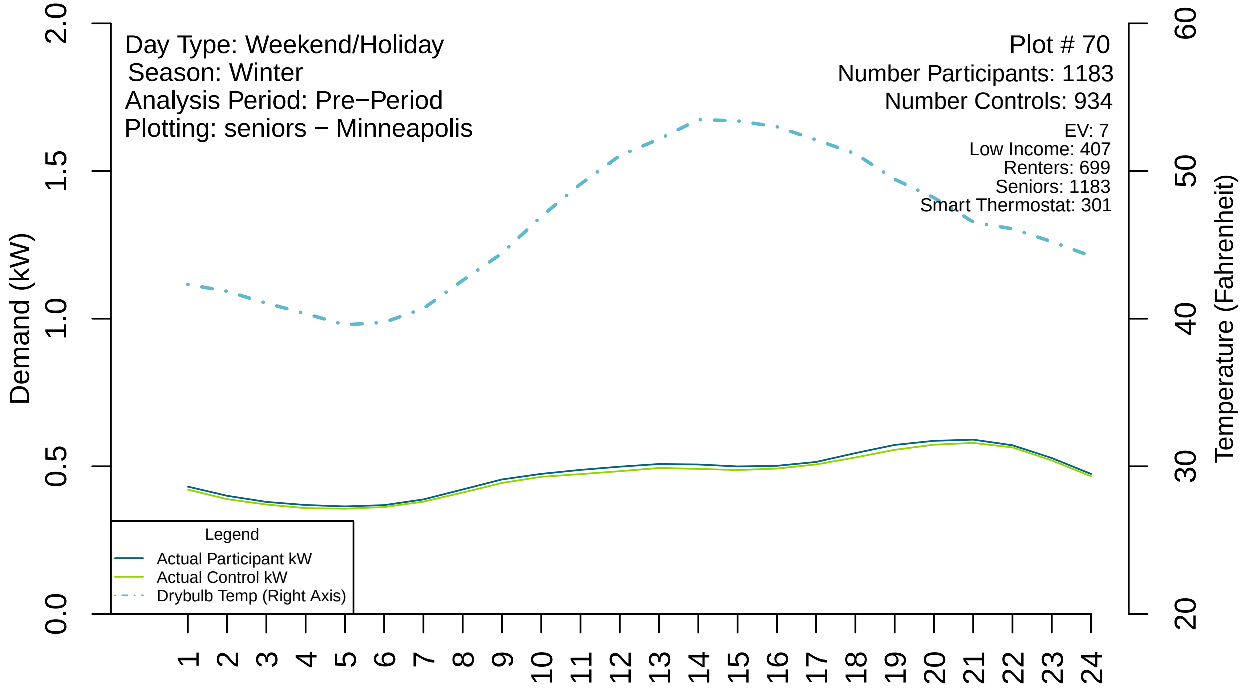

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: seniors − Minneapolis
Plot # 65
Number Participants: 1183
Number Controls: 934
EV: 7
Low Income: 407
Renters: 699
Seniors: 1183
Smart Thermostat: 301
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

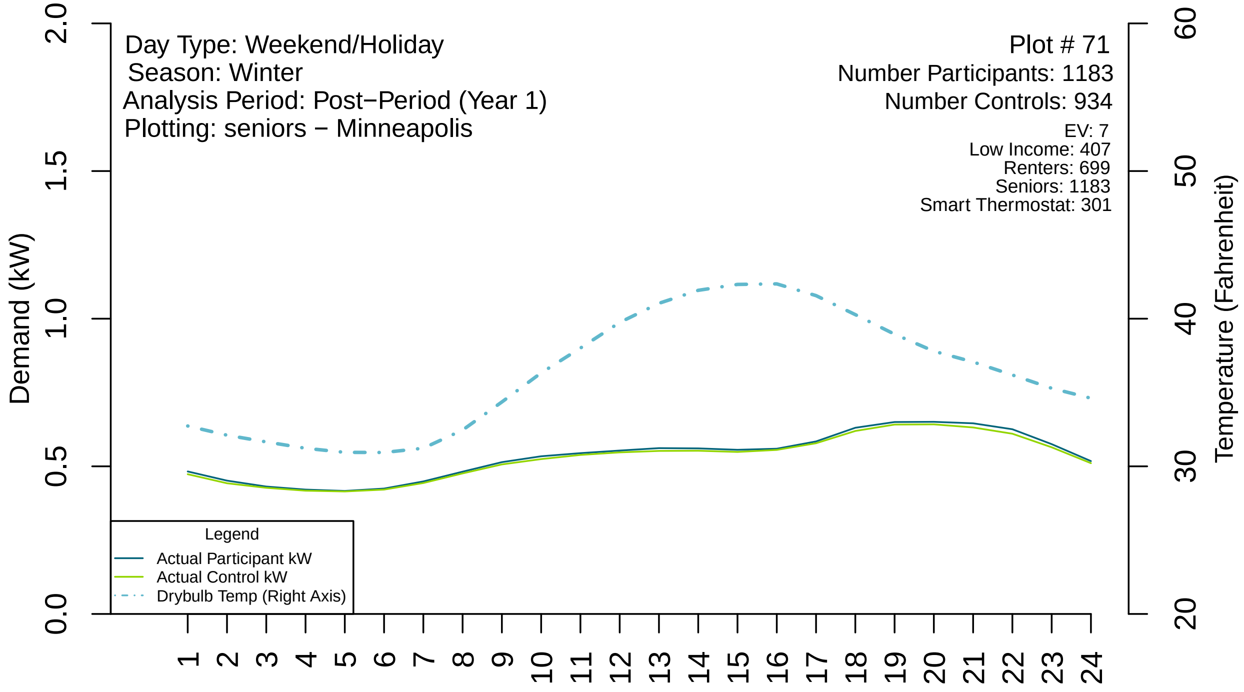

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: seniors − Minneapolis
Plot # 66
Number Participants: 1183
Number Controls: 934
EV: 7
Low Income: 407
Renters: 699
Seniors: 1183
Smart Thermostat: 301
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

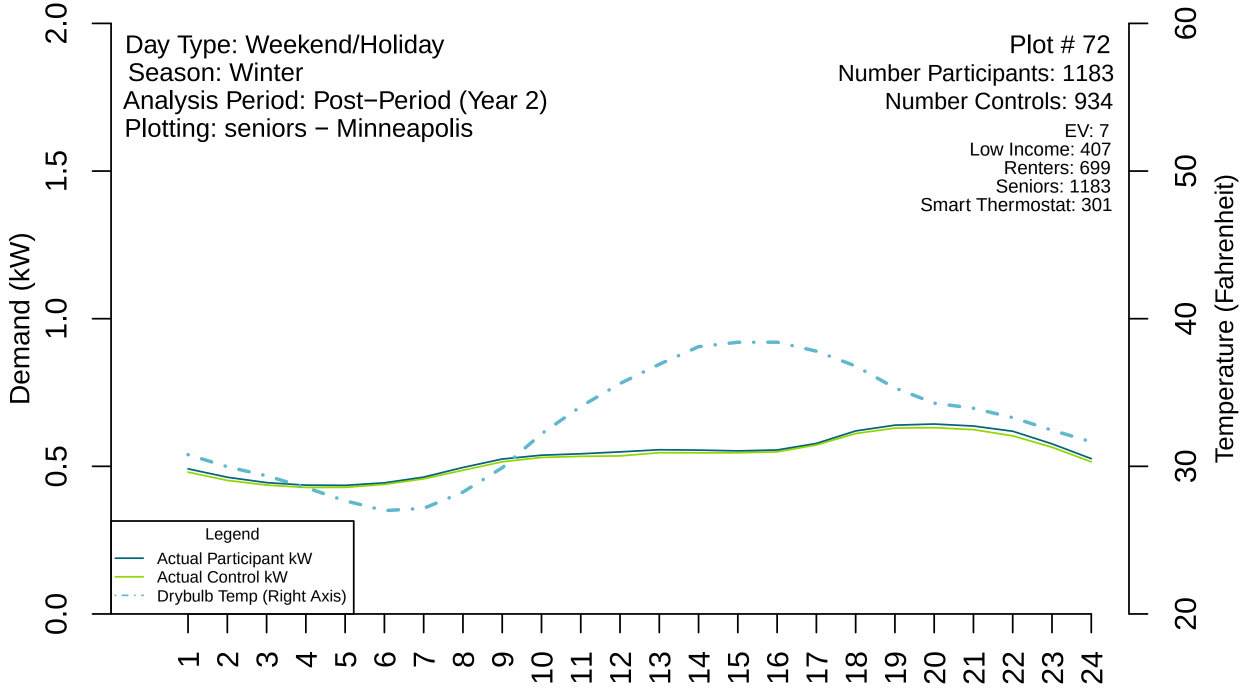

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Pre−Period
Plotting: seniors − Minneapolis
Plot # 67
Number Participants: 1183
Number Controls: 934
EV: 7
Low Income: 407
Renters: 699
Seniors: 1183
Smart Thermostat: 301
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

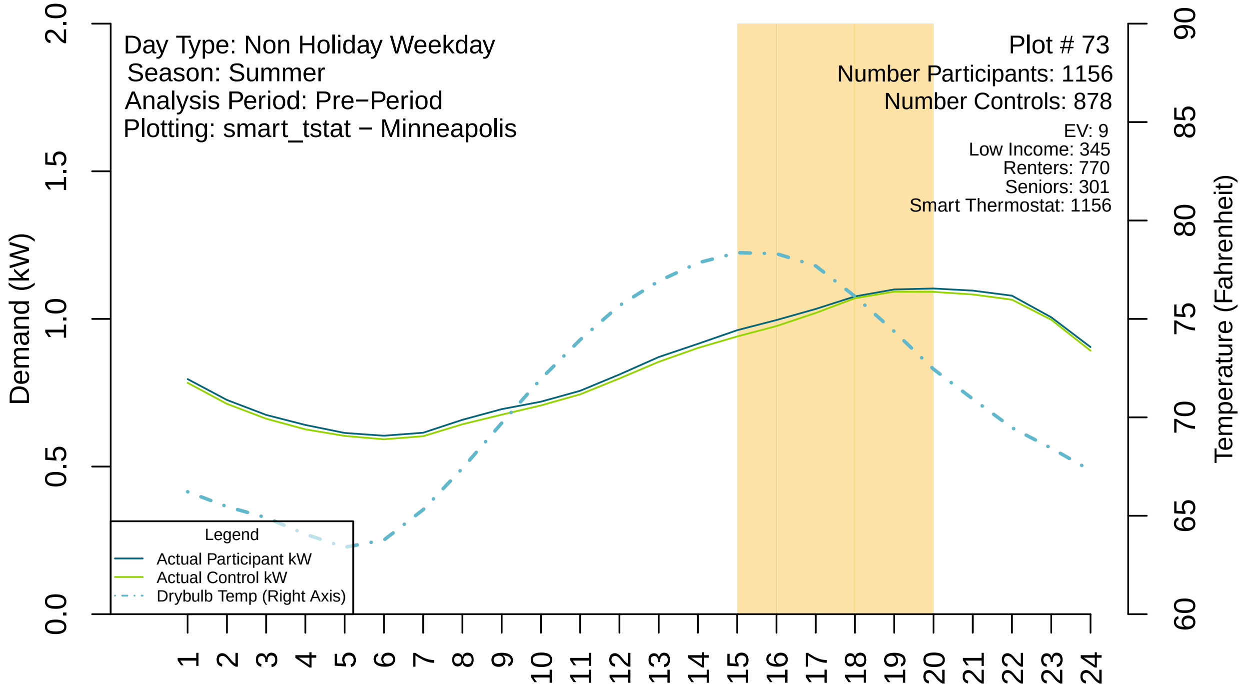

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: seniors − Minneapolis
Plot # 68
Number Participants: 1183
Number Controls: 934
EV: 7
Low Income: 407
Renters: 699
Seniors: 1183
Smart Thermostat: 301
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

