



**Verified Carbon
Standard**

IMPROVING ENERGY EFFICIENCY IN HOMES THROUGH SMART THERMOSTAT OPTIMIZATION

ecobee

Project title	Improving Energy Efficiency in Homes Through Smart Thermostat Optimization
Project ID	3352
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PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

This project activity will use smart thermostats installed in homes to reduce heating and cooling usage. ecobee manufactures smart thermostats and recently developed a thermostat optimization platform titled eco+ to control these devices remotely in a manner that enhances the levels of energy savings beyond what would have occurred in the absence of this enhanced functionality. Eco+ is offered for free to both existing and new consumers and will continue to be offered for free throughout the entirety of the crediting period and any subsequent crediting period renewals¹. The energy efficiency enhancement provided by the implementation of eco+ is the project activity.

Prior to the project activity, energy usage was higher - leading to more electricity and gas consumption and greater emission as a result. This project reduces greenhouse gas emissions by reducing the electricity and gas consumed in homes as compared to the baseline, the use of an ecobee device without the enhanced thermostat optimization capability, while still offering the same level of comfort to the consumer. The energy efficiency optimizations resulting from this platform generate no additional revenue for ecobee but do represent a significant cost for the company. This approach reduces both electricity and natural gas usage in air conditioning and heating units in residential homes.

ecobee's thermostat optimization software, eco+, reduces GHG emissions by regulating the home's preferred indoor temperature by controlling the HVAC equipment. This energy efficiency enhancement uses individual customer comfort preferences, real-time and historical occupancy patterns and data regarding a home's specific thermodynamic properties and HVAC system performance to create personalized, real-time optimization. The optimizations utilize occupancy sensing, which identifies when a home is vacant; machine learning, to predict temperature and customer schedules; geolocation, which determines a customer's proximity to home; and the ability to continuously adjust for indoor humidity conditions.

The project activity and primary driver of energy savings through eco+ is the patented² feature "Adjust for Humidity".

The development of this feature was informed by the principles of thermal comfort and the humidity index (i.e., humidex). Thermal comfort refers to the subjective feeling of temperature in the surrounding environment. The humidity index is a measurement that expresses how the combined effects of warm temperatures and humidity are perceived by a person. By applying these two principles, the ecobee smart thermostat and the "Adjust for Humidity" feature measures and takes into consideration the home's temperature and humidity when determining the temperature at which a customer feels comfortable.

¹ Please refer to Appendix F for ecobee's Executive Vice President's attestation that eco+ will continue to be offered for free throughout the entirety of the crediting period and any subsequent crediting period renewals.

² Trinh, K. (2021). Thermostat device with improved energy optimization. (U.S. Patent No. US20210302052A1) <https://patents.google.com/patent/US20210302052A1/en?q=US20210302052A1>

In essence, the feature takes advantage of a home's indoor humidex (a blend of temperature and moisture in the air) and automatically controls the HVAC equipment to manage the desired setpoint temperature to lower energy consumption while keeping residents feeling comfortable. It monitors these conditions around-the-clock and all year-long to deploy micro-HVAC adjustments to lower energy consumption while ensuring the home feels comfortable for its residents.

Figure 1 shows the scientific explanation of the “Adjust for Humidity” feature and Figure 2 shows the layman's illustration. The psychometric chart is a staple of building science and HVAC design. The graph illustrates dry bulb temperature on the x-axis and moisture content on the y-axis. Lines of constant relative humidity are represented by the curved lines running from the bottom left and sweeping up through to the top right of the chart. The annotated areas of the chart show where the feature is active. Essentially, the feature exploits the fact that humans feel wet bulb temperature rather than dry bulb temperature, and thus at certain moisture content levels, the executed setpoint of the thermostat can be raised (in cooling mode) or lowered (in heating mode) to reduce HVAC consumption.

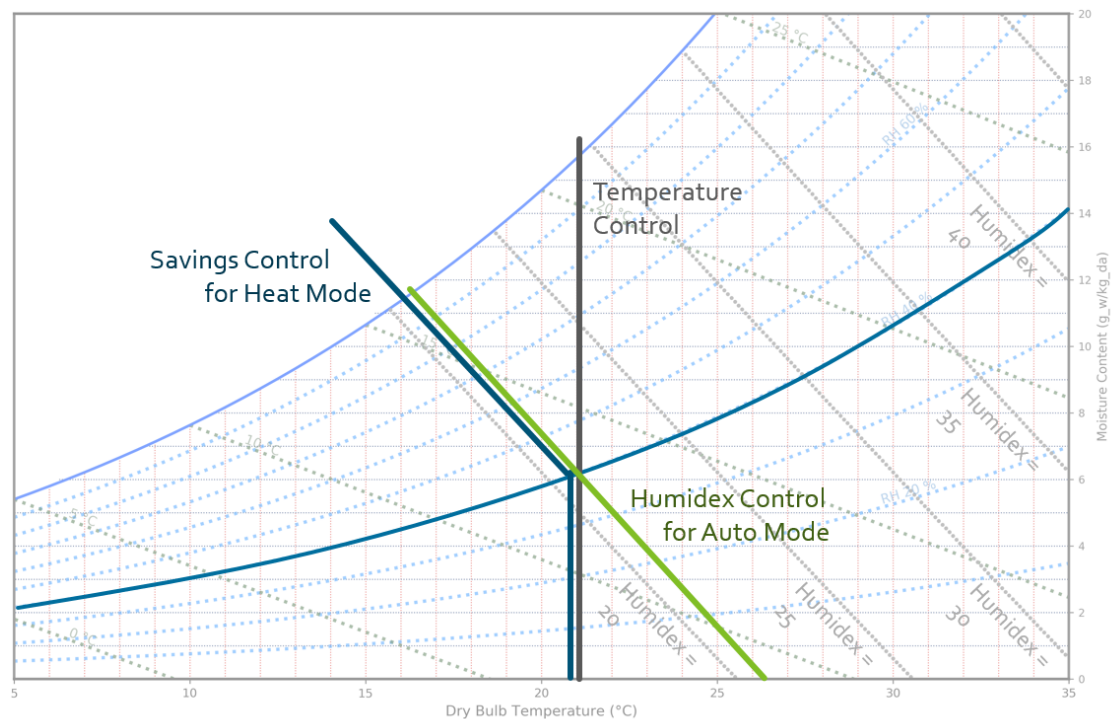


Figure 1: Psychometric Chart with Adjust for Humidity Illustration

Figure 2 compares average sensed and executed temperatures for devices in the Hot-Humid climate zone during July 2021. The difference between the blue and grey line is the “offset” imposed by the humidity feature. By raising thermostat setpoints, the amount of cooling energy required is lowered. These small micro-adjustments across millions of thermostats add up to significant energy savings and emissions reductions. In heating mode, the offset works in the opposite direction with executed setpoints less than sensed temperatures.

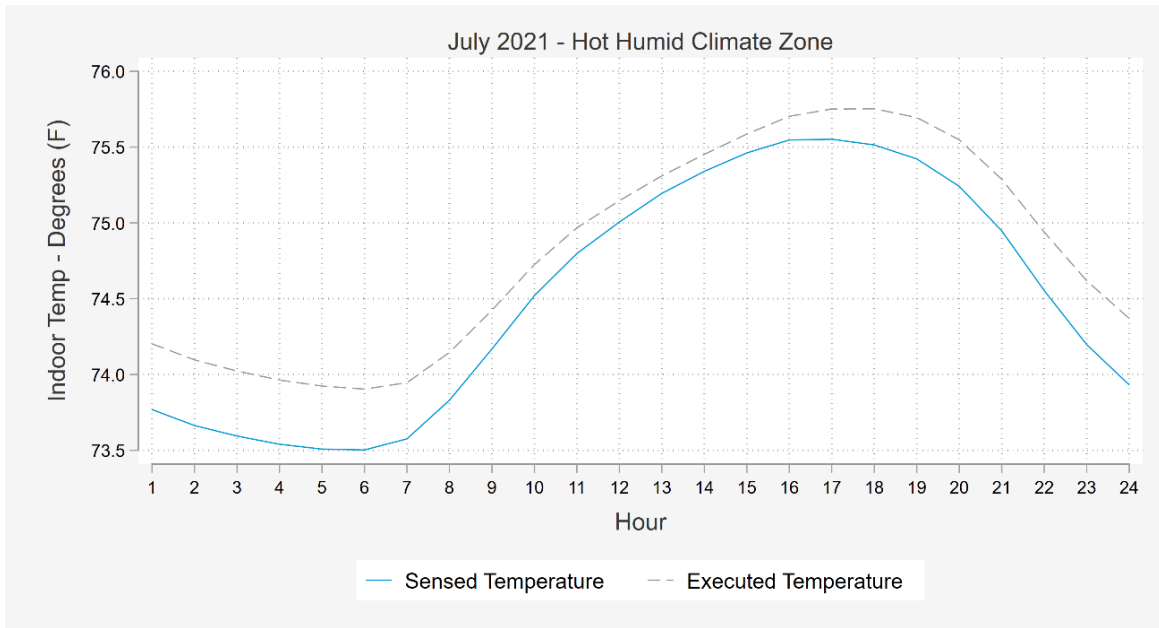


Figure 2: Adjust for Humidity Applied Example

Figure 3 illustrates how the feature works across different ambient conditions using the same data from July 2021 in the Hot-Humid climate zone. Each point is one day (31 points). While some level of offset is present every day, the algorithm is more aggressive when outdoor temperatures are high and relative humidity is low.



Figure 3: Offset Versus Outdoor Temperature and Relative Humidity (July 2021)

ecobee undertook a pilot study in 2019 and 2020 to assess the results of eco+ including the energy efficiency enhancement.³ During this time, the eco+ platform was deployed across North America to a large pilot group of ecobee thermostats to demonstrate the capabilities of the eco+ platform. The pilot included a population of approximately 240,000 ecobee smart thermostats.

Following the pilot, ecobee enlisted a third-party measurement and verification (M&V) consultant, Demand Side Analytics, LLC (DSA) to assess the energy impacts of the eco+ platform. The results of the pilot demonstrated measurable energy efficiency improvements when comparing the experimental group (devices that received eco+ and participated in the pilot) against the control group (devices without eco+). With positive results demonstrated from the pilot study, ecobee began implementing a phased roll out of eco+. The full roll out was completed by March 03, 2021 to existing ecobee smart thermostats and offered on new ecobee smart thermostats on a go forward basis.

The project activity expands this functionality to 3,276,993 ecobee thermostats in the U.S during the second monitoring period which includes 1,226,319 already installed devices that received the free eco+ thermostat optimization platform through an over-the-air software upgrade and another 2,050,674 devices offered eco+ for free upon installation. Carbon revenue would support the one time and on-going costs ecobee incurs for implementing the energy efficiency enhancement provided by eco+ which generates no additional revenue for the company.

The project start date is March 03, 2021. The table below provides a summary of the emission reductions generated by the project activity during the second reporting period, March 3, 2023 – March 02, 2025. The total emission reductions generated during this monitoring period is **504,264 tCO₂**.

Table 1: Summary of 03-MAR-2023-02-MAR-2025 Emissions Reductions (tCO₂)⁴

	03-March-2023 to 02-March-2025
Baseline Emissions (tCO ₂)	16,276,417
Project Emissions (tCO ₂)	15,646,088
Total Emission Reductions (tCO ₂)	630,330
VM0008 Applicability Condition ⁵ – Occupied Dwelling Discount (20%)	504,264

³ Evaluation Performed by Demand Side Analytics, available at <https://www.ecobee.com/en-us/ecoplusemv/>

⁴ Summary of emission reductions based on DSA's emissions quantification using EPA's eGRID emission factors and the lower bound of the 95% confidence interval.

⁵ VM0008 Applicability Condition states "The Dwelling must be occupied. Vacancy is permitted on an intermittent basis for up to three months, or if the Dwelling is occupied seasonally on an annual basis." ecobee performed a detailed occupancy analysis to determine percentage of dwellings in project activity that meets applicability condition. Based on the analysis, ecobee infers 80% of dwellings in second monitoring period are occupied and not vacant for up to 3 months. Please see ecobee_PDD-VM0008 Section 3.2 "Applicability of Methodology" for full details. To be conservative, the results of the analysis has been factored into total claimed emissions reductions for the second monitoring period as a discount of 20%.

1.2 Audit History

Audit type	Period	Program	Validation/verification body name	Number of years
Validation	03-March-2021 to 02-March-2028	VCS	TUV SUD America Inc. (formally Ruby Canyon)	7 years
Verification	03-March-2021 to 02-March-2023	VCS	TUV SUD America Inc. (formally Ruby Canyon)	2 years
Verification	03-March-2023 to 02-March-2025	VCS	ERM Certification and Verification Services (ERM CVS)	2 years

1.3 Sectoral Scope and Project Type

Sectoral scope ⁶	Scope 3, Energy Demand
Project activity type	Grouped Project

Sectoral scope	This is a non-AFOLU project. This section is not applicable.
AFOLU project category ⁷	Not applicable
Project activity type	Not applicable

1.4 Project Proponent

Organization name	ecobee Technologies, ULC ("ecobee")
Contact person	Tamara Dzubay
Title	Sr. Director, Energy Sales
Address	207 Queens Quay West, 6 th Floor, Toronto, Ontario M5J 1A7
Telephone	(630) 269-1779
Email	tamara.d@ecobee.com
Organization name	ecobee Technologies, ULC ("ecobee")

⁶ Projects, activities, or methodologies may be developed under any of the 16 VCS sectoral scopes: <https://verra.org/programs/verified-carbon-standard/vcs-program-details/#sectoral-scopes>

⁷ See Appendix 1 of the VCS Standard

Contact person	Jeanny Do
Title	Sr. Specialist, Energy and Emerging Markets
Address	207 Queens Quay West, 6 th Floor, Toronto, Ontario M5J 1A7
Telephone	(416) 827-0229
Email	jeanny.d@ecobee.com

1.5 Other Entities Involved in the Project

Organization name	Demand Side Analytics, LLC (“DSA”)
Role in the project	Evaluation, measurement and verification experts enlisted to perform quantification analysis of GHG emission reductions of project activity
Contact person	Jesse Smith
Title	Partner
Address	691 John Wesley Dobbs Ave NE Suite V3, Atlanta, GA, 30312 USA
Telephone	(770) 401-9018
Email	jsmith@demandsideanalytics.com

1.6 Project Start Date

Project start date	03-March-2021
Justification	The start date of the project activity is 03-March-2021 which is when ecobee completed version 1 of the phased roll out of eco+ as an energy efficiency enhancement upgrade. Below is evidence of the rollout schedule and email campaigns that were deployed to customers: 1. ecobee’s Product Team internal release plan and timeline of eco+ roll out. See line 4 where eco+ (“8.3”) was released to all customers at 100%.