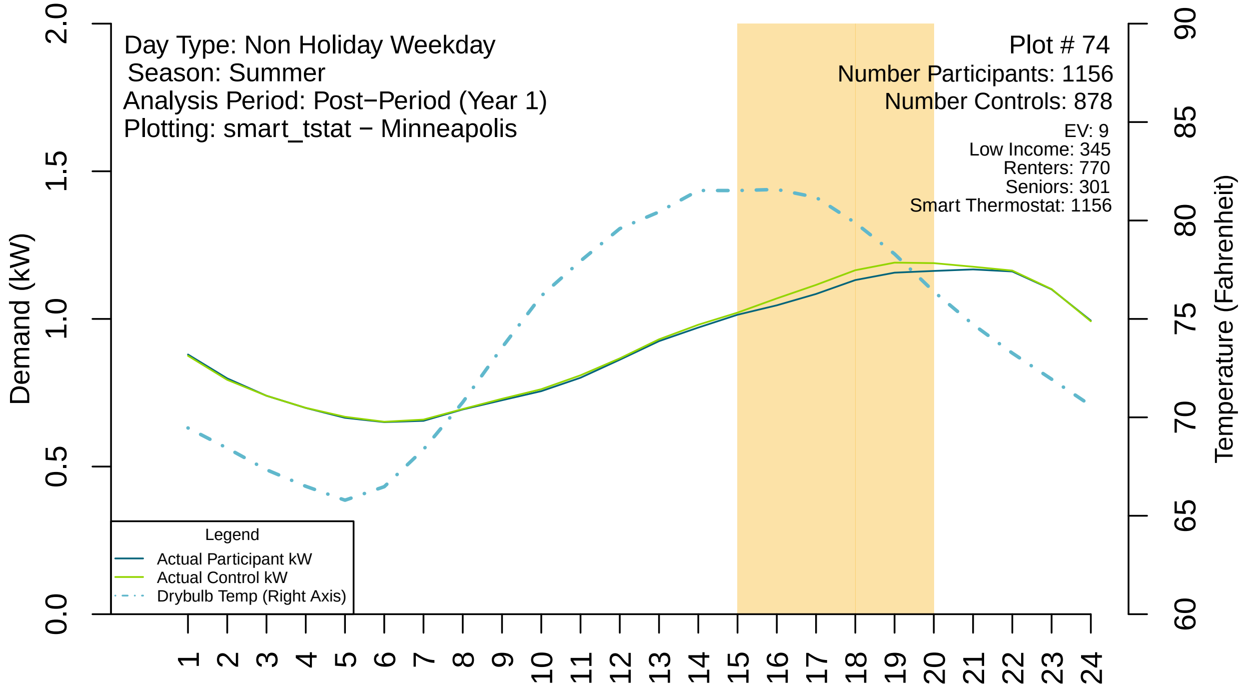

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: seniors − Minneapolis
Plot # 69
Number Participants: 1183
Number Controls: 934
EV: 7
Low Income: 407
Renters: 699
Seniors: 1183
Smart Thermostat: 301
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

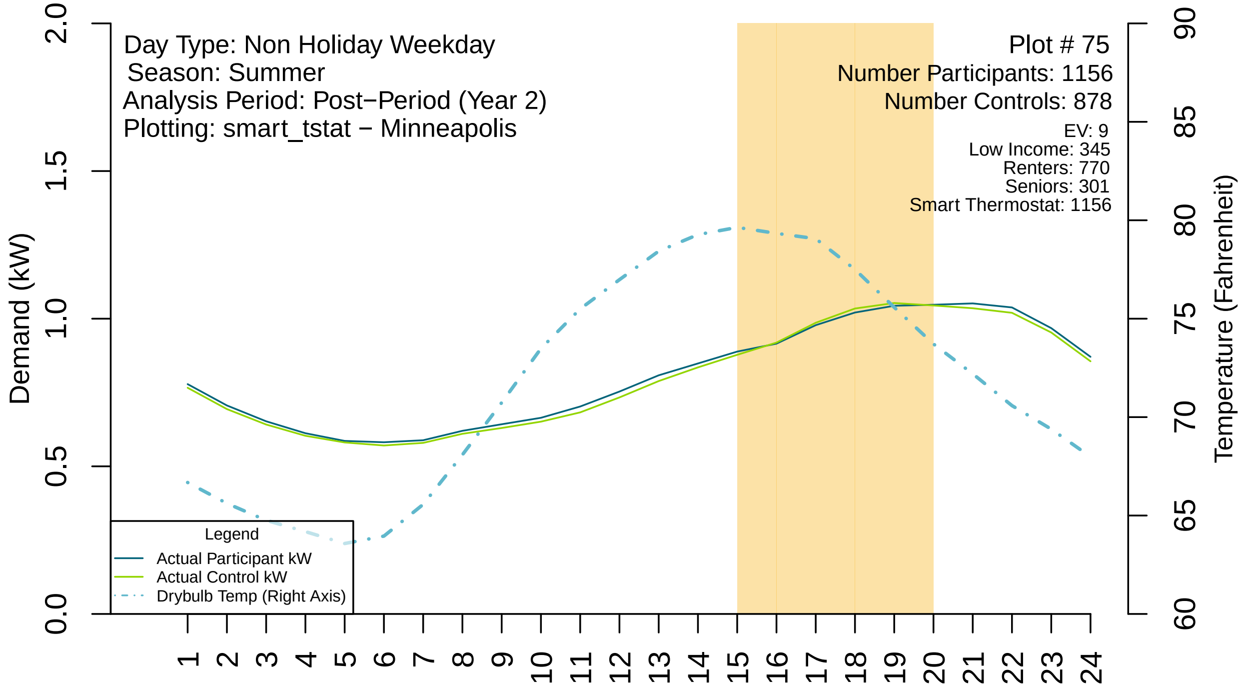

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Pre−Period
Plotting: seniors − Minneapolis
Plot # 70
Number Participants: 1183
Number Controls: 934
EV: 7
Low Income: 407
Renters: 699
Seniors: 1183
Smart Thermostat: 301
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

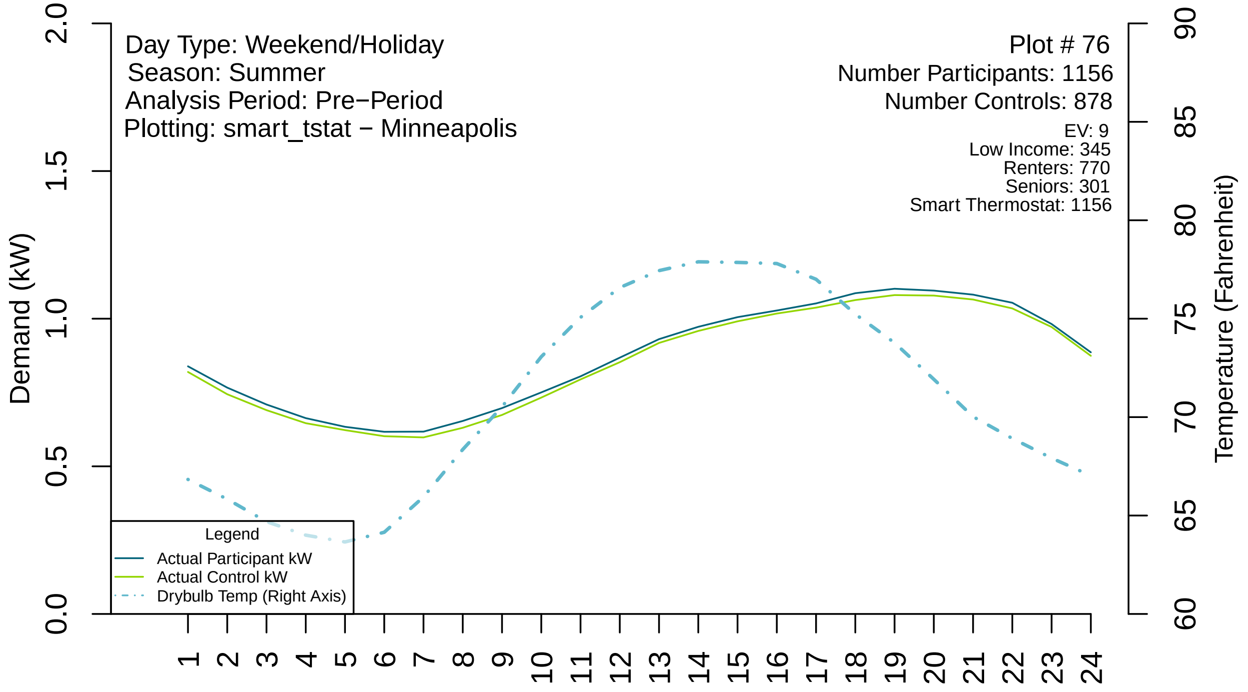

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: seniors − Minneapolis
Plot # 71
Number Participants: 1183
Number Controls: 934
EV: 7
Low Income: 407
Renters: 699
Seniors: 1183
Smart Thermostat: 301
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