OOTB Release plan



Owned by Valentin Randon (Deactivated) ...
Last updated: Mar 02, 2021 • 1 min read • 30 people viewed

Definitions

- V1: includes mobile setup changes. Does not include FW changes
- V2: includes FW changes (manufacturing build)

Timeline

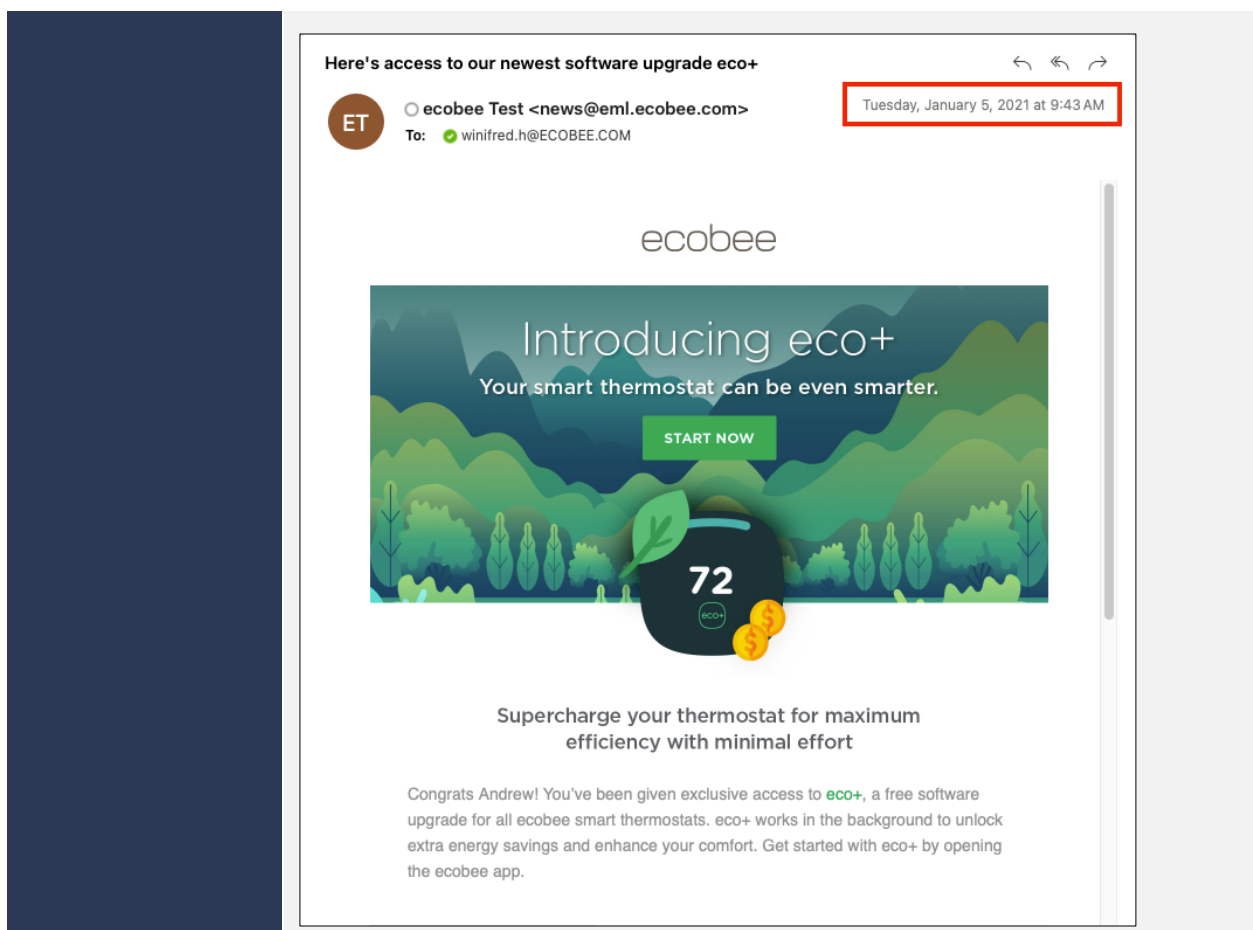
	Date	Milestone
1	Feb 17th	all OOTB work part of Codefreeze for 8.3 Mobile release
2	Feb 24th	Beginning of progressive roll out of 8.3.
3	Feb 24th March 4th	Beginning of A/B test. Update: Android only
4	March 3rd	8.3 released at 100%.
5	March 8th	start of FW rollout for V2
6	March 12th	Beginning of progressive roll out of 8.4 iOS users will now be part of the A/B test.
7	March 17th March 26th	Provided A/B test is conclusive: Feature rolled out to 100% users
8	April 19th	V2 rolled out to 100% users

2. ecobee's Marketing Communication team's e-mail campaign tracker of eco+ introduction e-mail completing in March 2021.

My Tracking > 1. Production > 2021 > Energy Services > eco+ Feature Announcement		
Move Delete Pause Send Resume Send Cancel Send Compare Email Sends Showing: 2021-01-01 to 2021-03-02		
Job ID	Name	Date/Time Sent
7464	2021-01-05_BCH_NRG_ecoplus_FeatureAnnouncement	2021-03-02 2:16 PM
7350	2021-01-05_BCH_NRG_ecoplus_FeatureAnnouncement	2021-02-23 5:52 PM
7311	2021-01-05_BCH_NRG_ecoplus_FeatureAnnouncement	2021-02-18 10:10 AM
6980	2021-01-05_BCH_NRG_ecoplus_FeatureAnnouncement	2021-02-02 4:57 PM
6973	2021-01-05_BCH_NRG_ecoplus_FeatureAnnouncement	2021-01-28 2:06 PM
6972	2021-01-05_BCH_NRG_ecoplus_FeatureAnnouncement	2021-01-28 2:04 PM
6932	2021-01-05_BCH_NRG_ecoplus_FeatureAnnouncement	2021-01-22 5:59 PM
6743	eco+ Feature Announcement email - Generic - USCAN - wBlogarticle	2021-01-05 3:31 PM
6742	eco+ Feature Announcement email - Generic - USCAN - wBlogarticle	2021-01-05 3:31 PM
6741	eco+ Feature Announcement email - Generic - USCAN - wBlogarticle	2021-01-05 2:55 PM
6740	eco+ Feature Announcement email - Generic - USCAN - wBlogarticle	2021-01-05 2:54 PM
6739	eco+ Feature Announcement email - Generic - USCAN - wBlogarticle	2021-01-05 2:24 PM
6738	eco+ Feature Announcement email - Generic - USCAN - wBlogarticle	2021-01-05 2:08 PM

3. eco+ introduction e-mail template sent to customers. The e-mail campaign introducing customers to eco+ was completed on March 02, 2021.

The test email dated January 5, 2021 displays the content that customers would have received throughout the e-mail campaign period.



1.7 Project Crediting Period

Crediting period	☒ Seven years, twice renewable ☐ Ten years, fixed ☐ Other (state the selected crediting period and justify how it conforms with the VCS Program requirements)
Start and end date of first or fixed crediting period	03-March-2021 to 02-March-2028 (7 years)

1.8 Project Location

The project boundary is the geographical boundary of continental United States, shown below in Figure 4, with the coordinates of 39.9023, -100.1146, where 3,882,395 ecobee smart thermostats with eco+ and “Adjust for Humidity”, reside in 62% of U.S. zipcodes as illustrated in the map below. Each dot on the map represents US zip codes with ecobee smart thermostats with eco+ and “Adjust for Humidity”.

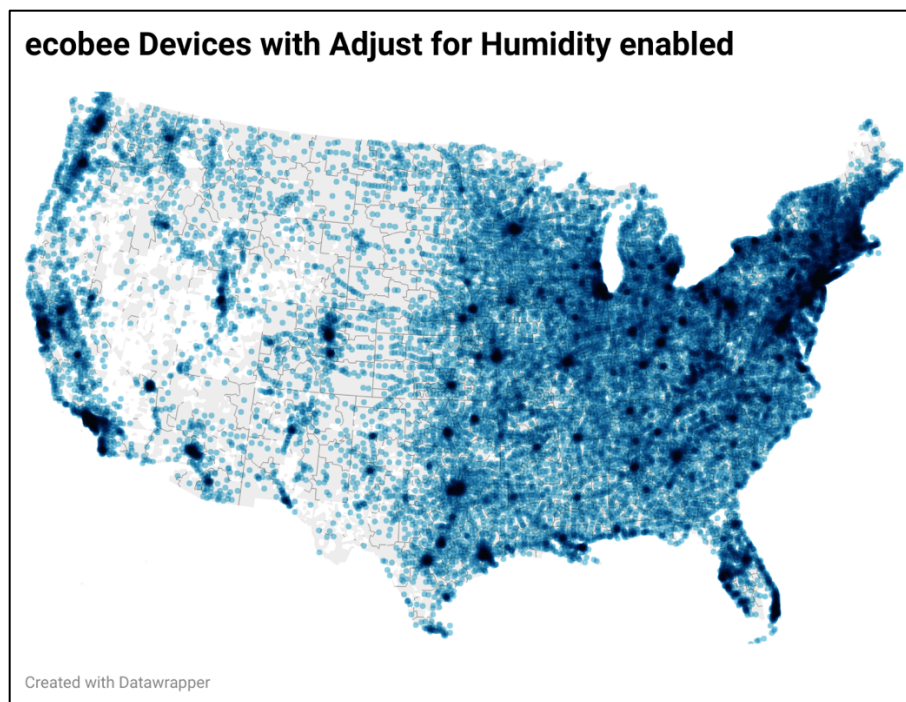


Figure 4: Map of Contiguous USA with Project Thermostat Locations

1.9 Title and Reference of Methodology

Type (methodology, tool or module).	Reference ID	Title	Version
Approved VCS Methodology	VM0008	Weatherization of Single Family and Multi-Family Buildings – Sectoral Scope 3	1.1

1.10 Double Counting and Participation under Other GHG Programs

1.10.1 No Double Issuance

Is the project receiving or seeking credit for reductions and removals from a project activity under another GHG program?

☐ Yes ☒ No

If yes, provide required evidence of no double issuance as outlined by the VCS Standard.

1.10.2 Registration in Other GHG Programs

Is the project registered or seeking registration under any other GHG programs?

☐ Yes ☒ No

If yes, provide the registration number and all relevant details.

1.11 Double Claiming, Other Forms of Credit, and Scope 3 Emissions

1.11.1 No Double Claiming with Emissions Trading Programs or Binding Emission Limits

Are project reductions and removals or project activities also included in an emissions trading program or binding emission limit? See the *VCS Program Definitions* for definitions of emissions trading program and binding emission limit.

☐ Yes ☒ No

If yes, provide all required evidence of no double claiming as outlined by the VCS Standard.

1.11.2 No Double Claiming with Other Forms of Environmental Credit

Has the project activity sought, received, or is planning to receive credit from another GHG-related environmental credit system? See the *VCS Program Definitions* for definition of GHG-related environmental credit system.

☐ Yes ☒ No

1.11.3 Supply Chain (Scope 3) Emissions

Do the project activities affect the emissions footprint of any product(s) (goods or services) that are part of a supply chain?

☐ Yes ☒ No

If yes:

Is the project proponent(s) or authorized representative a buyer or seller of the product(s) (goods or services) that are part of a supply chain?

☐ Yes ☐ No

If yes:

Has the project proponent(s) or authorized representative posted a public statement on their website saying, "Carbon credits may be issued through the Verified Carbon Standard project [project ID] for the greenhouse gas emission reductions or removals associated with [project proponent or authorized representative organization name(s)] [name of product(s) whose emissions footprint is changed by the project activities]."

☐ Yes ☐ No

Not applicable to this project activity.

1.12 Sustainable Development Contributions

The project activity contributes to Sustainable Development Goals 7.3, 8.2, 11.6 and 13.0 through the development and deployment of an energy efficiency enhancement, the patented feature “Adjust for Humidity” delivered through a thermostat optimization platform, eco+, to ecobee smart thermostats. The project directly contributes to SDG 7.3, 8.2, 11.6 and 13 in several ways. The development of this feature directly contributes to economic productivity, technological upgrade and innovation as the development, operation and maintenance of eco+ is supported by more than 30 full-time equivalents in the area of Data Science, Product Management and Engineering and is projected to increase by dozens of additional full-time equivalents in addition to the retention of the core team to continuously improve and maintain the project activity.

The development of the project activity directly impacts the efficiency and energy usage of a home’s heating and cooling system, thereby improving overall energy efficiency, reducing energy usage including fossil fuels, decreasing harmful pollutants (i.e., PM2.5), improving air quality and reducing adverse impact on the environment.

The Biden-Harris Administration in the United States has set federal level climate goals⁸, including reducing U.S greenhouse gas emissions 50-52% below 2005 levels in 2030, reaching 100% carbon pollution free electricity by 2035, achieving a net-zero emissions economy by 2050 and delivering 40% of the benefits from federal investments in climate and clean energy to disadvantaged communities. The project activity contributes to the reduction of U.S. GHG emissions as the “Adjust for Humidity” feature reduces the HVAC energy usage in millions of homes across the USA. The reduction in total kWh of electricity consumption and mmcf reduction in natural gas consumption equates to reduction and avoidance of GHG emissions released into the atmosphere. *Additional details are available in the table below.*

⁸ The White House. President Biden’s Historical Climate Agenda.
<https://www.whitehouse.gov/climate/#:~:text=President%20Biden's%20Actions%20to%20Tackle%20the%20Climate%20Crisis&text=As%20part%20of%20that%20vision,zero%20emissions%20economy%20by%202050>

Table 2: Sustainable Development Contributions

Row #	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	7.3	7.3.1. Energy intensity measured in terms of primary energy and GDP.	Implemented activities to decrease.	eco+ reduces CO2 emissions by lowering consumption of electricity and fossil fuel for heating and cooling, thereby lowering the energy intensity of 3.2 million participating households. Lowering energy consumption while increasing GDP through job creation positively affects both parts of this indicator. By improving energy efficiency of residential HVAC systems in 3.2 million homes in the USA in this monitoring period, the project has prevented the generation of 707,930 MWh and 7,413,166 MMBtu – These are aggregated savings of electricity and natural gas in both cooling/heating scenarios.	The project has prevented the generation of 707,930 MWh and 7,413,166 MMBtu cumulatively since the project start date, lowering overall energy intensity in the USA.
2)	8.2	8.2.1 Annual growth rate of real GDP per employed person.	Implemented activities to increase.	No further changes this monitoring period.	Highly technical positions created at ecobee through the implementation of the project activity. Technical jobs at ecobee created through the project will create new, highly-skilled employment opportunities. The development, operation and maintenance of eco+ continues to be supported by more than 30 full time equivalents in the area of Data Science, Product Management and Engineering, contributing an annual growth rate of +3.17 per year since project start date.

3)	11.6	11.6.2. Annual mean levels of fine particulate matter (eg., PM2.5 and PM10) in cities (population weighted)	Implemented activities to decrease.	Project activity takes place within the U.S. where over 3.2 million ecobee devices with eco+ and “Adjust for Humidity” resides in 62% of U.S zipcodes including major metropolitan areas. Project activity reduces energy usage and maximizes HVAC energy efficiency thereby decreasing PM2.5 emissions and improving air quality. By improving energy efficiency in homes, the project has reduced PM2.5 emissions by more than 61,563 lbs during the monitoring period.	The project has reduced PM2.5 emissions by 61,563 lbs since the project start date.
4)	13.0	Tonnes of greenhouse gas emissions avoided or removed.	Implemented activities to increase.	The implementation of the project activity results in MWh reduction of electricity consumption and mmcf reduction in natural gas consumption. The project activity has decreased electricity consumption by more than 707,930 MWh and natural gas consumption by more than 7,413,166 MMBtu during the monitoring period, thereby preventing the release of 504,264 tonnes of CO₂	Prevented 894,916 tonne of CO ₂ from being released into the atmosphere since project start date.

1.13 Commercially Sensitive Information

No commercially sensitive information has been excluded from the public version of this monitoring report.

2 SAFEGUARDS AND STAKEHOLDER ENGAGEMENT

2.1 Stakeholder Engagement and Consultation

2.1.1 Stakeholder Identification

VCS Program defines a stakeholder⁹ has “any person or entity who can potentially affect or be affected by the project activities”.