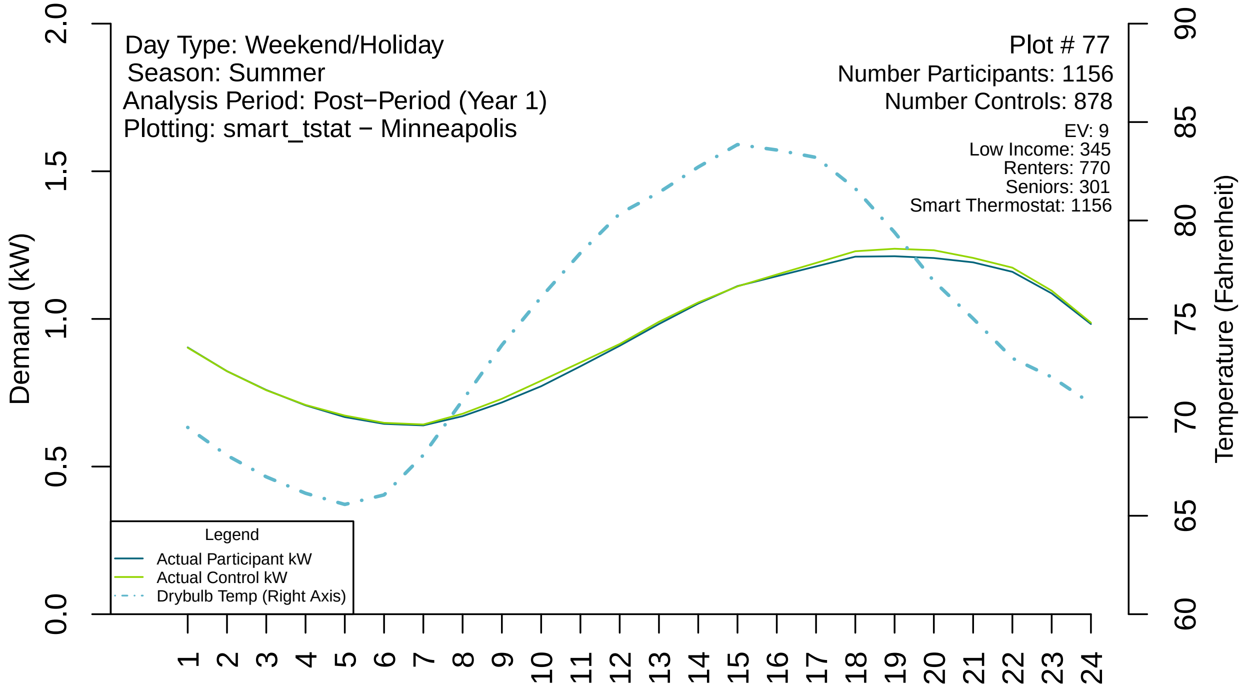

Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: seniors − Minneapolis
Plot # 72
Number Participants: 1183
Number Controls: 934
EV: 7
Low Income: 407
Renters: 699
Seniors: 1183
Smart Thermostat: 301
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

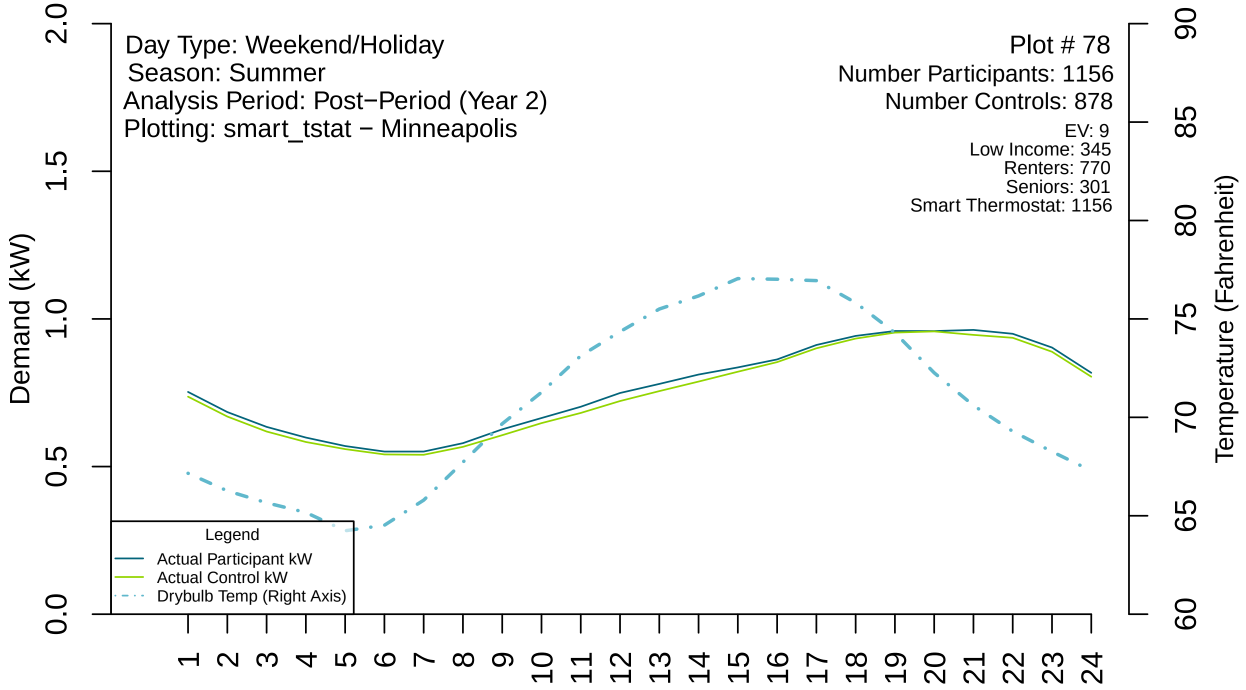

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Pre−Period
Plotting: smart_tstat − Minneapolis
Plot # 73
Number Participants: 1156
Number Controls: 878
EV: 9
Low Income: 345
Renters: 770
Seniors: 301
Smart Thermostat: 1156
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

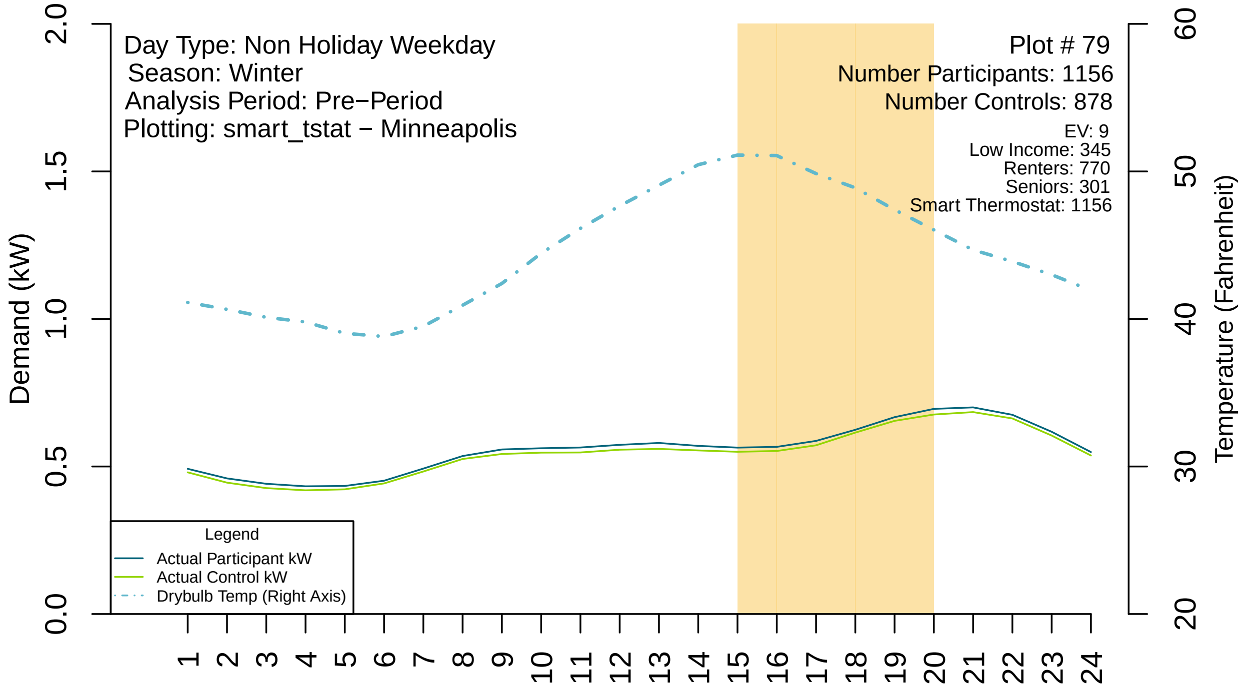

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: smart_tstat − Minneapolis
Plot # 74
Number Participants: 1156
Number Controls: 878
EV: 9
Low Income: 345
Renters: 770
Seniors: 301
Smart Thermostat: 1156
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