The project activity involves ecobee smart thermostats equipped with eco+ which enables additional functionality resulting in personalized energy efficiency optimization that will further reduce heating and cooling usage in the home beyond what would happen in the absence of the energy efficiency enhancement. The primary driver of energy savings through eco+ is the patented feature “Adjust for Humidity”. The feature takes advantage of a home’s indoor humidex (a blend of temperature and moisture in the air) and automatically controls the HVAC equipment to manage the desired setpoint temperature to lower energy consumption while keeping residents feeling comfortable. It monitors these conditions around-the-clock and all year-long to deploy micro-HVAC adjustments to lower energy consumption while ensuring the home feels comfortable for its residents.

Stakeholder Identification

Based on the project activity’s scope and potential impacts, ecobee identified two groups of stakeholders:

Group 1: Industry Professionals. 7 participants were selected based on their professional backgrounds and experiences in the energy industry, energy efficiency, environmental law, energy measurement and verification, building and sustainability, carbon accounting, ESG reporting and some being owners of ecobee devices. 3 of 7 (or 43%) of the participants were also owners and users of ecobee smart thermostats. The remainder of the participants were familiar with and had a good understanding of ecobee and smart thermostats in general.

Group 2: ecobee Customers. 12 ecobee users were selected and were recruited based on these requirements:

- Is an ecobee smart thermostat user
- Based in the United States
- Had awareness of eco+
- Enabled eco+
- Range across age, gender and region

⁹ VCS Program Definitions v4.4. <https://verra.org/wp-content/uploads/2023/08/VCS-Program-Definitions-v4.4.pdf>

Legal or customary tenure/access rights	This section is not applicable. The stakeholder groups and participants who attended the consultation sessions do not come from groups that hold access rights to territories and resources.
Stakeholder diversity and changes over time	This section is not applicable. The project activity does not impact the social, economic or cultural diversity of the stakeholder group. Stakeholder groups who were identified and attended the consultation sessions were experienced professionals and users of ecobee smart thermostats with eco+ enabled.
Expected changes in well-being	This section is not applicable. There are no expected changes in the well-being and other stakeholder characteristics relative to the baseline scenario, including changes to ecosystem services identified important to stakeholders.
Location of stakeholders	Stakeholder groups that attended the consultation sessions are located throughout the USA and Canada and attended the sessions virtually.
Location of resources	This section is not applicable as stakeholders who attended the consultation do not come from groups that hold customary access rights to resources and territories.

2.1.2 Stakeholder Consultation and Ongoing Communication

Ongoing consultation	Group 1: Industry Professionals During the session, ecobee presented the overall objectives of the project activity, provided explanations on why carbon finance was needed and what the benefits would be for consumers and the environment. Throughout the session, participants had access to the chat function to raise questions, add comments and provide inputs. Questions that were raised by stakeholders during the Q&A segment primarily focused on project design, offset ownership and emissions calculation clarification points. No major objections to the project were raised. At the end of session, stakeholders were provided with contact details of ecobee members Tamara Dzubay and Jeanny Do who remain available for follow up inquiries. Since the session on 16-January-2023, no additional comments, inquiries and inputs have been received by ecobee from stakeholder group. The video recording and transcript of Q&A portion has been provided to the VVB and can be provided to Verra upon request. Group 2: ecobee Customers ecobee facilitators presented on the overall objectives of the focus group session, the project activity itself including eco+ and the “Adjust for Humidity” feature, provided explanation on why carbon finance is needed to sustain the project activity and introduced participants to the voluntary carbon markets, carbon standards and the project validation and verification process. Throughout the session, participants were encouraged to use the chat function to raise questions, add comments and provide inputs. The sessions were recorded and all feedback and discussion points were documented for
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	future reference. Recordings and presentation slide deck were provided to the VVB and can be made available to Verra upon request. Following the presentation, the guided discussion during the Q&A segment primarily focused on familiarity of eco+, “Adjust for Humidity” feature and the carbon markets. Participants reacted very positively when they learned about how ecobee is seeking to register a carbon project for carbon finance to sustain the project activity. It was their preference for ecobee to keep eco+ and its feature free and for ecobee to use carbon finance to continuously maintain and improve eco+ operations. By keeping eco+ free, it helps participants feel they are making a small, collective contribution towards climate change by enabling the feature, with one participant commenting “nice to hear that [ecobee] is using offsets to better things.” Other participants who were familiar with eco+ but less familiar with the “Adjust for Humidity” feature were excited to enable or keep the feature on to contribute to the positive environmental impact. No major objections were raised. At the end of the sessions, participants were provided with contact details of the facilitators who remain available for follow up inquires. Since the sessions on 20-June-2024, no additional comments, inquires and inputs have been received from the stakeholder group.
Date(s) of stakeholder consultation	Group 1: Industry Professionals – Virtual session held on 16-January-2023 Group 2: ecobee Customers – Virtual sessions held on 20-June-2024
Communication of monitored results	Following both stakeholder sessions with Group 1 and Group 2, participants were provided with e-mail address of session facilitators: jeanny.d@ecobee.com, tamara.d@ecobee.com, jamie.b@ecobee.com and insights@ecobee.com. Throughout the monitoring period of 03-Mar-2023 to 02-Mar-2025, facilitators and the ecobee Research Team that monitors insights@ecobee.com inbox, confirms no additional comments or feedback has been received since 20-June-2024 and during the monitoring period as it pertains to the ecobee carbon project.
Consultation records	Recording, transcripts and presentation decks for both stakeholder group session have been shared with VVB and can be provided to Verra upon request.
Stakeholder input	Group 1: Industry Professionals Participants posed questions during a Question & Answer session at the end of the presentation primarily related to project design, offset ownership and other issues addressed in the PDD. Group 2: ecobee Customers A guided discussion was conducted following main presentation of the carbon project. The primary facilitator posed questions about eco+, “Adjust for Humidity” and the voluntary carbon markets to each participant and documented their responses for reference.

	The key takeaways and comments from the session were: - Users were familiar with eco+, its features and somewhat familiar with carbon programs and carbon markets. - Users reacted positively to learning about ecobee registering a carbon offset project for carbon finance. - Users prefer eco+ to remain free and use of carbon finance to sustain eco+ was welcomed - Other comments include general feedback on other features and UX experience of ecobee's mobile app.
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2.1.3 Free, Prior, and Informed Consent

Use the table below to describe the discussion of FPIC which took place as part of the stakeholder consultation.

Consent	This section is not applicable as obtaining consent from those concerned including indigenous people, local communities and customary rights holder is not applicable. The project activity involves ecobee smart thermostats equipped with eco+ which enables additional functionality resulting in personalized energy efficiency optimization that will further reduce heating and cooling usage in the home beyond what would happen in the absence of the energy efficiency enhancement.
Outcome of FPIC	Not applicable.

2.1.4 Grievance Redress Procedure

Grievances received	Resolution and outcome
Not Applicable.	Throughout the monitoring period facilitators of the stakeholder sessions (Tamara D. [tamara.d@ecobee.com], Jeanny D. [jeanny.d@ecobee.com], and Jamie B. [jamie.b@ecobee.com]) and the ecobee Research Team that monitors insights@ecobee.com inbox confirms no additional comments, feedback or grievances were received during the monitoring period as it pertains to the ecobee carbon project. Facilitators of consultation sessions remain active and employed at ecobee with full access to their inboxes throughout the monitoring period to receive communication, including grievances and ongoing communications.

2.1.5 Public Comments

Summary of comments received	Actions taken
No comments were received outside the public comment period of 26/07/2022 – 25/08/2022.	Not applicable.

2.2 Risks to Stakeholders and the Environment

2.2.1 Management Experience

The project management team comprises of technical experts from ecobee's Firmware and Data Engineering team and statistical and research experts from Demand Side Analytics who have the expertise and experience to implement the project activity and measure the project activity's emission reduction. The project management team has been involved on the project since the project start date of March 03, 2021 and has been managing and implementing the project activity throughout the first and second verification periods.

The technical experts from ecobee is comprised of skilled professional in the field of Data Engineering and Engineering who are responsible for managing the transmission of data from ecobee smart thermostats to the server and overseeing firmware development, operations and functionalities. The core technical team involved in this project activity include:

- 1) Senior Machine Learning Engineer who has over 8 years of experience at ecobee and is considered the leading company authority and internal expert on the operation of ecobee's "Adjust for Humidity" feature
- 2) Senior Manager, Embedded Systems (Firmware), who has over 6 years of experience at ecobee and is responsible for overseeing the team of embedded firmware engineers that develop the software that goes on the thermostats that collects the data and delivers it to the ecobee servers
- 3) Engineering Manager, Data Platform who has over 3 years of experience at ecobee and is responsible for maintaining the data pipelines for any new library/data upgrades, creating monitoring policies to ensure the team is aware of if the pipeline is not working as intended and maintaining the data storage where the thermostat runtime data gets stored as an end result. I

In addition to ecobee's technical experts, Demand Side Analytics LLC (DSA) was enlisted as a third-party evaluation, measurement and verification firm to analyze and quantify the project activity's emission reductions. DSA was enlisted for their expertise on data on data driven research and insights and on predictive and casual analytics. DSA offers extensive expertise in evaluation, measurement and verification (EM&V), distributed energy resource integration, transmission and distribution system planning, targeting analytics, and benefit cost analysis. The strength of their team is that they provide access to true experts. The team includes data scientists, applied statisticians, economists, and engineers. The experts involved in the development of the regression model and quantification of ecobee's project activity emission reductions include:

- 4) Partner and Applied Statistician whose work is centered around estimating the impacts of demand side interventions to alter the way homes and businesses use energy. Their experiences include over 10+ years in the energy industry performing evaluation, measurement and verification (EM&V) on a wide variety of demand response, dynamic pricing, and energy efficiency programs implemented across North America. They specialize in statistical analysis of energy usage data, sampling, experimental design, and benefit cost modeling and is comfortable working in Stata, SAS, SQL, and Excel. They hold Bachelor's of Science in Psychology and a Masters of Science in Applied Statistics from Kennesaw State University.
- 5) Consultant, who has extensive training in causal inference and experimental design and has experience working in economics at both think tanks and in the private sector. They hold a Ph.D in in Agriculture and Resource Economics from UC Berkeley, where their research focused on using large datasets to study energy efficient and climate-friendly consumer products, and where they taught a course on energy markets.
- 6) Quantitative Analyst, Data Scientist with a background in economics, specializing in causal inference research designs applied to real-world problems and has contributed to demand response evaluations in multiple states. Their expertise lies in leveraging predictive modeling techniques, including machine learning algorithms, to drive actionable insights from complex datasets and they hold a Master's Degree in Economics from the University of Texas at Austin.

2.2.2 Risk Assessment

	Risk identified	Mitigation or preventative measure taken
Natural and human-induced risks to stakeholders' wellbeing	No risks identified at validation and/or during the monitoring period related to natural and human-induced risks to stakeholders wellbeing.	There are no negative consequences or risks associated with this project. This project activity involves existing and new ecobee smart thermostat optimization platform (eco+) that reduces a home's incremental energy usage by controlling the HVAC equipment and does not involved natural and human-induced risks that would result in negative impact to stakeholders' wellbeing.
Risks to stakeholder participation	No risks identified at validation and/or during the monitoring period to any stakeholders and the environment.	There are no negative consequences or risks associated with this project. This project activity involves existing and new ecobee smart thermostats receiving the free thermostat optimization platform (eco+) that reduces a home's incremental energy usage by controlling the HVAC equipment and does not involve the construction of any facility or involve actions that would have measurable environmental impact or risks to stakeholders.

Working conditions	No risks identified at validation and/or during monitoring period related to working conditions as result of project activity	There are no risks to the working conditions associated with this project. The development, operation of eco+ is supported by more than 30 full-time ecobee employees. ecobee is an Equal Opportunity Employer, adheres to Employment Standards Act, Accessibility for Ontarians with Disability Act, Occupational Health and Safety Act and maintains policies in Employee Privacy Workplace Violence, Harassment and Psychological Safety to ensure it provides safe and healthy working conditions for all employees.
Safety of women and girls	No risks identified at validation and/or during monitoring period related to the safety of women and girls in local community as a result of project activity.	There are no risks to the safety of women and girls associated with this project. This project activity involves existing and new ecobee smart thermostats receiving the free thermostat optimization platform (eco+) that reduces a home's incremental energy usage by controlling the HVAC equipment and thus poses no danger or harm to women and girls.
Safety of minority and marginalized groups, including children	No risks identified at validation and/or during monitoring period related to the safety of children, minority and marginalized groups in local community as a result of project activity.	There are no risks to the safety of children, minority and marginalized groups associated with this project. This project activity involves existing and new ecobee smart thermostats receiving the free thermostat optimization platform (eco+) that reduces a home's incremental energy usage by controlling the HVAC equipment and thus poses no danger or harm to children, minority and marginalized groups.
Pollutants (air, noise, discharges to water, generation of waste, release of hazardous materials)	No risks or impacts caused by pollutants identified as result of project activity.	There are no negative pollutant impacts associated with this project. This project activity involves existing and new ecobee smart thermostats receiving the free thermostat optimization platform (eco+) that reduces a home's incremental energy usage by controlling the HVAC equipment. Project activity reduces pollutants such as PM2.5 in addition to reducing CO ₂ emissions.

2.3 Respect for Human Rights and Equity

2.3.1 Labor and Work

Use the table below to demonstrate the project's respect for rights related to work and labor during the monitoring period.

Discrimination and sexual harassment	ecobee is a wholly-owned subsidiary of Generac Power Systems who is a member of the Responsible Business Alliance (RBA), and therefore adheres to the RBA's Code of Conduct commitment that includes establishing systems and structures necessary to ensure
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	the business does not infringe on workers' rights nor the wellbeing of their communities. ecobee is an Equal Opportunity Employer, adheres to Employment Standards Act, Accessibility for Ontarians with Disability Act, Occupational Health and Safety Act and maintains policies in Employee Privacy Workplace Violence, Harassment and Psychological Safety. This project activity involves existing and new ecobee smart thermostats receiving the free thermostat optimization platform (eco+) that reduces a home's incremental energy usage by controlling the HVAC equipment. The project activity does not directly impact the human rights of its customers and users of the thermostat and eco+.
Management experience	ecobee is a wholly-owned subsidiary of Generac Power Systems who is a member of the Responsible Business Alliance (RBA), and therefore adheres to the RBA's Code of Conduct commitment that includes establishing systems and structures necessary to ensure the business does not infringe on workers' rights nor the wellbeing of their communities. ecobee is an Equal Opportunity Employer, adheres to Employment Standards Act, Accessibility for Ontarians with Disability Act, Occupational Health and Safety Act and maintains policies in Employee Privacy Workplace Violence, Harassment and Psychological Safety. This project activity involves existing and new ecobee smart thermostats receiving the free thermostat optimization platform (eco+) that reduces a home's incremental energy usage by controlling the HVAC equipment. The project activity does not directly impact the human rights of its customers and users of the thermostat and eco+.
Gender equity in labor and work	ecobee is a wholly-owned subsidiary of Generac Power Systems who is a member of the Responsible Business Alliance (RBA), and therefore adheres to the RBA's Code of Conduct commitment that includes establishing systems and structures necessary to ensure the business does not infringe on workers' rights nor the wellbeing of their communities. ecobee is an Equal Opportunity Employer, adheres to Employment Standards Act, Accessibility for Ontarians with Disability Act, Occupational Health and Safety Act and maintains policies in Employee Privacy Workplace Violence, Harassment and Psychological Safety. This project activity involves existing and new ecobee smart thermostats receiving the free thermostat optimization platform (eco+) that reduces a home's incremental energy usage by controlling the HVAC equipment. The project activity does not directly impact the human rights of its customers and users of the thermostat and eco+.
Human trafficking, forced labor, and child labor	ecobee is a wholly-owned subsidiary of Generac Power Systems who is a member of the Responsible Business Alliance (RBA), and therefore adheres to the RBA's Code of Conduct commitment that includes establishing systems and structures necessary to ensure

	the business does not infringe on workers' rights nor the wellbeing of their communities. ecobee is an Equal Opportunity Employer, adheres to Employment Standards Act, Accessibility for Ontarians with Disability Act, Occupational Health and Safety Act and maintains policies in Employee Privacy Workplace Violence, Harassment and Psychological Safety. This project activity involves existing and new ecobee smart thermostats receiving the free thermostat optimization platform (eco+) that reduces a home's incremental energy usage by controlling the HVAC equipment. The project activity does not directly impact the human rights of its customers and users of the thermostat and eco+.
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2.3.2 Human Rights

ecobee's parent company Generac Power Systems, is a member of the Responsible Business Alliance¹⁰ (RBA), the world's largest industry collation dedicated to response business conduct in global supply chains and endorses a policy regarding the Fighting Against Forced Labour and Child Labour in Supply Chains Act. As a subsidiary of Generac, ecobee adheres to the RBA's Code of Conduct commitment that includes establishing systems and structures necessary to ensure the business does not infringe on workers' rights nor the wellbeing of their communities. The project activity does not involve any persons, work or labor that would contravene international human rights law, and UN declarations and conventions. This project activity involves an energy efficiency enhancement deployed through a free thermostat optimization platform (eco+ and "Adjust for Humidity") that reduces a home's incremental energy usage by controlling the HVAC equipment.