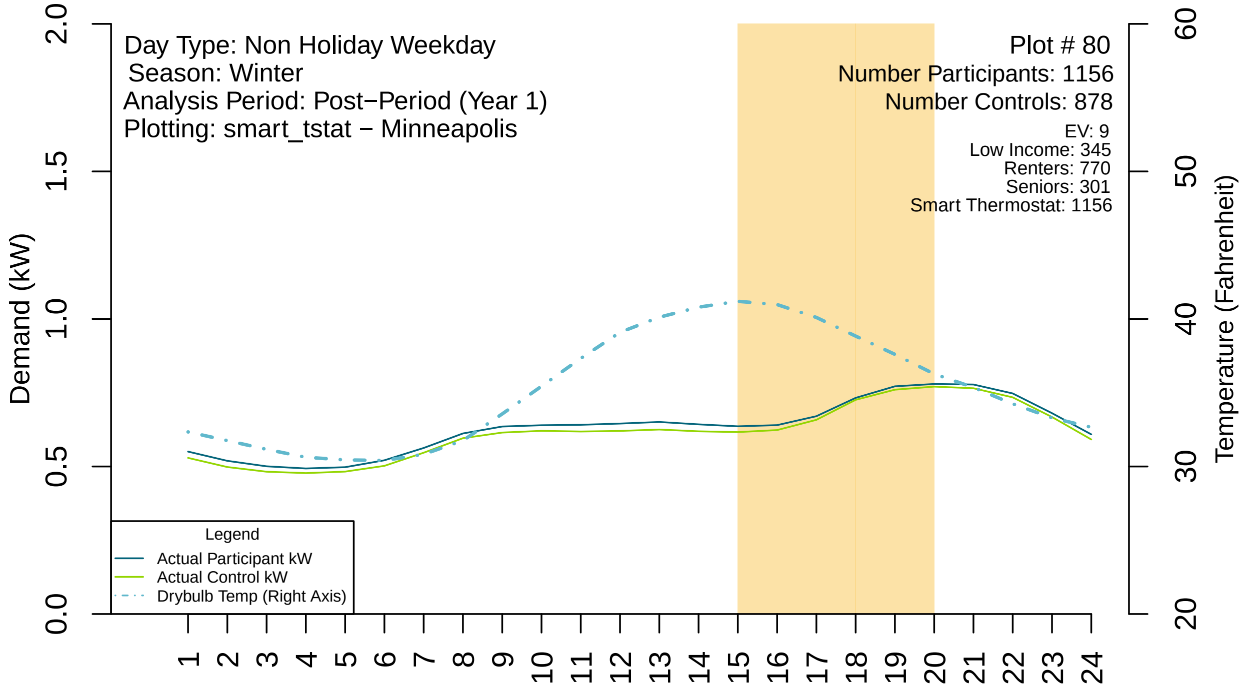

Day Type: Non Holiday Weekday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: smart_tstat − Minneapolis
Plot # 75
Number Participants: 1156
Number Controls: 878
EV: 9
Low Income: 345
Renters: 770
Seniors: 301
Smart Thermostat: 1156
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

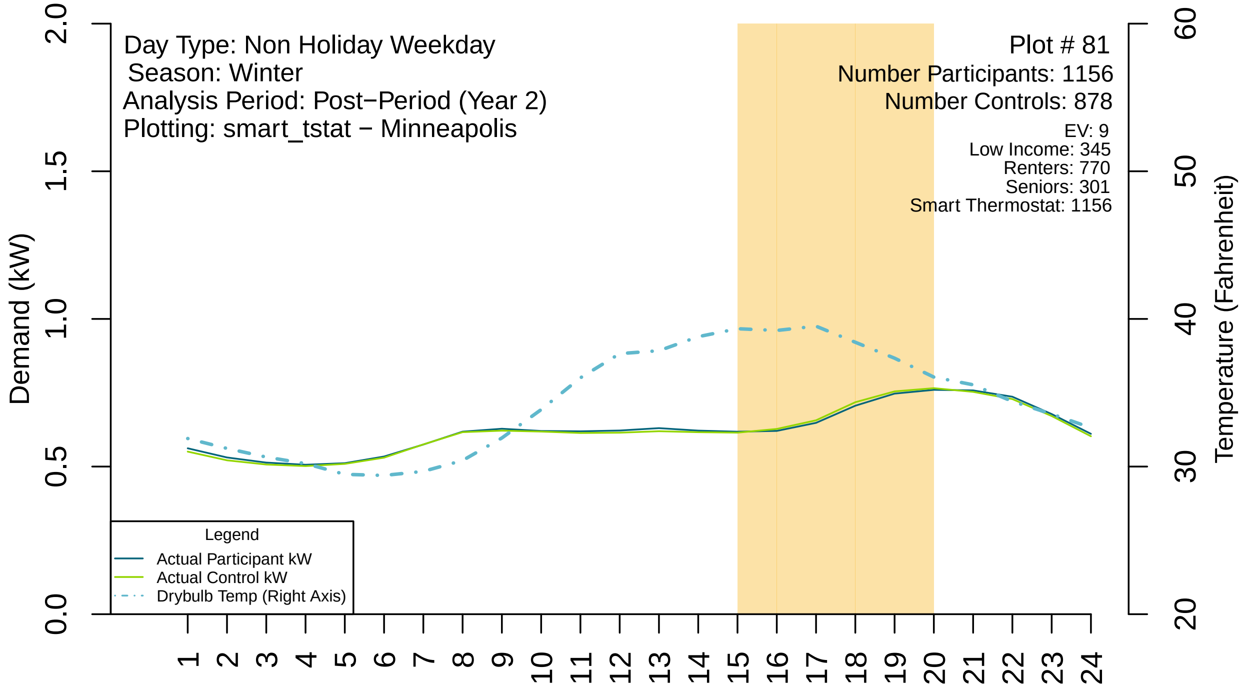

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Pre−Period
Plotting: smart_tstat − Minneapolis
Plot # 76
Number Participants: 1156
Number Controls: 878
EV: 9
Low Income: 345
Renters: 770
Seniors: 301
Smart Thermostat: 1156
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

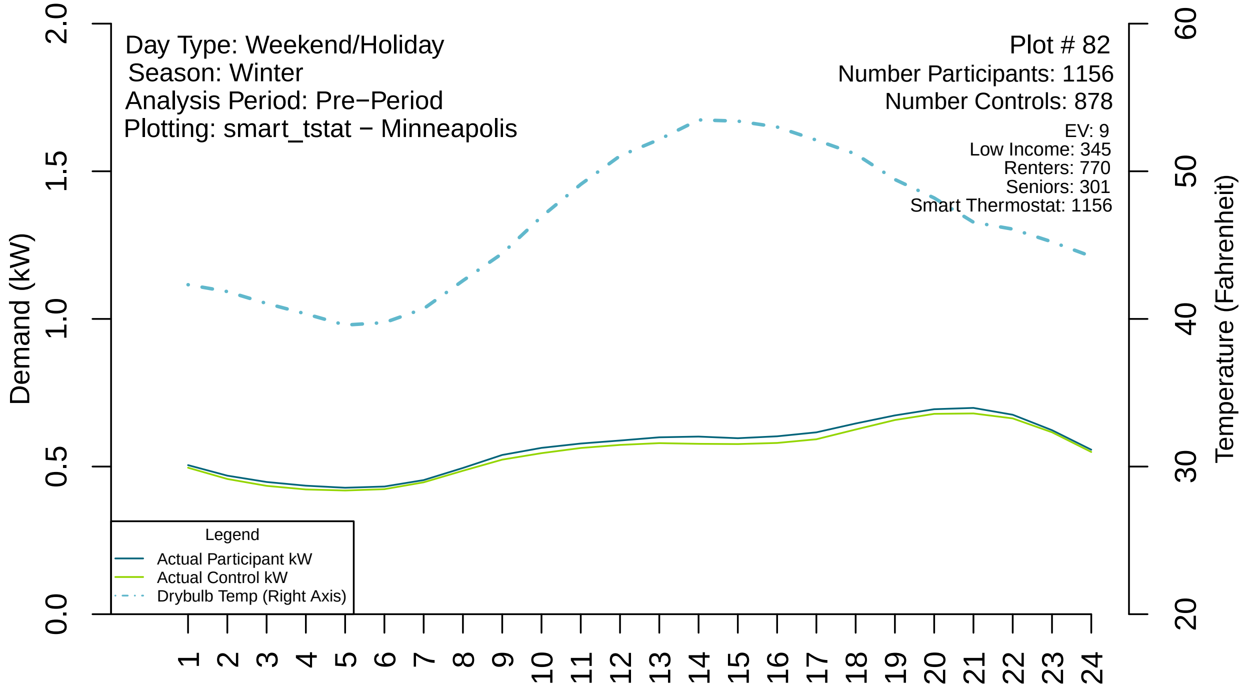

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 1)
Plotting: smart_tstat − Minneapolis
Plot # 77
Number Participants: 1156
Number Controls: 878
EV: 9
Low Income: 345
Renters: 770
Seniors: 301
Smart Thermostat: 1156
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

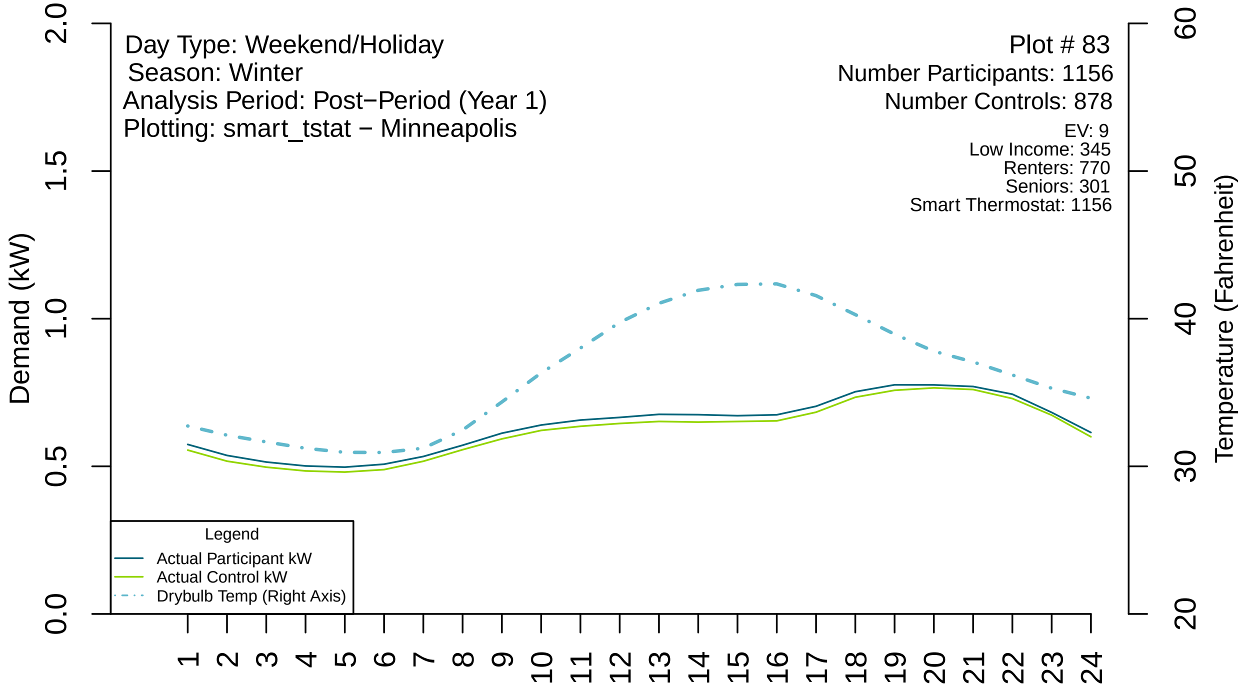

Day Type: Weekend/Holiday
Season: Summer
Analysis Period: Post−Period (Year 2)
Plotting: smart_tstat − Minneapolis
Plot # 78
Number Participants: 1156
Number Controls: 878
EV: 9
Low Income: 345
Renters: 770
Seniors: 301
Smart Thermostat: 1156
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)