2.3.3 Indigenous Peoples and Cultural Heritage

Risks identified	Mitigation(s) or preventative measure taken
No risks identified.	This section is not applicable as the project activity itself does not infringe on the rights of indigenous peoples and their cultural heritage. This project activity involves an energy efficiency enhancement deployed through a free thermostat optimization platform (eco+ and "Adjust for Humidity") that reduces a home's incremental energy usage by controlling the HVAC equipment.

2.3.4 Property Rights

Risks identified	Mitigation or preventative measure(s) taken
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¹⁰ Responsible Business Alliance. Members. <https://www.responsiblebusiness.org/about/members/>

No risks identified.	This section is not applicable as the project activity itself does not infringe on the rights of indigenous peoples and their cultural heritage. This project activity involves an energy efficiency enhancement deployed through a free thermostat optimization platform (eco+ and “Adjust for Humidity”) that reduces a home’s incremental energy usage by controlling the HVAC equipment.
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2.3.5 Benefit Sharing

Summary of the benefit sharing plan	This section is not applicable as the project does not impact property rights.
Benefit sharing during the monitoring period	This section is not applicable as the project does not impact property rights.

2.4 Ecosystem Health

	Risk identified	Mitigation or preventative measure taken during the monitoring period
Impacts on biodiversity and ecosystems	No risk or impacts on biodiversity and ecosystems identified	This project activity involves an energy efficiency enhancement deployed through a free thermostat optimization platform (eco+) that reduces a home’s incremental energy usage by controlling the HVAC equipment. The project activity itself does not involve any risks or impacts to the environment, including biodiversity, ecosystems, soil degradation, soil erosion, water consumption and stress.
Soil degradation and soil erosion	No risk of soil degradation and soil erosion identified.	Same as above.
Water consumption and stress	No risk of water consumption and stress identified.	Same as above.
Usage of fertilizers	No risk to fertilizers identified.	Same as above.

2.4.1 Rare, Threatened, and Endangered species

Species and habitat	Not applicable as project is not located in or adjacent to habitats for rare, threatened or endangered species.
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Areas needed for habitat connectivity

Not applicable as project is not located in areas needed for habitat connectivity during the monitoring period.

2.4.2 Introduction of species

This section is not applicable to this project activity.

2.4.3 Ecosystem conversion

This section is not applicable to this project activity.

	Risks identified	Mitigation or preventative measure(s) taken
Ecosystem conversion	No risks identified.	This section is not applicable to this project activity. This project activity involves an energy efficiency enhancement deployed through a free thermostat optimization platform (eco+ and “Adjust for Humidity”) that reduces a home’s incremental energy usage by controlling the HVAC equipment.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

The project activity was fully operational during the monitoring periods of 03-March-2021 to 02-March-2023 and 03-March-2023 to 02-March-2025. There were no changes to the operations of the project activity that affected or impacted CO₂ emission reductions. The project activity continues to meet and comply with all methodology applicability conditions of VM0008.

3.2 Deviations

3.2.1 Methodology Deviations

Methodology Deviation 1

VM0008’s Category B – efficiency enhancements of the building envelope and central heating/cooling and applying the control group approach states “electricity and fuel bills be collected for both groups annually throughout the project crediting period.” Both groups refers to

1) the control group comprising of Dwellings that have not been weatherized as part of the Project and 2) the sample group comprising of Dwellings to be weatherized.

ecobee proposes an alternative path to metering¹¹. Internet of Things (“IoT”) technology has advanced since the latest revision of VM0008 v1.1 in 2012. Advanced technologies now have embedded metering which directly measures outputs. ecobee smart thermostats have accompanying telemetry data¹² which directly measures granular intervals of time that an HVAC system is running. Using this data is the most accurate approach to measure the project activity because telemetry data does not include the noise of other end uses and those impacts on energy use that are unrelated to the project activity.

Additionally, given the number of individual homes within the project boundary, it is not feasible to get utility data from all of them because not all utilities have installed advanced metering infrastructure (AMI) for residential customers (in these instances, the utility meter only measures monthly consumption). Where utilities have installed AMI meters for residential customers, not all utilities have established a protocol to share this data with third parties. Even in instances where utilities have an established protocol for sharing interval consumption data with third parties, the customer authorization process is so cumbersome that very few customers complete the steps required to do so.

As outlined in Appendix A, ecobee’s approach directly measures reductions in run-time of the HVAC equipment. This data is complemented by conducting a sample of actual changes in electricity consumption at homes with ecobee thermostats installed. As Figure 5 below shows, there is a very high correlation ($R^2 = 0.988$) between ecobee’s telemetry/runtime data and the associated utility meter data. This demonstrates that if ecobee can measure changes in run-time pre and post project, estimating the actual reductions in electricity and gas consumption will be very accurate.

¹¹ ecobee does not collect data for energy use at the whole home level (ie., energy bills) for both statistical and practical reasons. ecobee devices and more specifically, eco+ incrementally lowers heating and cooling consumption of HVAC equipment without altering energy usage of other appliances in the home – making it nearly impossible for the device to record energy usage of other sources. As a result, the only impact is likely to be on the energy usage of when the HVAC equipment is on or off. The signal ecobee is measuring is a small change in usage on the order of minutes per day. If the electricity and gas utility bills of customers were measured, the analysis would be introducing numerous random variables (or noise) to the regressions from other energy consuming appliances in the dwelling. The additional variables from other end uses would make an already small signal difficult to correctly estimate. ecobee only has access to telemetry runtime data of heating and cooling systems and does not have access to whole home utility level data.

¹² The telemetry data directly measures the HVAC run-time scheduled by an ecobee thermostat and no other measurements from other end uses (i.e., other appliances in the dwelling) that are unrelated to the project activity. ecobee’s telemetry data directly takes measurements of 5 minute granular intervals of a HVAC system runtime.

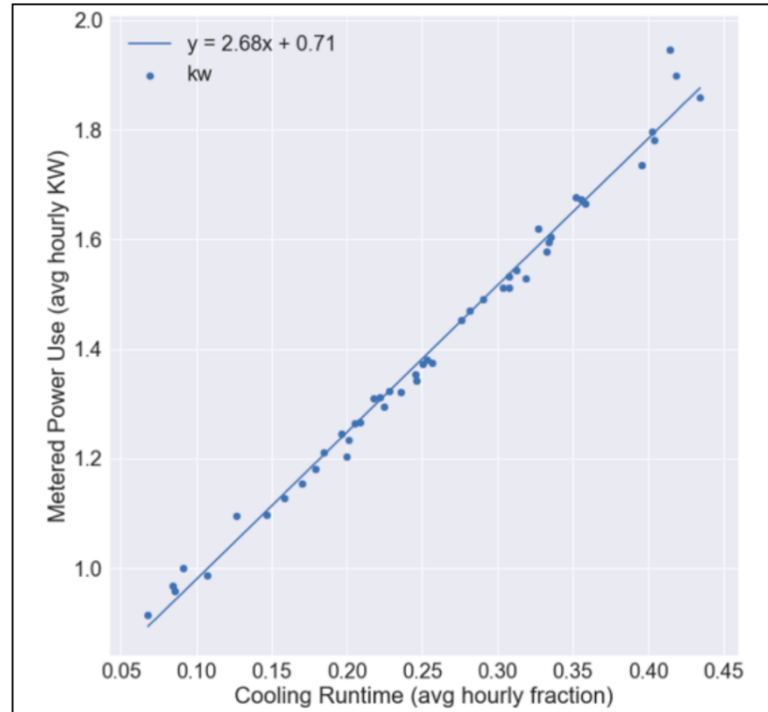


Figure 5 - Correlation of HVAC Runtime Data to Metered Data¹³

Thus, for this project activity, ecobee is seeking to deviate from VM0008 – Category B – Control Group Approach by not collecting electricity and fuel bills from the sample and control group annually to measure the difference in energy consumption between the two groups as the basis for calculating emission reductions. Instead, ecobee will collect data in run-time of HVAC appliances controlled by the ecobee smart thermostat.

Smart thermostats measure granular intervals of time that an HVAC system is running. To convert this to kWh, there needs to be an assumption on HVAC power draw. There has been extensive field research done in state technical reference manuals regarding average HVAC connected load at the state/regional level as detailed in Appendix B. Technical Reference Manuals (TRMs) are valuable resources for state regulators, utilities, and program administrators and implementers for estimating the energy and demand savings of end-use energy efficiency measures. Using these resources to determine average HVAC connected load, smart thermostat runtime data can be used as a proxy for retail meter data for measurement and verification (M&V) purposes as detailed in Appendix A.

In fact, thermostat runtime data is commonly used in this way for utility thermostat optimization evaluation, and the Department of Energy Uniform Method Protocol for evaluating smart thermostats specifically allows for the use of thermostat runtime data and recommends a uniform

¹³ Figure 5 - Correlation of HVAC Runtime Data to Utility Metered Data is showing percent of an hour the air conditioner is operating on the X-axis (0.25 equals to 15 minutes of cooling) and demand for electricity on the Y-axis. This graph demonstrates how the consumption of electricity is linear with cooling runtime as air conditioners consume a certain amount of electricity current when operating and consumes nothing when not operating.

method on how to use thermostat runtime data to quantify energy impacts.¹⁴ A 2019-2020 evaluation prepared for the Massachusetts Program Administrators stated that an impact analysis on smart thermostat programs “relied exclusively on thermostat telemetry data to estimate impacts after converting thermostat runtime data to estimated energy.” Table 3 below includes a sample of other examples of utility programs evaluated using thermostat runtime/telemetry data.

Table 3. Examples of North American Utility Programs Using Thermostat Telemetry for Measurement & Verification

Utility	Program Name	Link
Xcel Energy New Mexico	Saver’s Stat	https://www.xcelenergy.com/staticfiles/xcel-responsive/Company/Rates%20&%20Regulations/Regulatory%20Filings/NM-DSM-2017-Annual-Report-with-Attachments.pdf
Xcel Energy Colorado	Smart Thermostat Pilot	https://www.xcelenergy.com/staticfiles/xcel-responsive/Company/Rates%20&%20Regulations/Regulatory%20Filings/CO-Smart-Thermostat-Pilot-Evaluation.PDF
National Grid	ConnectedSolutions	http://ma-eeac.org/wordpress/wp-content/uploads/2017-NGrid-DR-Eval-Final-Report-2018-03-30.pdf
CPS Energy	Rush Hour Rewards Pilot Program	https://www.sanantonio.gov/Portals/0/Files/Sustainability/STEP/CPS-FY2015.pdf
Vectren	Residential Smart Thermostat Pilot	http://vectrened.com/assets/downloads/planning/irp/IRP-2018-smart-cycle-evaluation.pdf
United Illuminating	Smart Savers Rewards	https://energizect.com/sites/default/files/2022-07/CT%20X1932%20Demand%20Response%20EMV%20Support%20Study%20-%20Final%20Clean_060322.pdf

An illustrative example would be that ecobee runtime data shows a reduction of HVAC runtime of 0.1624 hours compared the baseline. The state/regional Technical Reference Manual lists the average HVAC system size (connected load) to be 3.6 kW. In order to obtain the impacts, the coefficient impacts can be multiplied by the connected load assumption.

$$-0.1624 \text{ hours} * 3.60 \text{ kW per hour} = -0.58 \text{ kW}$$

$$(\text{Runtime}_{\text{project,hrs}} - \text{Runtime}_{\text{baseline,hrs}}) * \text{ConnectedLoad}_{\text{kW}} = \text{Impacts}_{\text{kWh}}$$

Note that a negative Impact implies savings.

¹⁴ In section 3.2.2 of the protocol, the DOE supports the use of thermostat runtime/telemetry data as appropriate for measurement and verification by stating: “Because thermostat telemetry data are usually available for the periods before, during, and after the optimization for both participants and nonparticipants, evaluators can construct accurate baseline HVAC runtimes and estimate the optimization savings.” (<https://www.nrel.gov/docs/fy23osti/86175.pdf>)

Methodology Deviation 2

VM0008's Category B – efficiency enhancements of the building envelope and central heating/cooling and applying the Control Group approach states, "...the project shall not prevent or deny weatherization to any homeowner or individual for the purposes of maintaining the control group" and in a subsequent section, "...the sample group shall come from Dwellings included in the Project Activity. The control group shall be selected from dwellings not included in the project activity and shall have the following requirements established in section 1.9 Part A: 1) Participants shall not have the ability to "opt-in" to the control group".

The control group approach describes two (2) requirements that could be interpreted as being mutually exclusive and at odds to one another. Any project with a control group would deviate from VM0008 because it is impossible to satisfy two mutually exclusive requirements.

If "opting into the control group" is defined as declining the eco+ offer then ecobee can either:

- 1) Withhold the eco+ offer from some devices to create the control group (which is at odds with methodology because weatherization is denied), or
- 2) Rely on the fact that some ecobee owners decline the eco+ offer to construct the control group (which is at odds with methodology because ecobee is allowing them to decline the treatment)

Ultimately, the project can't have a control group unless you either deny someone the treatment or allow them to deny it. If denying the eco+ offer is "opting into the control group" then it is impossible to have a control group

As stated above, the methodology does not allow prevention or denial of treatment (i.e., weatherization) to any individual which means in the case of this project, ecobee cannot have a random control group as that would deny the treatment for the purpose of maintaining the control group. For this project activity, the treatment (i.e., software upgrade) was made available to all devices which users could decide to enable or opt-in.

For this analysis, the control and treatment group could only be constructed with devices that either 1) never enabled the feature or 2) enabled the feature. The control group was deliberately constructed of devices that never ever had the feature enabled and if or when the feature is enabled, they are removed from the control group. An interpretation of this could be that users not enabling the feature and not opting into the treatment group are effectively opting into the control group unknowingly. However, by this logic there could be no other ability to construct a control group for this project that does not also deny them the treatment.

Methodology Deviation 3

VM0008 describes that project activities in Category B are to demonstrate additionality using the performance method and shall calculate performance benchmark using Equation 1 and Equation 2.

The performance benchmark procedure described in Equations 1 and 2 implies a household-by-household analysis where the determination is made for a given housing unit. As the project activity is assessing hundreds of thousands of devices using a panel regression, it does not produce results for each individual device. Instead, the panel regression provides the average effect for the entire population. If DSA were to run each unit individually and average the results of the individual regressions, the result would converge to the same result as the panel regression.

However, the notion of an individual household analysis is complicated by the control group approach. In VM0008 Section 8 on page 26 states that “the difference in the energy consumption between the control group and the sample group each year will constitute the fuel and electricity savings for all Dwellings in the Project for that year and shall serve as the basis for calculating emission reductions.” Since DSA is modeling a difference across groups, individual unit analysis is not feasible. We don’t create pairs of treated and untreated homes that would allow for an individual comparison of one treated and one control device. The interpretation of the method is that the difference in the groups is the output of interest.

There are a number of elements of the methodology which are deliberately conservative, but the decision to run a panel regression is not one of them. A panel regression pools the homes of interest together and returns an estimate of their average performance (what we care about). With an individual house level approach, we would have to run each device in the treatment and control group separately and then perform a second step to average them. It’s effectively an order of operation questions.

Imagine the following example with average ages of people in a restaurant.

Group A: 36, 29, 51, 55

Group B: 22, 30, 47, 64

The mean of Group A is 42.75 years old. The mean of Group B is 40.75. The difference in average age is 2 years. We could also take difference of each member in Group A with the average of B. Or do paired difference and average the results. No method is more conservative than another because the underlying math is the same. The use of a panel regression is more practical, uses less computing power, returns easier to interpret results, and consistent with most econometric research of the past two decades.

This approach is also using the lower bound of the confidence interval, meaning all claimed energy savings are statistically significant and claims the lower bound of the margin of error. The approach applied instead of the Equation 1 and 2 aligns with the methodology in spirit with respect to additionality and performance benchmarking. The approach was adapted for the scope and scale of the analysis and applied an extremely conservative assumption to the results by calculating CO₂ avoidance with the lower bound of the savings estimate. Please refer to Section 5 of the MR for full details on how panel regressions are used to demonstrate additionality and why they are the most appropriate approach for this project activity.

3.2.2 Project Description Deviations

There has been no deviations from the project description found in the Project Design Document (PDD) during this monitoring period of 03-March-2023 to 02-March-2025.

3.3 Grouped Projects

Because this is a grouped project, the project proponent will specify the eligibility criteria for including individual homes into the project boundary. These criteria include homes (or “dwellings”) that have connected thermostats manufactured by ecobee, which have been upgraded with a thermostat optimization software platform and which are occupied as per the definition of “occupied” in the methodology. Environmental attributes generated by these

subprojects are therefore owned by the sole project proponent as stipulated in *Section 1.8. Ownership of Project Description* document. Subprojects that do not follow this eligibility criteria will be excluded from the grouped project. Project instances must also comply with all of the applicability criteria outlined in VM0008. Specific eligibility criteria include:

Eligibility Criteria (VCS Standard 3.6.16)	Confirmation
1) <i>Meet the applicability conditions set out in the methodology applied to the project.</i>	It will be demonstrated to the VVB that all new project activity instances meet the requirements as laid out in VM0008 Section 4 (Applicability Conditions).
2) <i>Use the technologies or measures specified in the project description.</i>	All new project activity instances will be required to use the ecobee smart thermostat eco+ energy efficiency enhancement technology.
3) <i>Apply the technologies or measures in the same manner as specified in the project description.</i>	All new project activity instances will use the ecobee smart thermostats in exactly the same manner – to reduce energy use for both heating and cooling, without reducing the overall level of service.
4) <i>Are subject to the baseline scenario determined in the project description for the specified project activity, geographic area and Same Building Stock.</i>	This will be the case for all new project activity instances within the project boundary of the contiguous USA.
5) <i>Have characteristics with respect to additionality that are consistent with the initial instances for the specified project activity and geographic area</i>	The same additionality factors, as specified in Section 3.5, will apply to all new project activity instances.

Grouped projects provide for the inclusion of new project activity instances subsequent to the initial validation of the project, therefore all new project activity instances will:

Eligibility Criteria (VCS Standard 3.6.17)	Confirmation
1) <i>Occur within one of the designated geographic areas specified in the project description</i>	All new project activity instances will be within the designated geographic area of the contiguous USA, as specified in the project description.
2) <i>Conform with at least one complete set of eligibility criteria for the inclusion of new project activity instances.</i>	All new project activity instances will comply with the eligibility criteria for inclusion outlined in table above: 1) Meet the applicability condition set out in VM0008 Section 4 (Applicability Conditions) 2) New project activity instances will use the ecobee smart thermostat eco+ Adjust for

	Humidity energy efficiency enhancement technology 3) New project activity instances will use the ecobee smart thermostat in exactly the same manner – to reduce energy use for both heating and cooling without reducing the overall level of service 4) Subject to the same baseline scenario as determined in the project description, within the project boundary of the contiguous USA and of Same Building Stock 5) Subject to the same additionality factors, as Specified in Section 3.5 and will apply to all new project activity instances.
3) Be included in the monitoring report with sufficient technical, financial, geographic and other relevant information to demonstrate compliance with the applicable set of eligibility criteria and enable sampling by the validation/verification body.	All new project activity instances will be: 1) Reported in the monitoring reports 2) Compliant with all applicability conditions set out in VM0008 and found in PD Section 3.2 3) Have sufficient technical information to perform emission impact quantification, analysis and enable sampling by VVB 4) Be within the project geographic boundary of the contiguous USA
4) Have evidence of project ownership, in respect of each project activity instance held by project proponent from respective start date of each project activity instance.	All new project activity instances included from the respective start date of March 03, 2021 and later will remain under ecobee's ownership as ecobee is the sole project proponent and sole owner of all carbon offsets generated from the project activity. As noted in PD Section 1.8, ecobee has the right to claim ownership over environmental attributes from eco+ through the following clause in its Terms of Service for ecobee Remote Applications, Including eco+ Section 6 (g) "ecobee shall be eligible to claim any qualifying environmental attributes, benefits, credits, awards or bounties from Program Administrators resulting from savings gained by the benefit of eco+"

5)Have a start date that is the same as or later than the grouped project start date	All new project activity instances will have a start date that is later than the initial grouped project start date of March 03, 2021.
6)Only be eligible for crediting from the later of start date of project activity instance or the start of the verification period in which they were added to the group project, through to the end of the total project crediting period	All new project activity instances will be eligible for crediting from the later of start date of project activity instance or the start of the verification period through to the end of the project crediting period. The validation and crediting period is March 03, 2021 to March 02, 2028.
7)Not be or have been enrolled in another VCS project	All new project activity instances will be confirmed to not be or have been enrolled in another VCS project.
8)Adhere to the clustering and capacity limited requirements for multiple project activity instances set out in VCS Standard 3.6.8 – 3.6.9	Per 3.6.8, all new project activity instances that are within 10km from each other will be included in a singular project as all new project instances are of the same project activity and owned by the same project proponent. Per 3.6.9, methodology VM0008 does not impose a capacity limits on project activity. This is not applicable to this grouped project and new project activity instances.

3.4 Baseline Reassessment

Did the project undergo baseline reassessment during the monitoring period?

☐ Yes

☒ No

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

The below tables below are monitoring parameters for the Performance Benchmark of Category B – efficiency enhancement of the building envelope and/or central heating/cooling system as outlined in methodology VM0008. Demand Side Analytics (DSA) applied a daily regression model rather than the annual comparison of treatment and control group consumption suggested in VM0008.

Data / Parameter	Compressor Cooling _{it} (Y _{it} in cooling regression)
------------------	--

Data unit	Seconds of air conditioning runtime for device i on date t
Description	This value is aggregate from the 5-minute telemetry ecobee maintains from all devices for each thermostat in the treatment and control group of the measurement sample.
Source of data	ecobee thermostats
Value applied	N/A - This is a measured value.
Justification of choice of data or description of measurement methods and procedures applied	HVAC runtime varies seasonally based on weather trends. DSA chose to model using daily level run-time data rather than annual totals as suggested in VM0008 to significantly improve accuracy. Modeling based on 365 days provides more data points for the regression to be more precise in estimating the impacts of the project activity across a range of weather conditions.
Purpose of data	This parameter is the dependent variable of the cooling regression.
Comments	N/A

Data / Parameter	Auxiliary Heat _{it} (Y_{it} in heating regression)
Data unit	For furnaces and boilers: Seconds of heating runtime for device i on date t For heat pumps: Seconds of auxiliary (backup) heating runtime for device i on date t
Description	This value is aggregate from the 5-minute telemetry ecobee maintains from all devices for each thermostat in the treatment and control group of the measurement sample.
Source of data	ecobee thermostats
Value applied	N/A - This is a measured value.
Justification of choice of data or description of measurement methods and procedures applied	HVAC runtime varies seasonally based on weather trends. DSA chose to model using daily level run-time data rather than annual totals as suggested in VM0008 to significantly improve accuracy. Modeling based on 365 days provides more data points for the regression to more precise in estimating the impacts of the project activity across a range of weather conditions.
Purpose of data	This parameter is the dependent variable of the heating regression.
Comments	N/A

Data / Parameter	Compressor Heat _{it} (Y_{it} in heating regression)
------------------	---

Data unit	For furnaces and boilers: Not applicable For heat pumps: Seconds of compressor (outdoor condensing unit) heating runtime for device i on date t
Description	This value is aggregate from the 5-minute telemetry ecobee maintains from all devices for each thermostat in the treatment and control group of the measurement sample.
Source of data	ecobee thermostats
Value applied	N/A - This is a measured value.
Justification of choice of data or description of measurement methods and procedures applied	HVAC runtime varies seasonally based on weather trends. DSA chose to model daily level run-time data rather than annual totals as suggested in VM0008 to significantly improve accuracy. Modeling based on 365 days provides more data points for the regression to be more precise in estimating the impacts of the project activity across a range of weather conditions.
Purpose of data	This parameter is the dependent variable of the heating regression.
Comments	N/A

Data / Parameter	Standard Deviation
Data unit	Seconds
Description	Confidence interval on the coefficients that estimate the effect of eco+ by year and month
Source of data	Calculated from panel regression
Value applied	95% confidence interval, clustered on household
Justification of choice of data or description of measurement methods and procedures applied	Panel regressions are the preferred approach for assessing energy consumption data and preferred method of casual inference used by the National Renewable Energy Laboratory. Regressions are the best approach to understand if a significant effect exists by using all observations that are treated (regardless if their individual difference is significant) and then look at the joint significance of the coefficient on treatment. The measurement took place on April 14, 2025 and was conducted by Hal Gordon and Nixon Candiales from DSA. Data and code available upon request.
Purpose of data	• Calculation of baseline emissions • Calculation of project emissions
Comments	Provide any additional comments

Data / Parameter	m_t
------------------	-------

Data unit	Dummy variable
Description	Year by month dummy variables
Source of data	ecobee thermostats
Value applied	1/0
Justification of choice of data or description of measurement methods and procedures applied	When used alone, this vector of dummies controls for time variant unobserved variables. When it is interacted with treatment, it allows DSA to get a dynamic treatment effect by year and month
Purpose of data	• Calculation of baseline emissions • Calculation of project emissions
Comments	N/A

Data / Parameter	C_i
Data unit	Dummy variable
Description	This is the treatment variable, complier
Source of data	ecobee thermostats
Value applied	1/0
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of data	• Calculation of baseline emissions • Calculation of project emissions
Comments	N/A

Data / Parameter	y_{it-1}
Data unit	Seconds
Description	Lagged Dependent Variables
Source of data	ecobee thermostats
Value applied	N/A

Justification of choice of data or description of measurement methods and procedures applied	Lagged dependent variables control for the level of demand for heating or cooling by individual and month. This is a critical control as the treatment and control groups showed slight differences in pre-treatment period. Including pre-treatment data and performance period data results in a more precise estimate of the project activity impact. Using household lagged dependent variables means DSA is able to control for each individual households idiosyncratic taste for heating and cooling. After controlling for these, what remains is the true effect of eco+ and “Adjust for Humidity”.
Purpose of data	Control of trends in heating and cooling consumption at the device level during the pre-treatment period • Calculation of baseline emissions • Calculation of project emissions
Comments	N/A

Data / Parameter	cdd_{it} hdd_{it} & h_{it}
Data unit	Degrees above 60°F for cdd_{it} , degrees below 60°F for hdd_{it} and relative humidity for h_{it}
Description	Weather variables.
Source of data	ecobee thermostats
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	By separately estimating the coefficients on cold days and warm days, we allow for maximum flexibility in estimating the impact of disparate weather, which is critical because this helps to control for slight differences in geography
Purpose of data	• Calculation of baseline emissions • Calculation of project emissions
Comments	N/A

Data / Parameter	d_t
Data unit	Dummy variable
Description	Day of week dummy
Source of data	ecobee thermostats
Value applied	N/A

Justification of choice of data or description of measurement methods and procedures applied	Day of week is recognized as an important factor in estimating daily demand for heating and cooling as weekday and weekend residential demand profiles often look different since residents spend more time at home during weekends.
Purpose of data	• Calculation of baseline emissions • Calculation of project emissions
Comments	N/A

Data / Parameter	Number of fuel type • Electric heat (heat pump) • Fossil fuel heat (no heat pump)
Data unit	Calculated at the device level
Description	Indicator variable for having a heat pump
Source of data	ecobee thermostats
Value applied	1 or 0
Justification of choice of data or description of measurement methods and procedures applied	We calculate impacts separately for homes with heat pumps and homes with no heat pumps
Purpose of data	• Calculation of baseline emissions • Calculation of project emissions
Comments	N/A

Data / Parameter	Number of Dwellings in Building Stock b
Data unit	Number of houses
Description	Number of houses with the treatment (ie., treatment group) in sampling analysis
Source of data	ecobee thermostats
Value applied	Number of homes with eco+(treatment) in random sample analysis: • Non-heat pump cooling: 38,673 • Heat pump cooling: 18,619 • Non-heat pump aux heat: 38,673 • Heat pump compressor heat: 18,619

	Heat pump aux heat: 18,619
Justification of choice of data or description of measurement methods and procedures applied	The total building stock is used, along with the lower bound of the estimated impact of eco+ and the emissions rate, to calculate the total tons of emissions abated.
Purpose of data	- Calculation of baseline emissions - Calculation of project emissions
Comments	N/A

4.2 Data and Parameters Monitored

The list of monitored parameters are the same as the list of available parameters listed above in Section 4.1.