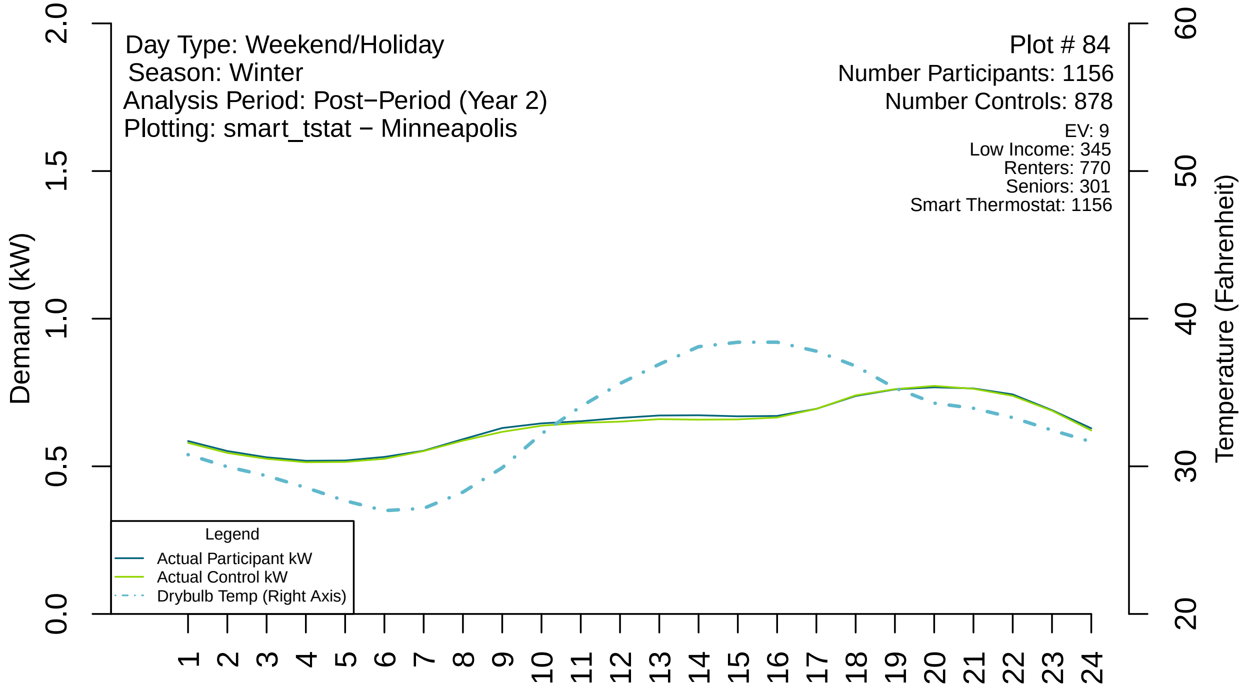

Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Pre−Period
Plotting: smart_tstat − Minneapolis
Plot # 79
Number Participants: 1156
Number Controls: 878
EV: 9
Low Income: 345
Renters: 770
Seniors: 301
Smart Thermostat: 1156
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)


Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: smart_tstat − Minneapolis
Plot # 80
Number Participants: 1156
Number Controls: 878
EV: 9
Low Income: 345
Renters: 770
Seniors: 301
Smart Thermostat: 1156
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)
Demand (kW)
Temperature (Fahrenheit)


Day Type: Non Holiday Weekday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: smart_tstat − Minneapolis
Plot # 81
Number Participants: 1156
Number Controls: 878
EV: 9
Low Income: 345
Renters: 770
Seniors: 301
Smart Thermostat: 1156
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)


Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Pre−Period
Plotting: smart_tstat − Minneapolis
Plot # 82
Number Participants: 1156
Number Controls: 878
EV: 9
Low Income: 345
Renters: 770
Seniors: 301
Smart Thermostat: 1156
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)


Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 1)
Plotting: smart_tstat − Minneapolis
Plot # 83
Number Participants: 1156
Number Controls: 878
EV: 9
Low Income: 345
Renters: 770
Seniors: 301
Smart Thermostat: 1156
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)


Day Type: Weekend/Holiday
Season: Winter
Analysis Period: Post−Period (Year 2)
Plotting: smart_tstat − Minneapolis
Plot # 84
Number Participants: 1156
Number Controls: 878
EV: 9
Low Income: 345
Renters: 770
Seniors: 301
Smart Thermostat: 1156
Demand (kW)
Temperature (Fahrenheit)
Legend
Actual Participant kW
Actual Control kW
Drybulb Temp (Right Axis)

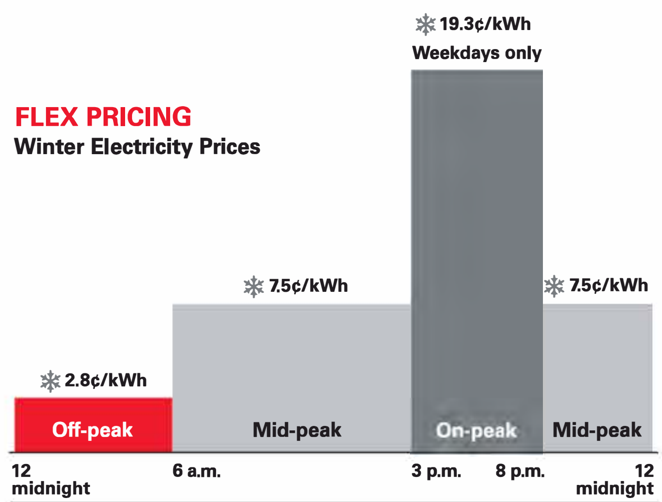
Please note, Attachment D is being filed in live, Microsoft Excel format.

NEW YEAR, MORE SAVINGS

This year, resolve to shift your energy use and save with Flex Pricing.

If you and your family can use major electric appliances before 3 p.m., after 8 p.m., or on weekends, you can save on your bill.

Find tips to save at **xcelenergy.com/FlexPricing**.



Winter electricity prices are in effect from October through May.

FLEX YOUR MONEY-SAVING MUSCLES

One simple lift: Run a full dishwasher before bed instead of rightafter dinner. Your dishwasher might have a "delay" button, making it extra easy.

Find more ways to save with Flex Pricing at **xcelenergy.com/FlexYourSavings**.

HELP OUR ENVIRONMENT WITH FLEX PRICING

And save money, too

Did you know that when you use energy plays a role in how energy is generated and distributed across our grid? And that impacts our environment.

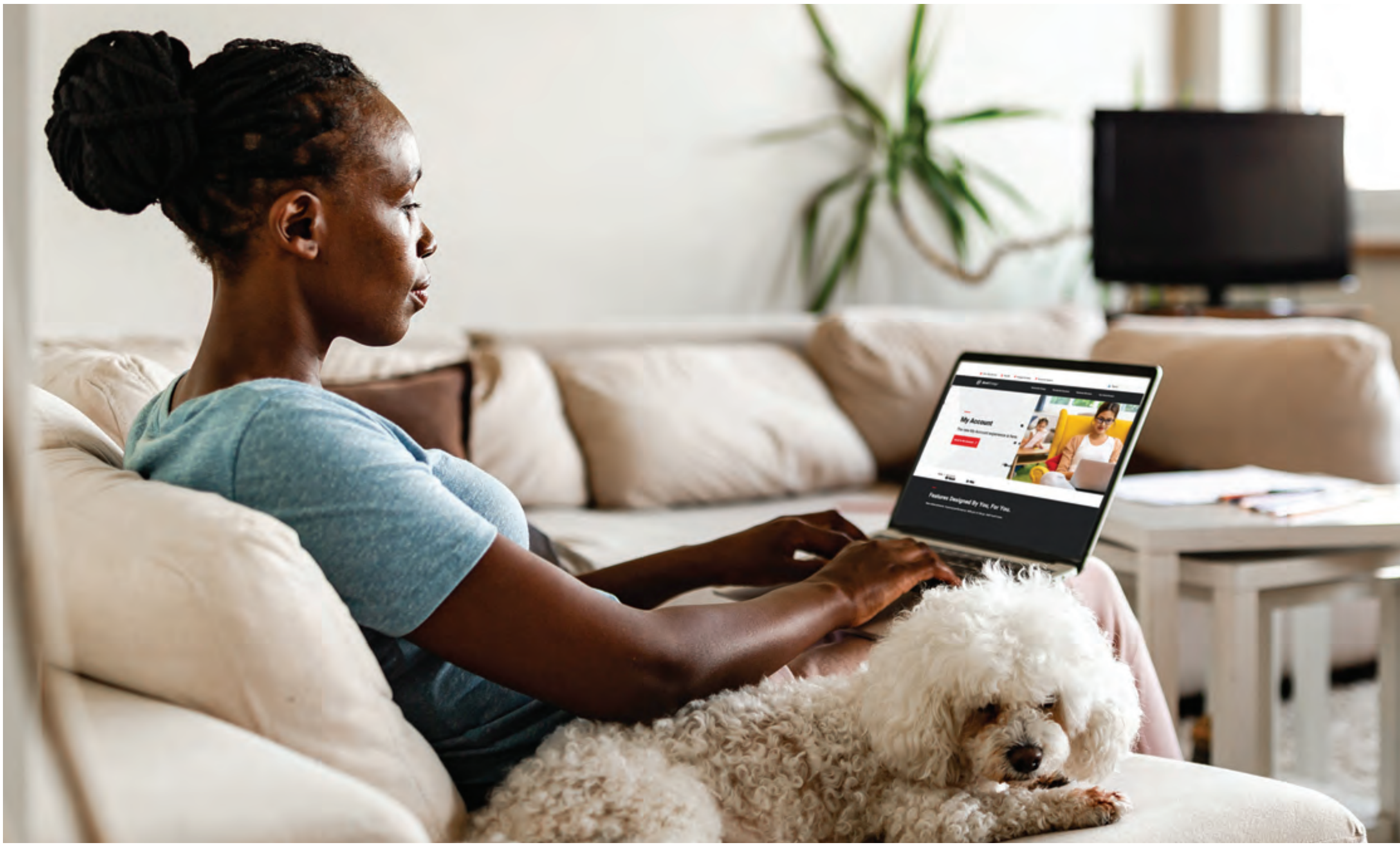
When demand spikes — usually on weekday evenings — Xcel Energy and other utilities often need to get that extra energy from sources that cost more and rely more on fossil fuels.