Data / Parameter	Compressor $Cooling_{it}$ (Y_{it} in cooling regression)
Data unit	Seconds of air conditioning runtime for device i on date t
Description	This value is aggregate from the 5-minute telemetry ecobee maintains from all devices for each thermostat in the treatment and control group of the measurement sample.
Source of data	ecobee thermostats
Value applied	This is a measured value with mean of 8,550.07 and standard error of 1.39
Justification of choice of data or description of measurement methods and procedures applied	HVAC runtime varies seasonally based on weather trends. DSA chose to model using daily level run-time data rather than annual totals as suggested in VM0008 to significantly improve accuracy. Modeling based on 365 days provides more data points for the regression to be more precise in estimating the impacts of the project activity across a range of weather conditions.
Purpose of data	This parameter is the dependent variable of the cooling regression. The panel regression is described in Section 3.4, 3.5 and 3.6.
Comments	N/A

Data / Parameter	Auxiliary $Heat_{it}$ (Y_{it} in heating regression)
Data unit	For furnaces and boilers: Seconds of heating runtime for device i on date t

	For heat pumps: Seconds of auxiliary (backup) heating runtime for device i on date t
Description	This value is aggregate from the 5-minute telemetry ecobee maintains from all devices for each thermostat in the treatment and control group of the measurement sample.
Source of data	ecobee thermostats
Value applied	This is a measured value, with mean of 4,036.6 and standard error of 0.84
Justification of choice of data or description of measurement methods and procedures applied	HVAC runtime varies seasonally based on weather trends. DSA chose to model using daily level run-time data rather than annual totals as suggested in VM0008 to significantly improve accuracy. Modeling based on 365 days provides more data points for the regression to be more precise in estimating the impacts of the project activity across a range of weather conditions.
Purpose of data	This parameter is the dependent variable of the heating regression. The panel regression is described in Section 3.4, 3.5 and 3.6.
Comments	N/A

Data / Parameter	Compressor $Heat_{it}$ (Y_{it} in heating regression)
Data unit	For furnaces and boilers: not applicable For heat pumps: Seconds of compressor (outdoor condensing unit) heating runtime for device i on date t
Description	This value is aggregate from the 5-minute telemetry ecobee maintains from all devices for each thermostat in the treatment and control group of the measurement sample.
Source of data	ecobee thermostats
Value applied	This is a measured value with mean of 1,370.58 and standard error of 0.63
Justification of choice of data or description of measurement methods and procedures applied	HVAC runtime varies seasonally based on weather trends. DSA chose to model daily level run-time data rather than annual totals as suggested in VM0008 to significantly improve accuracy. Modeling based on 365 days provides more data points for the regression to be more precise in estimating the impacts of the project activity across a range of weather conditions.

Purpose of data	This parameter is the dependent variable of the heating regression. The panel regression is described Section 3.4, 3.5 and 3.6.
Comments	N/A

Data / Parameter	Standard Deviation
Data unit	Seconds
Description	Confidence interval on the coefficients that estimate the effect of eco+ by year and month
Source of data	Calculated from panel regression
Value applied	95% confidence interval, clustered on household, with means of -204.67 for <i>Compressor cooling_{it}</i> mean of -296.91 for <i>Auxiliary heat_{it}</i> and a mean of -385.95 for <i>Compressor heat_{it}</i> for the second monitoring period (11/2023 to 3/2025)
Justification of choice of data or description of measurement methods and procedures applied	Panel regressions are the preferred approach for assessing energy consumption data and preferred method of casual inference used by the National Renewable Energy Laboratory. Regressions are the best approach to understand if a significant effect exists by using all observations that are treated (regardless if their individual difference is significant) and then look at the joint significance of the coefficient on treatment. The measurement took place on April 14, 2025 and was conducted by Hal Gordon and Nixon Candiales from DSA. Data and code available upon request.
Purpose of data	• Calculation of baseline emissions • Calculation of project emissions
Comments	Provide any additional comments

Data / Parameter	m_t
Data unit	Dummy variable
Description	year by month dummy variables
Source of data	ecobee thermostats
Value applied	1 or 0
Justification of choice of data or description of measurement methods and procedures applied	When used alone, this vector of dummies controls for time variant unobserved variables. When it is interacted with treatment, it allows DSA to get a dynamic treatment effect by year month

Purpose of data	- Calculation of baseline emissions - Calculation of project emissions
Comments	N/A

Data / Parameter	C_i
Data unit	Dummy variable
Description	The treatment variable, complier
Source of data	ecobee thermostats
Value applied	1 or 0
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of data	- Calculation of baseline emissions - Calculation of project emissions
Comments	N/A

Data / Parameter	y_{it-1}
Data unit	Seconds
Description	Lagged Dependent Variables
Source of data	ecobee thermostats
Value applied	Measured value with means of 8,118.63 for <i>Compressor cooling</i> _{it} mean of 4,543.93 for <i>Auxiliary heat</i> _{it} and a mean of 1,391.23 for <i>Compressor heat</i> _{it}
Justification of choice of data or description of measurement methods and procedures applied	Lagged Dependent variables control of the level of demand for heating or cooling by individual and month. This is a critical control as the treatment and control groups showed slight differences in pre-treatment period. Including pre-treatment data and performance period data results in a more precise estimate of the project activity impact. Using household lagged dependent variables means DSA is able to control for each individual households idiosyncratic taste for heating and cooling. After controlling for these, what remains is the true effect of eco+ and Adjust for Humidity.

Purpose of data	Control of trends in heating and cooling consumption at the device level during the pre-treatment period - Calculation of baseline emissions - Calculation of project emissions
Comments	N/A

Data / Parameter	cdd_{it} hdd_{it} & h_{it}
Data unit	Degrees above 60°F for cdd_{it} , degrees below 60°F for hdd_{it} and relative humidity for h_{it}
Description	Weather variables
Source of data	ecobee thermostats
Value applied	Measured values with means of 6.80 for cdd_{it} mean of 7.3 for hdd_{it} and a mean of 66.94 for h_{it}
Justification of choice of data or description of measurement methods and procedures applied	By separately estimating the coefficients on cold days and warm days, we allow for maximum flexibility in estimating the impact of disparate weather, which is critical because this helps to control for slight differences in geography
Purpose of data	- Calculation of baseline emissions - Calculation of project emissions
Comments	N/A

Data / Parameter	d_t
Data unit	Dummy variable
Description	Day of week dummy
Source of data	ecobee thermostats
Value applied	1 or 0
Justification of choice of data or description of measurement methods and procedures applied	Day of week is recognized as an important factor in estimating daily demand for heating and cooling as weekday and weekend residential demand profiles often look different since residents spend more time at home during weekends.
Purpose of data	- Calculation of baseline emissions - Calculation of project emissions

Comments	N/A
Data / Parameter	Number of fuel type - Electric heat (heat pump) - Fossil fuel heat (no heat pump)
Data unit	Calculated at the device level
Description	Indicator variable for having a heat pump
Source of data	ecobee thermostats
Value applied	1 or 0
Justification of choice of data or description of measurement methods and procedures applied	We calculate impacts separately for homes with heat pumps and homes with no heat pumps
Purpose of data	- Calculation of baseline emissions - Calculation of project emissions
Comments	N/A

Data / Parameter	Number of Dwellings in Building Stock <i>b</i>
Data unit	Number of houses
Description	Number of houses with the treatment (ie., treatment group) in random sampling analysis
Source of data	ecobee thermostats
Value applied	Number of homes with eco+ (treatment) in random sampling analysis: - Non-heat pump cooling: 38,673 - Heat pump cooling: 18,619 - Non-heat pump aux heat: 38,673 - Heat pump compressor heat: 18,619 - Heat pump aux heat: 18,619 Source: Summary statistics of sample provided by ecobee
Justification of choice of data or description of	The total building stock is used, along with the lower bound of the estimated impact of eco+ and the emissions rate, to calculate the total tons of emissions abated.

measurement methods and procedures applied	
Purpose of data	• Calculation of baseline emissions • Calculation of project emissions
Comments	N/A

4.3 Monitoring Plan

Method of Measurement

To cause an HVAC system to run, ecobee thermostats power specific relays on the back of the device corresponding to specific HVAC systems. When a relay is powered, its corresponding system runs. In regular operation, ecobee thermostats record whether a relay is powered or unpowered. This information is discretized on device to 5 minute intervals. Every 15 minutes, a packet of data corresponding to the previous 3 intervals is sent from the device to ecobee's servers. This data is then consumed on the server side, preprocessed, and stored in a Google Cloud BigQuery table known as ISM (Interval Status Messages). It is from the ISM table that runtime data was pulled for the purposes of this analysis. Broadly, the server side processing can be abstracted as 3 steps:

1. Read and store data sent from devices
2. Validate data
3. Group data by thermostat and writes data to table

The architecture diagram in Figure 6 illustrates the flow of data from its reception on the server side to its storage in the ISM table.

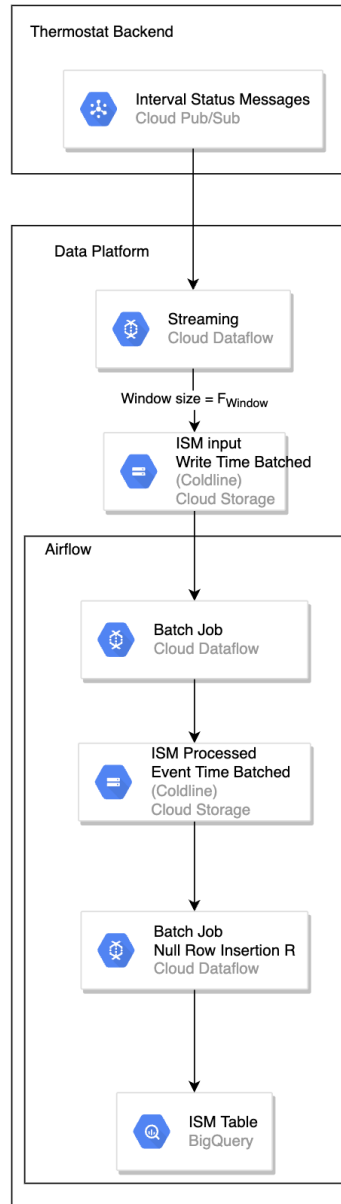


Figure 6 - Architecture diagram to illustrate the flow of data from its reception on the server side to its storage in the ISM table

Organizational Responsibilities and Competencies

The above pipeline is managed by the Data Platform team at ecobee. This team is comprised of skilled professionals in the field of Data Engineering. The transmission of the data from the device to the server is managed by the Firmware team. This team is comprised of skilled professionals in the field of firmware development, some of whom have been overseeing this process for over 5 years without issue.

The core technical team involved in this project activity includes the following individuals:

1. Senior Machine Learning Engineer as the project activity's Technical Lead. They are required to have extensive knowledge and expertise in the fields of applied math's,

- statistics, machine learning, data science, data analysis data engineering, software engineering, orchestration, automating and hold at least a Bachelor's Degree in Engineering and Applied Science or a related degree. They are considered the leading company authority and internal expert on the operation of ecobee's "Adjust for Humidity" feature which has helped customers save energy without sacrificing thermal comfort.
2. Senior Manager, Embedded Systems (Firmware), who is responsible for overseeing the team of embedded firmware engineers that develop the software that goes on the thermostats that collects the data and delivers it to the ecobee servers. They are required to have extensive knowledge and expertise in the fields of software engineering, platform development, software design and architecture, agile development and holds a least a Bachelor's Degree in Computer Science or a related degree.
 3. Engineering Manager, Data Platform, who is responsible for maintaining the data pipelines for any new library/data upgrades, creating monitoring policies to ensure the team is aware of if the pipeline is not working as intended and maintaining the data storage where the thermostat runtime data gets stored as an end result. They are required to have extensive knowledge and expertise in the fields of data engineering, software engineering, data modelling and hold at least a Bachelor's Degree in Computer Science or a related degree.

Oversight Policies and Internal Auditing

Firmware: The Firmware Team executes a series of integration tests that are run using ecobee's thermostat simulation platform to ensure that, for a given version of firmware, the runtime values sent from the device in simulation are as expected.

Server: Along with managing the automated execution of the pipeline itself, the Data Platform team also manages an alerting policy to ensure pipeline health. If the number of unprocessed messages exceeds 1,000,000 (this corresponds to ~2 minutes of inactivity/delay), an alert is sent to a person on call. There is a person on call 24 hours a day, every day of the year. The Data Platform team also monitors that the ISM table upload pipelines run successfully. Any issues with this pipeline are committed to be resolved within 24 hours.

The pipelines that populate the ISM table also include writes to cold storage (as illustrated in the architecture diagram above). This ensures that if ISM data is ever lost, it can be recreated using the exact data from which it was originally generated. While this provides a safety net in the case of larger issues, this has never been required. In addition to this, there exist integration tests for all 3 pipelines used for ISM table population. Any time a change is made to any of these pipelines, these tests are run to ensure that the pipelines still operate as desired.

Data Recording: Runtime data fields that are recorded are listed in the data dictionary presented in Table 4 below.

To prevent data anomalies, ecobee employs the use of Protocol Buffers (protobuf in short). Messages are composed using a pre-defined and agreed-upon format which is then put into code and handed to all parties involved in the message transfer. This means message is:

- composed inside the thermostat firmware into a "protobuf message",
- converted to a transferable format that cannot be modified (i.e. serialized),
- sent over / forwarded to the Data Platform team for storage,

- deserialized and decomposed using the same rules that were used to compose it,
- stored in the database forever (indefinitely)

This eliminates the process of dealing with erroneous data and data is assured to be abided to expected format 100% of the time. It avoids the human intervention of correcting the data by 100%. Internal auditing procedures and policies for handling non-conformances:

There are two ways the team handles non-conformances:

- 1) Threshold for the data: If the data is empty and does not reach the threshold of 655.375 MB it is discarded for that time period.
- 2) Map values as is for all the data. To make data more readable the following procedures are followed:
 - Convert temperature and humidity readings to Fahrenheit (°F)
 - Combine readings from many sensors associated with a thermostat into a single row corresponding to that particular thermostat
 - Remove non-ascii characters from string values
 - Map null to null strings

ecobee tracks the failures that occur due to threshold and they are very rare (occurring less than <1% of the time).

Sampling and Data Transfer Process

ecobee maintains a database containing thermostat metadata. This includes data points such as thermostat location, HVAC equipment types, heating/cooling mode, and other relevant thermostat information. This table is populated upon installation and registration of a new thermostat and updated whenever a user makes a change. For a given monitoring period, ecobee uses this table to filter for eligible devices (i.e., units) within the period that meet the project activity's prescribed criteria and applicability conditions in order to perform emission quantification analysis.

HVAC malfunctions were not explicitly considered during runtime determination. HVAC malfunctions are independent of the eco+ intervention so it would occur at equivalent rates in the treatment and control group. The strength of utilizing a control group approach lies in the fact that HVAC malfunctions occur in both the control and treatment group. This ensures that the estimated impact of the eco+ remains unbiased, as any influence of malfunctioning units is distributed equally across both groups. Consequently, the presence of malfunctions does not disproportionately affect the treated population and thereby safeguarding the validity of the impact estimate.

The data sets that were securely transferred from ecobee's databases to DSA include a sample of 111,262 randomized devices that meets criteria (listed in Table 4 below) for defined control group and treatment group. The sampling data and protocol are outlined below.

Data Transfer Process between ecobee and DSA:

1. ecobee's Technical Lead developed SQL queries to obtain data requested by DSA (found in Table 4: Data Request) while maintaining user anonymity.

2. Queries were executed in ecobee's private BigQuery. Query results were written to private BigQuery Tables.
3. Tables were exported to Google Cloud Storage bucket hosted by ecobee.
4. DSA was granted viewer access to the specific bucket containing relevant data. No other permissions were granted to DSA.
5. Link to Google Cloud bucket was passed securely to DSA using Keybase.

The sampling protocol had the following steps:

1) Pre-Screening of eligible thermostat devices:

Eligible thermostats devices that were used for panel regression had to meet the following criteria:

- Runtime data is available continuously from March 1, 2018 to March 31, 2025.
- Device location is within the continuous United States (one of the lower 48 states) with a valid postal zip code
- There was no change in location (home/dwelling) over the five-year period
- Device is connected to either a heating or cooling system
- Device is in a home / location where all devices either enabled eco+ or did not

For the accepters (i.e., the treatment group)

- Device received the eco+ offer and enabled eco+ by March 1, 2021
- The "Adjust for Humidity" feature was enabled for at least 95% of the days since eco+ was enabled and activated. Based on date range, this means the feature was enabled for ~700 days depending on the exact invitation and acceptance date

For the deniers (i.e., the control group)

Either:

- Devices that do not have eco+ at all
- Devices that received eco+ but did not enable any of the features

2) Sampling Protocol:

The data for the panel regression came from a random sample of ecobee customers:

- The sample were randomly selected from the millions of ecobee customers who were active from early March 2018 to late October 2023.
 - 80,000 customers without heat pumps, evenly divided between those who opted into eco+ (treatment group) and those who did not (control group)
 - 31,828 customers with heat pumps, where 20,000 were in treatment group and 11,282 were control in control
- DSA was provided with daily thermostat data for each customer starting on March 01, 2018 until March 31, 2025. For heat pump owners, three dependent variables were made available: 1) seconds of cooling, 2) seconds of heating, and 3) seconds

of auxiliary heating, while non-heat pump customers have 4) seconds of cooling and 5) seconds of auxiliary heating.