Shifting electricity use to hours with lower demand, or "off-peak" hours, helps us better manage our energy grid, reduce fossil fuel use, and use more renewable energy.

That's why with Flex Pricing, you pay less for electricity you use earlier in the day, later in the evening and overnight.

Find tips to shift and save at **xcelenergy.com/FlexPricing**.

Xcel Energy®



SUMMER SAVINGS WITH MY ACCOUNT AND FLEX PRICING

Make the most of Flex Pricing this summer with My Account. Get personalized savings tips for your home and visualize your energy use. More information means more power to save.

Create an account or sign in at **MyAccount.xcelenergy.com**. Click on the “My Energy” button to find your Flex Pricing tools and insights.

TAKE YOUR POWER TO THE NEXT LEVEL WITH FLEX PRICING AND MY ACCOUNT.

The Flex Pricing Pilot gives you access to new tools in My Account to help you better understand how you're using energy and make the most out of Flex Pricing, so you can save.

Create an account or sign in at **MyAccount.xcelenergy.com**. Click on the "My Energy" button to find the new tools and personalized insights.

HELP OUR ENVIRONMENT WITH FLEX PRICING

And save money, too

Did you know that the time of day, and the day of the week, you use energy plays a role in how energy is generated and distributed across the grid? And that impacts our environment.

"Demand" is the total amount of electricity needed to supply everyone with the power they need at any moment in the day. When demand spikes — usually on weekday evenings — Xcel Energy and other utilities often need to get that extra energy from sources that cost more and rely more on fossil fuels.

Shifting electricity use to hours with lower demand, or "off-peak" hours, helps us better manage our energy grid, reduce fossil fuel use, and use more renewable energy.

That's why with Flex Pricing, you pay less for electricity you use earlier in the day, later in the evening and overnight.

Find tips to shift and save at **xcelenergy.com/FlexPricing**.

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414 Nicollet Mall
Minneapolis, MN 55401

PRSRT STD
U.S. POSTAGE
PAID
TWIN CITIES MN
PERMIT NO. 3580

WAYS TO SAVE ON FLEX PRICING

Save $3.50 per month:
Start your dishwasher before you go to bed, instead of right after dinner.

Save $6 per month:
Use countertop appliances during weekday evening meal prep instead of your electric stove or oven.

Save $4 per month:
Do laundry later in the evening or on weekends instead of weekday afternoons

THE FLEX PRICING PILOT ENDS NOVEMBER 1, MAXIMIZE YOUR SAVINGS WHILE YOU STILL CAN.

With Flex Pricing, your energy bill depends on when and how much electricity you use. If you use less energy from 3-8 p.m., you save more money. **To maximize your savings, use big appliances before 3 p.m. or after 8 p.m.**

One of the best ways to save on your electricity is to manage your cooling with a smart thermostat. Now you can claim your free thermostat while supplies last. We are offering Flex Pricing pilot participants one free money-saving kit. Each kit contains at least 4 LEDs and 1 Flex Pricing Guide.

Available Flex Pricing Pilot Kits:

- **One Smart AC Kit:** Two Wi-Fi smart switches, one Ecobee smart thermostat
- **One Central AC Kit:** Two Wi-Fi smart switches, one Emerson programmable thermostat
- **One Water Heater Control Kit:** One Aquanta smart water heater control

Kit quantities are limited and are only available while supplies last.
Only one kit can be provided per household.

GET YOUR FREE KIT NOW at

414 Nicollet Mall
Minneapolis, MN 55401

Dear Xcel Energy Customer,

As the Flex Pricing Pilot comes to a close on November 1, 2022, we would like to thank you for your participation over the past two years. With your help we have gathered valuable information that will guide us towards a cleaner, more sustainable future.

After the Flex Pricing Pilot ends, you will remain on the Flex Pricing rate unless you choose to opt out. Please keep in mind that once you opt out you will not be able to opt in again.

Thank you again for your continued support as an Xcel Energy customer and for your participation and feedback throughout the Flex Pricing Pilot.

For more information at **xcelenergy.com/FlexPricing**.

Sincerely,
Xcel Energy

From: WD email@xcelenergy-emailnews.com (EXT)
Sent: Friday, February 10, 2023 8:39 AM
To: EmailDrafts
Subject: [FINAL PROOF]: MN Flex Sept_Hot tip: Use large appliances before 3pm and after 8pm to SAVE

EXTERNAL - STOP & THINK before opening links and attachments.

Xcel Energy®

YOUR APPLIANCES CAN HELP YOU SAVE

Flex Pricing makes it possible.

DISCOVER HOW

WITH FLEX PRICING, YOU CAN SAVE MONEY AND BE ENVIRONMENTALLY FRIENDLY.

A Simple Shift Can Help You Save

Use your major appliances before 3pm and after 8pm. Really, it's that easy! You'll use less fossil-based energy and more renewable energy, put less stress on our energy grid, and help reduce the need for more power plants in the future. Together, we can build a cleaner and greener future for your family.

Here are some quick energy shifts you can make with just a press of a button:

1. Delay start your dryer to run after 8pm.
2. Delay start your dishwasher to run after 8pm.
3. Use your smart thermostat to schedule your air conditioning to run before 3pm and after 8pm.

For more ways to save, go to xcelenergy.com/FlexPricing.

Download the App Today

Download on the App Store   GET IT ON Google Play

My Account   Customer Support   Privacy Policy   Unsubscribe

Our Blog

414 NICOLLET MALL, MINNEAPOLIS, MN 55401

From: WD email@xcelenergy-emailnews.com (EXT)
Sent: Friday, February 10, 2023 8:33 AM
To: EmailDrafts
Subject: [FINAL PROOF]: MN Flex TY_Thank You For Being a Pilot Participant!

EXTERNAL - STOP & THINK before opening links and attachments.

Xcel Energy®

Thank You for Participating in Our Flex Pricing Rate Program

This pilot program has helped us gain valuable insights into creating programs that give customers, like you, more control over their electricity bill and help reduce carbon emissions.

The Flex Pricing Program is ending November 1, 2022.

You are automatically enrolled to continue taking advantage of this program—or you can opt out.

To opt out, please call **800-895-4999**. If you opt out, you won't be able to opt back in.

Thanks again for your valuable participation in this pilot program.

Sincerely,

Xcel Energy

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Our Blog

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SHIFTING YOUR ENERGY ROUTINE HAS NEVER BEEN EASIER

Free Flex Pricing Savings Kit Order Form

Participants in the Flex Pricing Pilot can save money on their bills by using energy earlier in the day, later in the evening, and overnight. These free, money-saving kits include items to make shifting your energy routine even easier.

Complete the form at this link to request a **free** Flex Pricing Pilot Kit. Your kit will arrive within four to six weeks. Kit quantities are limited and are only available while supplies last.

Or visit https://getwise.org/flexpricing

Xcel Energy®

CAMBIAR SU RUTINA DE USO DE ELECTRICIDAD NUNCA HA SIDO TAN FÁCIL

Kits Gratuitos del Programa de Precios Flexibles

Los participantes del programa piloto de Precios Flexibles pueden ahorrar dinero en sus facturas de luz si cambian su rutina de uso de energía y usan energía más temprano en la mañana o durante la noche. Estos kits gratuitos incluyen artículos que hacen más fácil cambiar las horas de uso de electricidad.

Llene el formulario en el enlace para pedir un kit gratuito del programa de Precios Flexibles. El kit llegará dentro de cuatro a seis semanas. Hay una cantidad limitada de kits y solo están disponibles hasta que se agoten los suministros.

O visite https://getwise.org/flexpricing

From: WD email@xcelenergy-emailnews.com (EXT)
Sent: Friday, February 3, 2023 9:27 AM
To: EmailDrafts
Subject: [PROOF]: MN Pilot_Cleaner energy while you save

EXTERNAL - STOP & THINK before opening links and attachments.

WHAT'S EASY, CLEAN AND SAVES YOU GREEN?

You can pay less on your energy bill and use more clean energy when you reduce energy use on weekdays from 3pm - 8pm.

TOGETHER, WE CAN CREATE A 100% CARBON-FREE FUTURE AND LOWER ENERGY COSTS FOR EVERYONE.

Be an Advocate for Lower Cost Clean Energy

As a Flex Pricing pilot participant, when you use energy outside of 3pm - 8pm, you are using more renewable energy and saving money while doing it. Here are a few tips to use:

- **Run the dishwasher at night** - Save up to $3.50/month and use more wind power.
- **Do laundry in the morning** - Save up to $6.00/month and use more solar power.
- **Run the AC before 3pm and after 8pm** - This reduces the need for fossil-fuel based energy.

- **Sign Up for AC Rewards** - Get bill credits for shifting energy use outside of peak times.

For more ways to save, go to xcelenergy.com/FlexPricing.

Download the App Today

Download on the App Store GET IT ON Google Play

My Account Customer Support Privacy Policy Unsubscribe

Our Blog

414 NICOLLET MALL, MINNEAPOLIS, MN 55401

From: WD email@xcelenergy-emailnews.com (EXT)
Sent: Friday, February 3, 2023 9:26 AM
To: EmailDrafts
Subject: [PROOF]: MN Pilot_Your FREE smart thermostat is inside!

EXTERNAL - STOP & THINK before opening links and attachments.

Xcel Energy®

IT'S NOT A TREND. IT'S A MOVEMENT.

As part of the Flex Pricing Pilot, you are part of a bold movement to deliver clean energy by using more renewables while keeping electricity reliable and affordable.

THINK SMARTER, NOT HARDER. SHIFT ENERGY, SAVE MONEY.

GET YOUR FREE FLEX PRICING KIT*

As a pilot participant, you are eligible to choose one of three energy-saving kits to help you lower your bill. Each kit comes with LED lightbulbs and a Flex Pricing guide.

Water Heater Control Kit: 1 Aquanta smart water heater control
Smart AC Kit: 2 WiFi smart switches + ecobee smart thermostat
Central AC Kit: 2 WiFi smart switches + Emerson programmable thermostat
Get Your Flex Pricing Kit >>

*While supplies last. Only one kit per household.

RENEWABLE ENERGY MEANS LOWER ENERGY COSTS

With Flex Pricing, it's easy to save money by using electricity when it's cheapest and generated by renewable sources. Electricity rates are highest on weekdays from 3pm - 8pm. To maximize your savings, use big appliances before 3pm or after 8pm.