3) Post-Screening of Data.

Any daily observations that had mean temp below -20 and above 115°F were dropped¹⁵.

Table 4: Data Request

Data Item	Description
1. Device Characteristics and Configuration	a) Thermostat ID (hashed) b) Home/Location ID c) Time Zone d) State e) Postal Code f) Group (Acceptor or Denier) g) Has Heat Pump (Boolean) h) Allow Heat Pump with Aux Heat (Boolean) i) Eco+ Enabled Date (null for Deniers) j) Home Details (type, size, floors, bedrooms, age, occupants) if available k) Climate Zone (if available) l) Cool stages (n) m) Heat stages (n)
2. Eco+ Features Data	At the daily level: a) Thermostat ID (hashed) b) Date c) Comfort Level (Slider Level) d) Adjust for Humidity Enabled (Boolean) e) Occupancy Enabled (Boolean) f) TOU Feature Enabled (Boolean) g) DR Feature Enabled (Boolean)
3. Thermostat Runtime Data	At the <u>hourly</u> level: a) Thermostat ID b) Datetime UTC

¹⁵ Such high and low temperature reading composed a vanishingly small number of readings in the sample. Of the 57,812,467 customer days in the sample, only 329 had temperature readings that were lower than -20 or higher than 115, which means DSA dropped 0.0005% of the sample. These drops were made because many of them were obviously anomalous, ranging from -2449°F (nearly 2000 degrees colder than absolute zero) to 142°F (ten degrees warmer than the all time high measured on Earth). ecobee relies on Apple Weatherkit and Darksky Weather API for these daily outdoor temperature measurements, and occasional erroneous values are impossible to avoid. By dropping 0.0005% of observations with obviously wrong readings, DSA avoid errors in this weather data from making the weather controls less effective.

- c) Observations (count of 5-minute records collapsed across the day. 12 indicates a complete series for the hour)
- d) Compcool1 (sum of seconds in hour)
- e) Compcool2 (sum of seconds in hour)
- f) Auxheat1 (sum of seconds in hour)
- g) Auxheat2 (sum of seconds in hour)
- h) Compheat1 (sum of seconds in hour)
- i) Compheat2 (sum of seconds in hour)
- j) Cooling Setpoint (Average)
- k) Heating Setpoint (Average)
- l) Outdoor Temperature (Average)
- m) Outdoor Relative Humidity (Average)
- n) Indoor Humidity (Average)
- o) Indoor Temperature at the Thermostat without Adjust for Humidity (Average)

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

Demand Side Analytics, LLC and Using Panel Regressions to Quantify Project Activity Emission Reductions

ecobee has enlisted Demand Side Analytics, LLC (DSA), a third-party evaluation, measurement and verification firm, to analyze and quantify this project activity's emission reductions. DSA was enlisted for their expertise on data driven research and insights and on predictive and casual analytics. DSA offers extensive expertise in evaluation, measurement and verification (EM&V), distributed energy resource integration, transmission and distribution system planning, targeting analytics, and benefit cost analysis. The strength of their team is that they provide access to true experts. The team includes data scientists, applied statisticians, economists, and engineers. The experts involved in the development of the regression model and quantification of ecobee's project activity emission reductions include:

- Partner and Applied Statistician whose work is centered around estimating the impacts of demand side interventions to alter the way homes and businesses use energy. Their experiences include over 10+ years in the energy industry performing evaluation, measurement and verification (EM&V) on a wide variety of demand response, dynamic pricing, and energy efficiency programs implemented across North America. They specialize in statistical analysis of energy usage data, sampling, experimental design, and benefit cost modeling and is comfortable working in Stata, SAS, SQL, and Excel. They hold Bachelor's of Science in Psychology and a Masters of Science in Applied Statistics from Kennesaw State University.

- Consultant, who has extensive training in causal inference and experimental design and has experience working in economics at both think tanks and in the private sector. They hold a Ph.D in Agriculture and Resource Economics from UC Berkeley, where their research focused on using large datasets to study energy efficient and climate-friendly consumer products, and where they taught a course on energy markets.

Quantitative Analyst, Data Scientist with a background in economics, specializing in causal inference research designs applied to real-world problems and has contributed to demand response evaluations in multiple states. Their expertise lies in leveraging predictive modeling techniques, including machine learning algorithms, to drive actionable insights from complex datasets and they hold a Master's Degree in Economics from the University of Texas at Austin.

DSA's quantification model employs a panel regression using lagged dependent variables¹⁶ and clustered standard errors to jointly measure 1) additionality and 2) quantify the impacts of ecobee devices with eco+ and "Adjust for Humidity".

For this project activity, panel regressions are the most suitable approach for evaluating energy usage of energy efficiency activities of HVAC systems in buildings. As noted by the National Renewable Energy Laboratory¹⁷ and given the wealth of data recorded by ecobee devices, regressions are the best approach to control for unobserved trends in electricity use and allows for more flexibility in controlling for temperature rather than relying on a correction factor. It is the only approach suitable to assess energy consumption data. Regression, specially ordinary least squares (OLS) regression, is the preferred method of casual inference according to the Nobel Prize winners Josh Angrist and his co-author Jorn-Steffen Pischke. In their book Mostly Harmless Econometrics, "regression can be used to approximate experiments in the absence of random assignment." OLS regression provides the best linear unbiased estimators (the Gauss-Markov theorem¹⁸) and when there are omitted variable bias due to non-random selection. Regression

¹⁶ In a panel regression analysis, a lagged dependent variable refers to the value of the dependent variable from a previous time period or period of observation. Panel data typically involves observing multiple entities (such as individuals) over multiple time periods. When including a lagged dependent variable in a panel regression model, it is essentially using past values of the dependent variable as an explanatory variable for its current or future values.

¹⁷ Agnew, K. and Goldberg, M. (2016). Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol – The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. National Renewable Energy Laboratory. <https://www.nrel.gov/docs/fy17osti/68564.pdf>

¹⁸ The Gauss-Markov theorem states that the OLS estimator is the best linear unbiased estimator and give five conditions: linearity, random sampling, non-collinearity, exogeneity, and homoscedasticity.

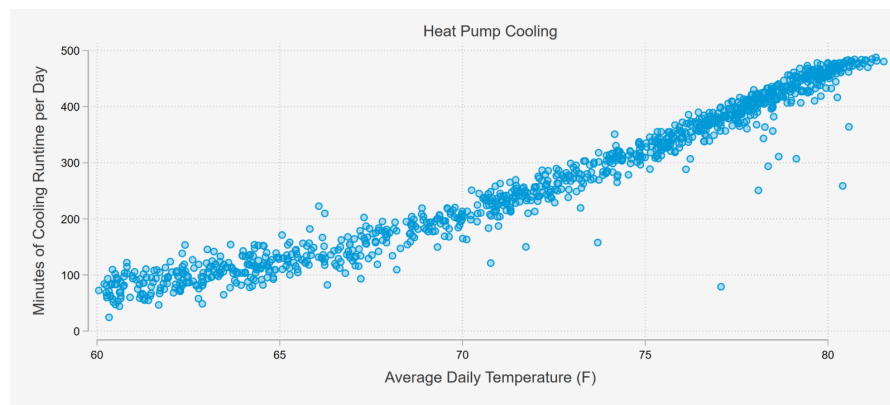
1. Linearity: this condition is never possible to prove, but the assumption is a common one used in all regression analysis. This means that all parameters have a mathematical transformation that allows them to have the same marginal effect regardless of value. The relationship between outdoor temperature and heating/cooling consumption across the heating/cooling range is widely accepted to follow a linear relationship. We create the CDD and HDD terms to separate cooling and heating operation, allowing and satisfying the linearity assumption. The figure below shows average daily cooling runtime as a function of outdoor temperature and reveals a classic linear relationship.

allows the analysis to include controls that correct for bias and discovery of causal relationship. It is for these reasons that the project activity is employing a panel regression to quantify the baseline and project emissions.

Panel regressions enable DSA to assess whether the effect of eco+ in each month differs significantly from zero, thereby confirming that any observed changes in electricity usage are additional. VM0008 defines a performance benchmark above average, representing energy savings that dwellings are unlikely to achieve with 90% certainty without the project. DSA employs regressions to rigorously test the project's impact each month at a 95% confidence level (more rigorous than 90%), ensuring that changes in electricity usage measured are indeed in addition to the baseline usage.

This approach is analogous to Equation 1 and Equation 3 of VM0008 Performance Method, because the energy usage of homes and impact of the treatment is distributed normally. As the usage data is normally distributed, Equation 1 was considered instead of Equation 2. As a reminder, Equation 1 computes x , the benchmark:

$$x = a + 1.85\sigma$$



2. Random Sampling: DSA took random samples conditional on treatment from the population, so this condition is satisfied. Note, this assumption does not assume random assignment of treatment.
3. Non-Collinearity: the regressors are not perfectly correlated with each other. This condition is satisfied by dropping one of the values of the months from the vector of month variables when calculating the month fixed effects. Without dropping one month from that control vector, the regression would be impossible to solve for. This has no effect on the values of the estimates of βt and only slightly changes the interpretation of the betas calculated for the time fixed effects, which are of no interest to us anyway. This is a very common way of dealing with the non-collinearity condition.
4. Exogeneity: This is the most important condition and is often referred to as the zero conditional mean assumption. This states that there are no confounding variables that are omitted from the regression that are included in the error term. For instance, if weather was omitted then the effect of weather on HVAC runtime would then be loaded into the error term. If we had a truly random experiment, that might be okay, since treatment and control samples would experience the same weather on aggregate, but since we have non-random treatment, we need to include weather in the regression. Other non-observable factors likely played into the decision to self-select into treatment, so we use a lagged dependent variable as well, which allows us to not only use the controls of non-treated customers, but the control of the treated customers before treatment, which removes the selection into treatment bias and maintains exogeneity.
5. Homoskedasticity: This condition states that the error term is consistent across all values of the explanatory variables. If it was not, then we might calculate error terms that are too low. In practice, this condition is almost never met, so researchers use different standard errors that are larger and robust to heteroskedasticity, essentially increasing the standard errors to account for this variation in the size of the error term. We do this when we cluster our standard errors by household. By making this correction, we may fail to reject the null hypothesis when we should have (type 2 error), but we ensure that our 95% confidence intervals never reject the null hypothesis when it should not have (type 1 error).

Where a is the average performance of all housing stock, σ is the standard deviation of the performance of all housing stock. a is defined as: “the annual average percent savings in weather normalized energy consumption in Dwellings from the Same Building Stock over the three most recent years for which data are available”, and should be corrected for any statewide changes in electricity usage for the current year by “the statewide percent increase in electricity consumption, as reported by the U.S. Department of Energy or other recognized authority, will be added to the value of the average performance”.

To translate that into DSA’s frequentist approach, a is the average performance of all treated homes in the treatment period if they had been untreated. While a is ultimately unknowable, DSA makes an estimate of a by taking a sample of all ecobee customers, sampling equally from 1) customers who accepted the treatment and 2) customers who did not the treatment (ie, control group), and using that to estimate the lagged dependent variable OLS regression:

$$y_{it} = \beta_t m_t c_i + y_{it-1} m_t + m_t + cdd_{it} + hdd_{it} + h_{it} + d_t + \varepsilon_{it}$$

Ultimately a is analogous to the estimated value of y_{it} (the number of seconds the heating or cooling that is running for person i on day t) when $c_i = 0$ (where c_i is an indicator value of treatment) and where t is a post treatment time period. To ensure this estimate is weather normalized, DSA includes weather controls (heating degree days hdd_{it} , cooling degree days cdd_{it} , and humidity h_{it}). To ensure this is the same building stock, DSA uses the exact same homes, but before treatment as controls (in the form of the lagged dependent variable (y_{it-1})). To ensure this is controlled for the current year statewide trend in energy savings, DSA uses the untreated controls to help estimate year/month (m_t) and day of week (d_t) controls.

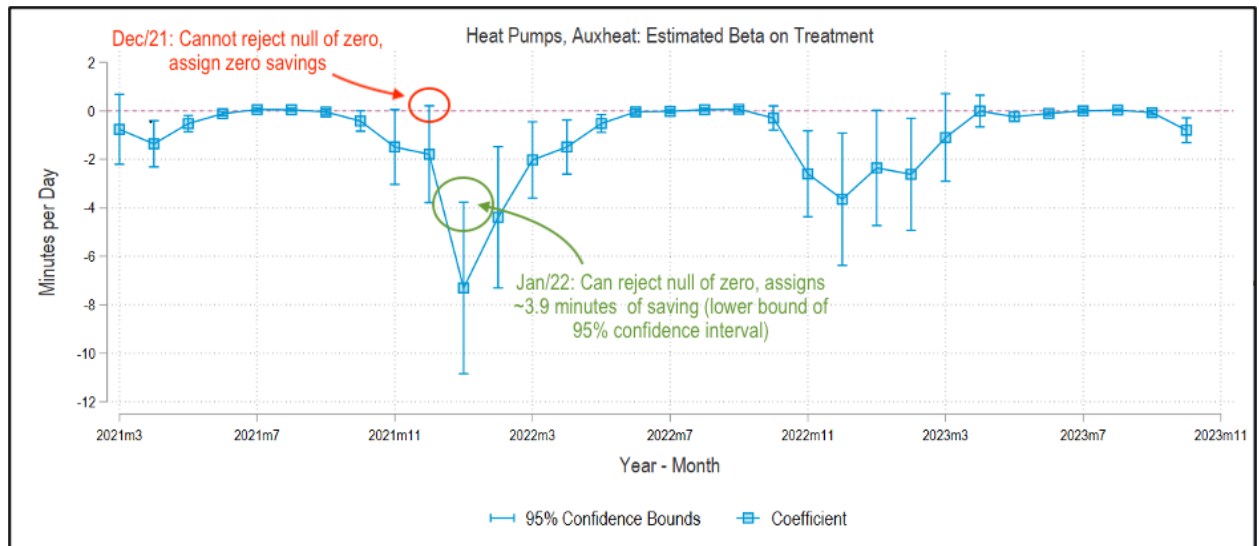
As this is a frequentist methodology, DSA does not use the standard deviation of a , but does apply something analogous and more direct. DSA calculates the estimated effect of being in the treatment group during treatment (that effect is represented by β_t), as the impact of using the eco+ technology. Since this is a regression, that estimated treatment effect has its own standard deviation. DSA only count estimates of β_t if they are statistically different than zero at the 95% confidence level. This test which measures the noisiness of the treatment effect is analogous to adding 1.85σ in Equation 1, but in VM0008’s 1.85σ , it measures the total home energy usage as a whole. VM0008’s Equation 1 is less conservative than DSA’s frequentist methodology because it includes false positive results from the energy usage of an entire home, while DSA limits energy usage to only the treatment effect of eco+ on the HVAC equipment.

The statistical test that DSA runs on each month/cooling/heating method’s estimate of β_t is also analogous to VM0008’s Equation 3 which describes that, in order for each home to be considered additional, the home’s change in energy usage must be above the benchmark. Rather than conducting an energy usage evaluation on every home in the project activity for additionality, DSA uses an approach whereby they either 1) reject the null hypothesis that eco+ treatment has a positive savings effect on the population of treated homes for a certain type of HVAC use in a certain month, or 2) cannot reject the null hypothesis that there is no effect from eco+ on the population as a whole, in which DSA continues to assume that the effect of eco+ is zero for cooling or heating method in a certain month.