Download the App Today

Download on the App Store | GET IT ON Google Play

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Minnesota Time of Use (TOU) Pilot: Community Outreach 2021 & 2022

Summary

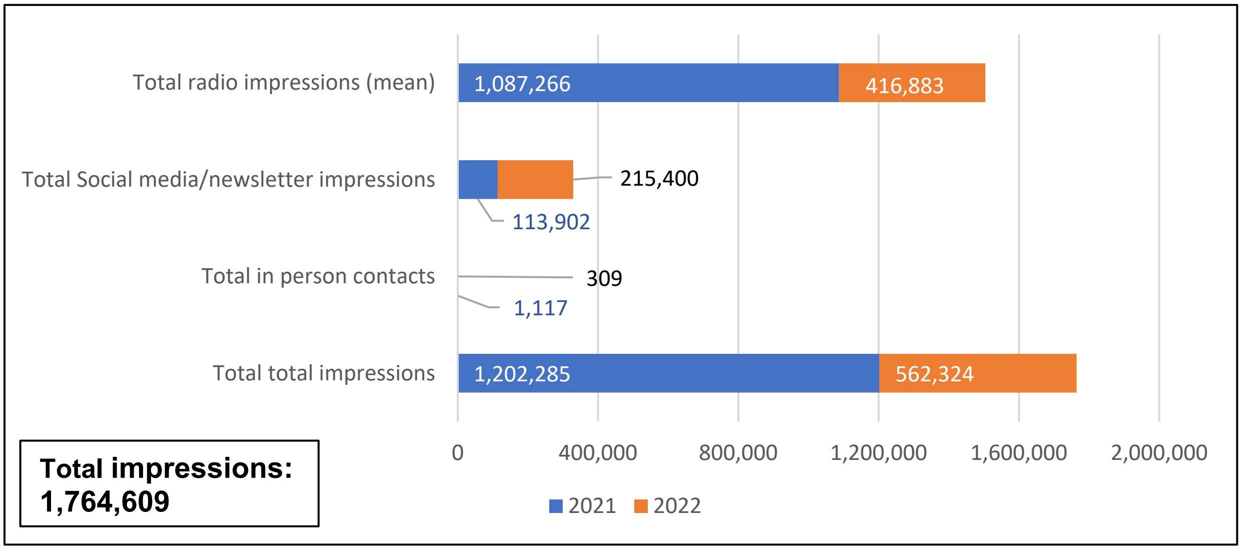
Minnesota Flex Pricing Pilot ran from November 2020 through November 2022. Community outreach began in November of 2020, with major pushes during the summer months, specifically May through August. The following information is a high-level overview of the different community engagement initiatives Xcel Energy (Company) took to help ensure customers in the MN Flex Pricing Pilot were well informed of, and understood how to save money on, the new Flex Pricing rates.

The Company partnered with community organizations to provide a variety of outreach including language specific radio, in-person outreach to patrons/members, tabling at local community events, and posting content on social media and newsletters. The outreach focused on customer education highlighting the benefits of flex pricing program. Educating customers gives them more control over their bills, encourages the use of renewable energy sources, provides better insight into energy use, and ultimately allows them the opportunity to save money on energy bills.

The organizations the Company partnered with ranged from direct service providers, such as Comunidades Organizando El Poder y La Accion Latina (COPAL) and African Community Services (ACS), to targeted media channels, like La Raza Spanish Radio and KALY Somali American Radio. Additionally, the Company partnered with four neighborhood associations located in the pilot area including Powderhorn Park Neighborhood Association (PPNA), Longfellow Community Council, Seward Neighborhood Group, and Central Area Neighborhood Development Organization (CANDO). By utilizing a variety of strategic targeted partnerships, the Company reached all customer segments impacted by the flex pricing pilot.

Throughout the pilot the Company was able to generate a significant number of impressions. As shown in Figure 1 below, the Company and its partners generated an estimated 1.76 million impressions, including over 1,400 in-person contacts at events and over 300,000 social media/newspaper impressions. The balance of this attachment will provide more information into the various forms of community outreach discussed above.

Figure 1
Impressions by Outreach Type and Year



Social Media

Strategically utilizing six different partner's social media pages allowed the Company to narrowly target their audience to the pilot area. The Company and partners attempted to align content with weather (ex. AC tips during hottest months) to provide more relevant information to the community and pilot participants. Over the course of the two years the Company and partners posted 125 times resulting in an astounding 329,000 impressions. As seen in Figure 3 below, in 2022 the Company and African Community Services included an additional social media channel, TikTok, providing content to a younger audience that ACS serves.

Figure 2
Total Posts by Partners 2021 vs. 2022

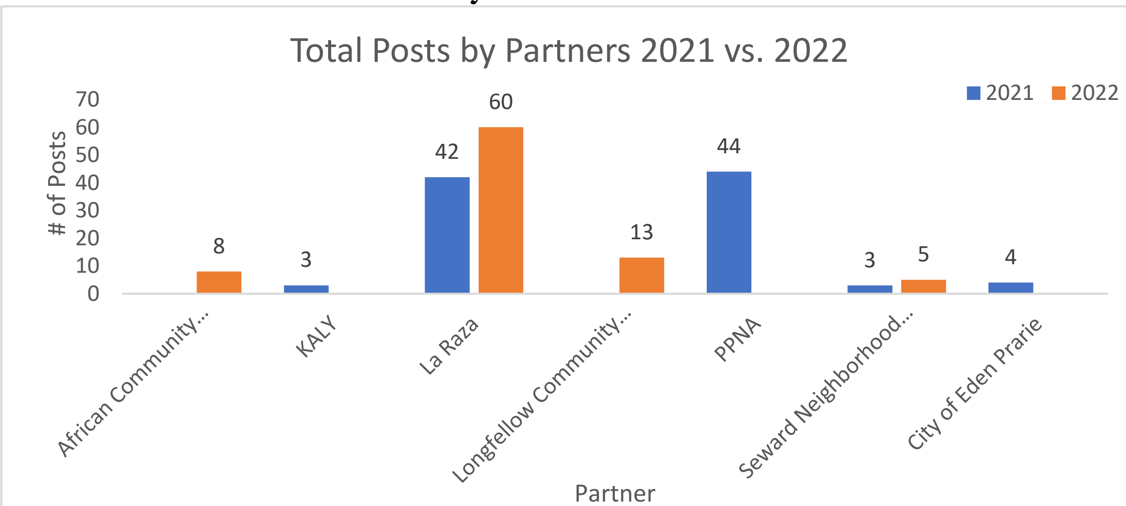


Figure 3
Total Posts per Platform 2021 & 2022

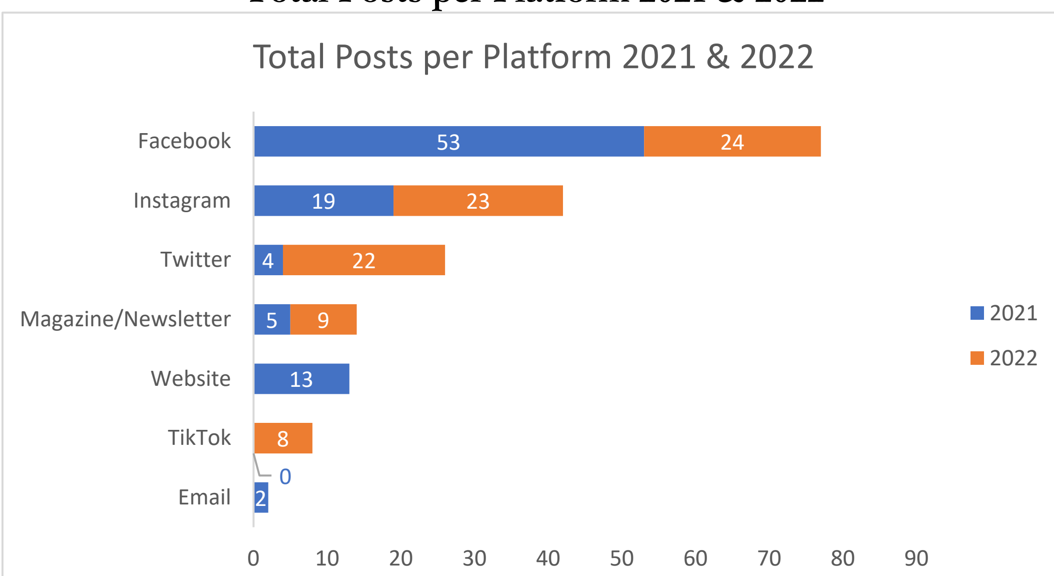


Table 1
Number of Posts per Channel by Partner 2021 & 2022

Partner	Total Number of Posts
African Community Services	**8**
TikTok	8
City of Eden Prairie	**4**
Email	2
Facebook	1
Website	1
KALY	**3**
Facebook	2
Magazine/Newsletter	1
La Raza	**102**
Facebook	48
Instagram	21
Twitter	22
Website	11
Longfellow Community Council	**13**
Facebook	4
Instagram	3
Magazine/Newsletter	4
Twitter	2
PPNA	**44**
Facebook	22
Instagram	18
Magazine/Newsletter	4
TikTok	0
Twitter	0
Seward Neighborhood Group	**8**
Magazine/Newsletter	5
Twitter	2
Website	1
Grand Total	**182**

Radio

In addition to social media and newsletters, the Company developed partnerships with language specific radio channels to target non-English speaking customers with energy savings tips and messaging. Through partnerships with KALY, Somali Radio, and La Raza, Spanish Radio, the Company was able to generate a significant number of impressions, with an estimated 1,504,149 impressions over the duration of the pilot.

Table 2
Total Radio Impressions

Year	Partner	Total Impressions (low)	Total Impressions (high)	Est. Total Impressions
2021	KALY	75,208	229,583	152,396
	La Raza	441,222	1,428,519	934,870
2021 Total		**516,431**	**1,658,102**	**1,087,266**
2022	KALY	29,688	90,625	60,156
	La Raza	168,361	545,093	356,727
2022 Total		**198,049**	**635,718**	**416,883**
Grand Total		**714,479**	**2,293,819**	**1,504,149**

Events

The Company attended several community events to inform customers about Flex Pricing rates and teach them how to save money. With the help of six different community group partners, the Company attended a total of 34 events and talked to an estimated 1,428 community members. The community groups the Company partnered with for these events were African Community Services (ACS), COPAL, PPNA, CEE, City of Eden Prairie.

During 2021 ACS conducted Flex Pricing outreach at Mosques, Malls, Parks, and in their office. The staff spoke with approximately 800 community members, in Somali, about Flex Pricing over 8 different outreach events. In 2022 COPAL leveraged vaccination events to share information about Flex Pricing with Spanish speaking community members, where their staff spoke with 150 patrons over 13 different vaccination events.

Figure 4
Time at Events per Month 2021 & 2022

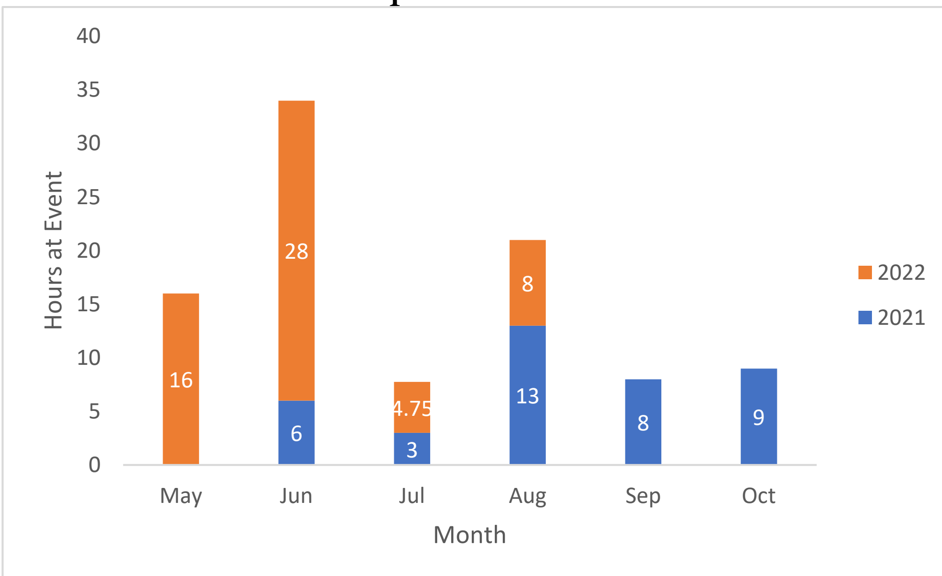


Figure 5
Interactions at Events per Month 2021 & 2022

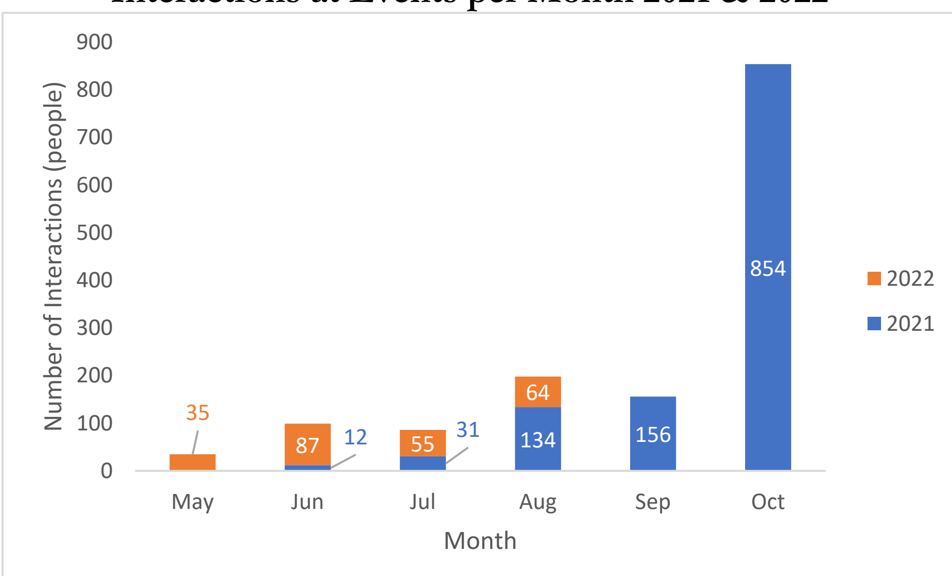


Table 3
Events Summary

Years	Event	Number of Events	Total Hours at Event	Number of Interactions	Est. Attendees
2021	ACS flex pricing flyer giveaway	2		500	500
	ACS presented at Cultural Center	1	1	20	20
	ACS Tabling	2		215	215
	ACS Tabling at St. Paul College Resource Fair	1	4	50	50
	COPAL Spanish Radio show	1	2	26	26
	Eden Prairie Arts in the Park	1	6	30	200
	Eden Prairie City Open House	1	4	40	300
	MPLS Open Streets - Minnehaha	1	4	73	400
	Powderhorn Art Pop Up	2	6	12	24
	Powderhorn Park Porch Fest	1	3	80	200
	Tabling at Powderhorn Park	3	6	83	121
	Tabling with African Community Services	2	5	58	81
2021 Total		**18**	**39**	**1,187**	**2,137**
2022	COPAL Radio Show	1	1	45	
	COVID-19 Vaccination clinic	13	52	150	
	Eden Prairie Home Garden Expo	1	-	-	
	Powderhorn Art Fair	1	4	46	
2022 Total		**16**	**57**	**241**	
Grand Total		**34**	**96**	**1,428**	**2,137**

In addition to attending community events, the Company conducted targeted door knocking at homes with higher-than-average energy use during on peak hours. Utilizing a heat map of energy usage data, the Company identified areas with higher-than-average energy use and targeted these premises when door knocking. Over three days the staff knocked on over 224 doors, with a 30 percent door open rate. The Company had conversations with these customers to increase awareness of energy use. Among households that answered their door, 63 percent of customers had not heard about flex pricing, while 76 percent said they were willing to shift their energy use. Ensuring all customers are aware of TOU rates will be imperative to the success of a TOU roll out.

Table 4
2022 Door Knocking Summary

Number of Days	3
Total Hours Spent	6.5
Total Doors Knocked	224
% of Doors Answered	30%
Aware of Flex Pricing Pilot	38%
Willing to Shift Energy Use	76%

Figure 6
Door Knocking, Number of Doors Answered

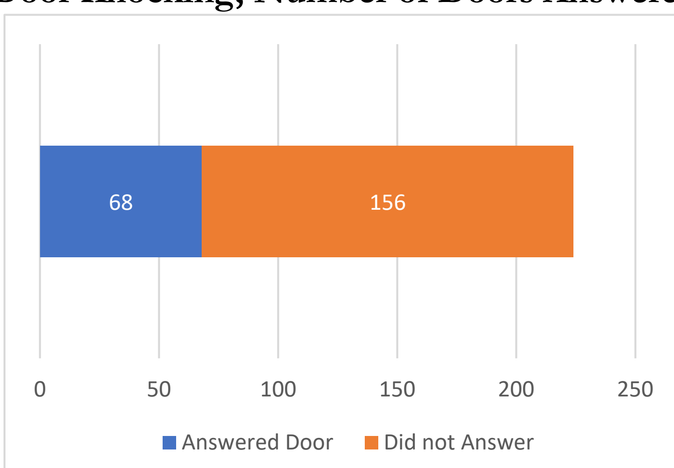


Figure 7
Awareness of Flex Pricing Among Households that Answered Their Door

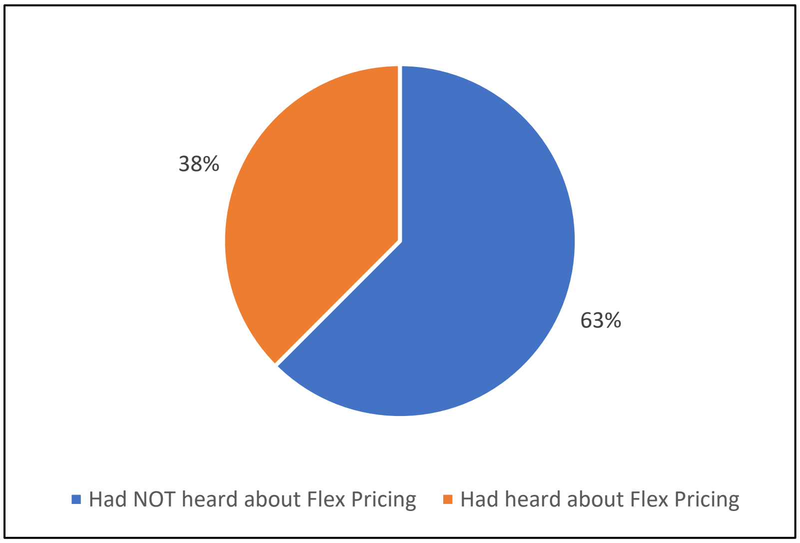
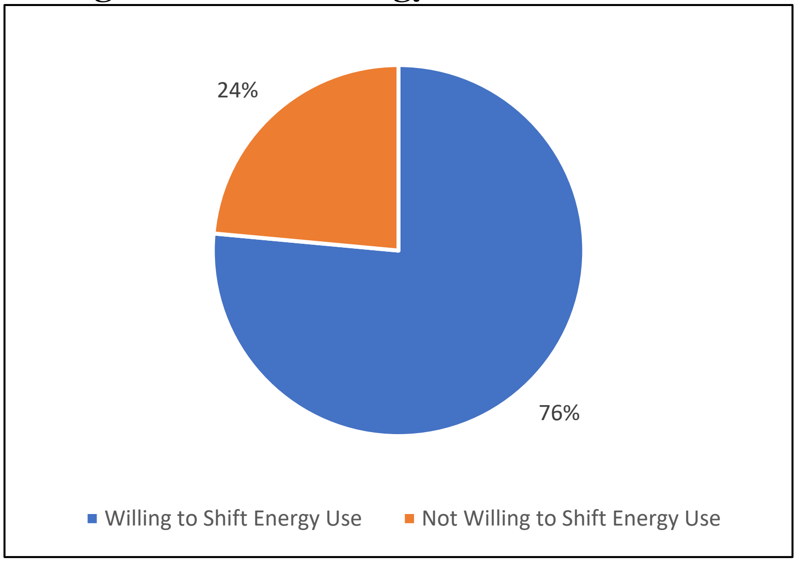


Figure 8
Willingness to Shift Energy Use Post Conversation



CERTIFICATE OF SERVICE

I, Crystal Syvertsen, hereby certify that I have this day served copies of the foregoing document on the attached lists of persons.

xx by depositing a true and correct copy thereof, properly enveloped with postage paid in the United States mail at Minneapolis, Minnesota

xx electronic filing

Docket No. E002/M-17-775

Dated this 10th day of February 2023

/s/

____

Crystal Syvertsen
Regulatory Administrator

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