This avoids including some number of homes that, by random chance, exhibit low energy usage during months where no treatment effect is observed on the whole for a certain month (for instance, the effect of eco+ on heating during summer months). Since DSA is estimating the effect of treatment on treated homes, it makes sense to include all of the treated homes in that estimate. If DSA excluded homes that have a lower sensitivity to treatment, then DSA would likely

accept an effect that in reality, did not exist and their estimate of the size of the effect would go up. While all treated homes are included in the additionality estimate, those with smaller reductions in energy usage drag down the total estimate of the impact of the treatment. DSA applies greater conservatism in their methodology than VM0008's Equation 3. For instance, if a month's β_t passes the statistical 95% confidence test, DSA's best guess for the true value of being in the treatment group is β_t . Instead of using β_t , DSA uses the lower bound of the confidence interval around β_t . This would be analogous to reducing the additionality estimates for each dwelling by 1.96σ (1.96 because DSA use 95% CI, not the 90% suggested by VM0008).

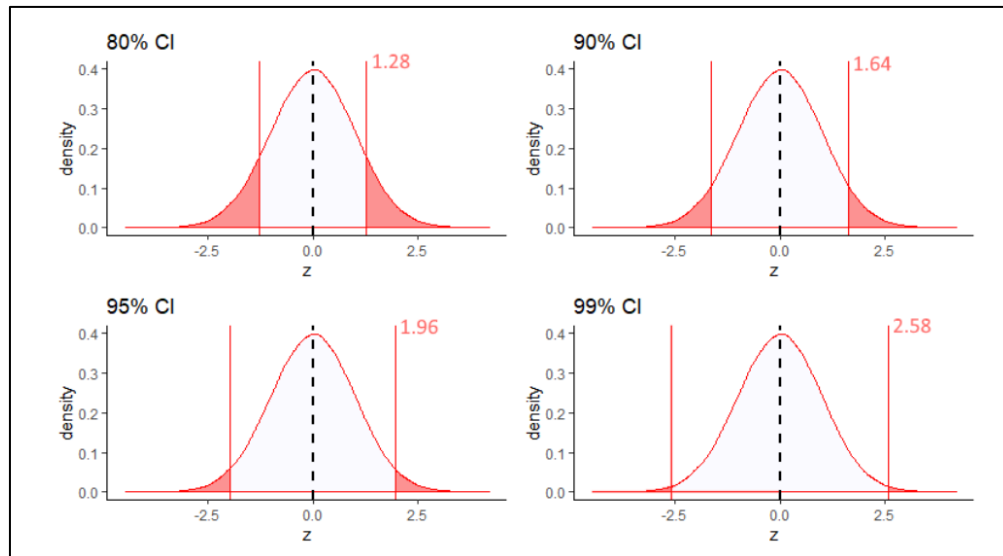
As an illustration, the point estimates of β_t for treatment's effect on the usage of heat pump-auxiliary heat customers is displayed in the figure below. The whiskers around each point estimate represent the 95% confidence interval. For most months, no effect of treatment is estimated, but the coldest months have larger treatment effects. For January 2022, DSA estimates a treatment effect of nearly 3.9 minutes a day, and since the confidence interval does not include zero, they reject the null and accepts the lower bound of the point estimate as the true value of treatment for that month (circled in green). However, in the month of December 2021, DSA estimates an impact of treatment of 2 minutes per day, but the null hypothesis of zero is included in the confidence interval (circled in red), so they cannot reject the null, and therefore assign no savings to the auxiliary heat components of heat pumps systems for December 2021.



While it's true that there were some customers in the treatment group in December 2021 that probably had large reductions in the use of their heat pump-auxiliary heating after controlling for weather, time fixed effects, and customers past usage (the lagged dependent variable), in aggregate, DSA cannot say with 95% confidence that the change over the entire population of treated customers was significant enough to be the result of treatment, and not due to chance alone for the particular month.

Use of the lower bound of the 95% confidence is more conservative than using the lower bound of the 90% confidence interval because the 95% confidence interval is wider. The image below shows four identical normal distributions. With a 90% confidence interval, 10% of the area under the curve sits outside the interval. With a 95% confidence interval, only 5% of the area is outside the interval. This means that the lower bound of 95% confidence interval is further left. Selecting the lower bound of the 90% confidence interval would (a) mean a less stringent performance benchmark than 95% confidence interval meaning fewer months are zeroed out and (b) returns a

lower estimated quantity of CO₂ avoided for those month that satisfy the performance benchmark.



Sampling for Panel Regression Model

When eco+ was rolled out to all ecobee customers, customers had the option to enable the software or not enable it, effectively self-selecting and creating a control group (deniers of eco+) and treatment group (acceptors of eco+) to sample from. To minimize bias introduced by the non-randomized selection into the treatment group, DSA constructed the sample for the panel regression by randomly selecting customers from the treatment groups (i.e., acceptors of eco+) and from the control groups (i.e., deniers of eco+)¹⁹. Between equipment type, control group and treatment group, a total of 111,282 devices were used for sampling.

While it is possible for customers in the treatment to turn on and off the function intermittently, keeping them in the treatment will not bias our results. While it is true that customers toggling off the feature would lower the total savings realized by eco+, their inclusion in the treatment during those times that the feature is off will attenuate our estimate of the treatment in the regression towards zero, which lowers our estimate of the impact of eco+. An alternate way to think of this is that the treatment we are actually measuring is not eco+, but the customers' acceptance of being in the eco+ group. If all customers in the treatment group toggled eco+ off everyday, then we presumably would measure no difference between the treatment and control, and would record no savings.

¹⁹ DSA constructed the control and treatment group for sampling analysis between “compliers – have eco+” and “deniers – do not have eco+”. Upon randomly selecting devices into control and treatment groups, DSA recognized a significant imbalance with respect to compliers and deniers amongst the Maryland population with 21% deniers and 2% compliers. From a statistical perspective, this would have created source of bias due to the oversampled control group from Maryland with only 2% in treatment and 19% in controls. Effectively, if any unobserved variable affects all Maryland devices differently than non-Maryland devices throughout the experiment, the control group will result with different outcomes than the treatment group in ways that are not related to the treatment, but related to the control group dominated by Maryland. As a solution and to ensure identical looking control and treatment groups and to minimize bias, DSA determined that Maryland would not be included for the sampling analysis and would omit these devices from the regression. A total of 12,282 Maryland devices were excluded from the analysis (10, 871 deniers and 1,411 compliers). The analysis in the PD takes into account the exclusion of Maryland for a final total of 111,282 devices split between heat pumps, not-heat pumps, compliers (treatment) and deniers (control).

Equipment Type	Control	Treatment
Not Heat Pump	40,000	40,000
Heat Pump	11,282	20,000
Total	51,282	60,000

Figure 7 illustrates how ecobee sampled both the treatment and control groups to perform the panel regression analysis. The sample size decreased between monitoring periods for two primary reasons. First, some customers initially assigned to the control group enabled the eco+ feature, leading to their exclusion from the analysis. Second, there was a natural rate of attrition due to customers closing their accounts. This left DSA with 95.8% of the original treatment group and 58.26% of the original control group. The attrition is larger in the control group because of the exclusion of those who turn eco+ on. The original samples were designed to be large enough to absorb this amount of attrition, and since the attrition reflects the reality of the population as a whole opting into eco+ and closing their accounts, this is not expected to introduce any bias. If anything, this may slightly increase the size of the confidence intervals. Since DSA uses the lower bound as their point estimate, the only expected impact is a slight attenuation towards zero of their estimate of the impact of eco+.

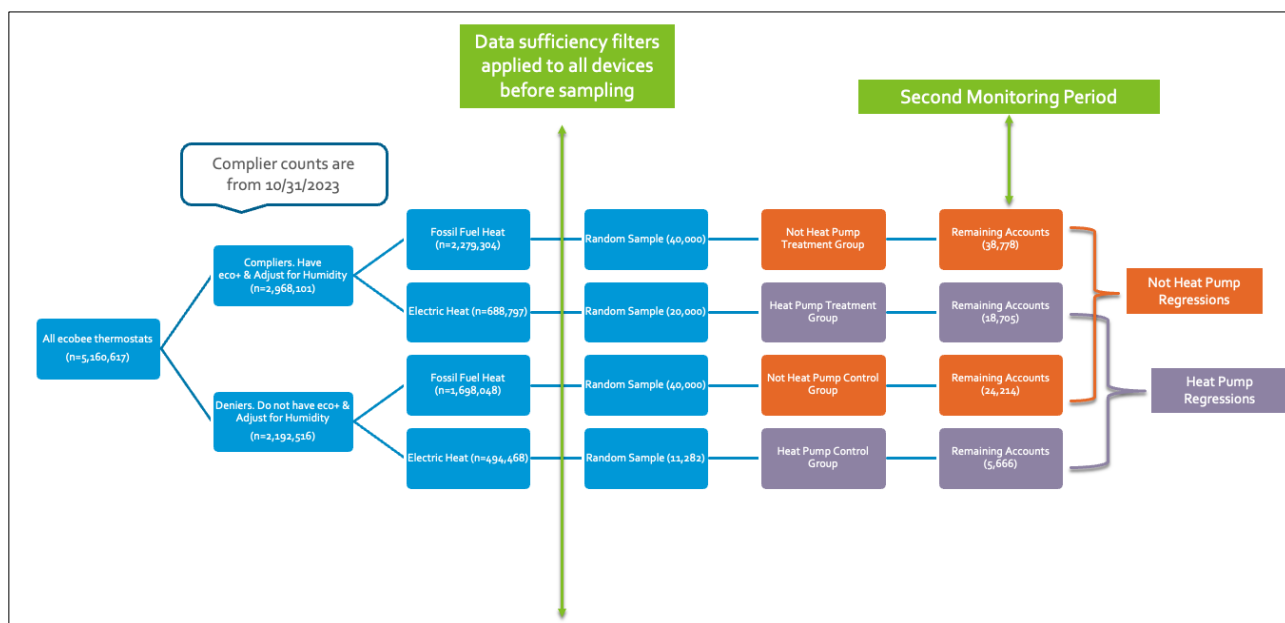


Figure 7. Sampling for control and treatment groups

Source: Summary Statistics of data provided by ecobee

Identification of HVAC Equipment and Heating Sources for Emission Quantification Analysis

The emission quantification analysis measures the project activity's impact based on the HVAC equipment and fuel sources connected to ecobee devices. For the purpose of this project activity, the emissions analysis considers impact only from fossil fuel furnaces (ie., natural gas furnaces) and electric heat pumps only (i.e., electricity).

ecobee identifies the type of HVAC system based on wiring configuration during installation of the device. An electric heat pump system is detected by the smart thermostat when a wire has been installed in the O/B terminal and a furnace / boiler is detected in lieu of the O/B terminal wire. Upon registration of the device, customers are asked to confirm their HVAC systems as either having a furnace /boiler or an electric heat pump. Once the customer confirms their HVAC

system, the response is recorded in ecobee's back-end systems under the variable "hasHeatPump" – 'TRUE' indicating a heat pump or 'FALSE' indicating a furnace/boiler.

As of March 02, 2025²⁰ (the end of second monitoring period), 2,455,105 (74.92%) of total ecobee devices were recorded to be connected to furnaces / boilers ('hasHeatPump - FALSE') indicating 'fossil fuel heat' and 821,888 (25.08%) were connected to heat pumps ('hasHeatPump - TRUE') indicating 'electric heat'.

The latest U.S. EIA's RECS²¹ which provides information on the adoption of heating equipment and fuel types across the US, reports that of the 117.74M surveyed homes that uses space heating equipment, 53.26M (or 45%) uses natural gas air furnaces, 16.13M (or 13.6%) uses electric heat pumps and 13.82M (or 11.7%) uses electric air furnaces. For the purposes of quantifying the emissions impacts result and based on what ecobee is able to determine from wiring configuration, devices connected to furnaces are assumed to have natural gas (ie., fossil fuel heat) and devices connected to heat pumps are assumed to have electricity (ie., electric heat). This was the conservative approach as electric furnaces are 2.5x more carbon intensive due to how inefficient electric furnaces are at heating²².

Sampling Group as Representative of ecobee population

This is intended to provide rationale and DSA's statistical analysis demonstrating that the sample group used to construct the panel regression model remains representative of the current ecobee device population in March 2025.

The sample size was reviewed and approved at validation, and the same set of devices is used across monitoring periods with new monitoring data drawn for each period. The analysis below addresses the two outstanding representativeness criteria: (1) geographic spread and (2) climate zone.

The original sample group was drawn as a random sample from the ecobee customer base in 2021. As the total project eligible ecobee device population has grown to 3.2 million, DSA assess whether the sample group remains representative by testing whether the geographic composition of the customer base has changed materially between March 2021 and March 2025. A stable state-level geographic distribution implies a stable climate zone distribution, demonstrating geographic stability therefore simultaneously addresses the climate zone representativeness criterion.

Not HeatPumps

HeatPumps

²⁰ The daily footprint list with the variables "USBuildingClimateZone", "hasHeatPump", "x_date" and "n_tstats" was shared with DSA to perform emission quantification analysis and to construct the CO₂_Dashboard file. The daily footprint list records exact number of active and registered devices and is not a national or regional average count of ecobee devices.

²¹ U.S. Energy Information Administration (EIA). Consumption and Energy. Residential Energy Consumption Survey (RECS). Space Heating in U.S homes, by climate region, 2020. <https://www.eia.gov/consumption/residential/data/2020/hc/pdf/HC%206.6.pdf>

²² Demand Side Analytics' calculates carbon intensity difference between electric furnaces and gas furnaces. Assumptions are 60000 BTU/hour and 1000 lbs per MWh. Electric uses 17.58 kWh/hr and gas uses 0.06 MMBtu/hr. CO₂ emission rates are 117 lbs/MMBtu of gas and 1000 lbs/MWh of electricity. CO₂ emissions from 1 hour of usage is: 17.585 lbs of CO₂ for 1 hour of electric furnace runtime and 7.02 lbs of CO₂ for 1 hour of gas furnace runtime. The ratio is 2.50.

State	Mar-21	Mar-25
AL	0.7%	0.9%
AR	0.5%	0.6%
AZ	2.3%	2.7%
CA	11.5%	10.3%
CO	3.2%	3.1%
CT	1.2%	1.1%
DC	0.2%	0.2%
DE	0.2%	0.2%
FL	3.7%	3.8%
GA	3.4%	3.7%
IA	0.6%	0.7%
ID	0.7%	0.9%
IL	8.4%	7.1%
IN	2.0%	2.3%
KS	0.7%	0.7%
KY	0.5%	0.5%
LA	1.1%	1.0%
MA	3.4%	3.0%
MD	1.8%	1.9%
ME	0.2%	0.2%
MI	6.3%	5.4%
MN	2.4%	2.4%
MO	1.7%	2.0%
MS	0.4%	0.4%
MT	0.2%	0.2%
NC	2.3%	2.4%
ND	0.1%	0.1%
NE	0.4%	0.4%
NH	0.6%	0.6%
NJ	3.5%	3.1%
NM	0.5%	0.6%
NV	2.6%	4.1%
NY	3.6%	3.3%
OH	3.1%	2.9%
OK	0.7%	0.7%
OR	1.4%	1.4%
PA	2.4%	2.6%

State	Mar-21	Mar-25
AL	3.9%	4.1%
AR	0.8%	0.8%
AZ	7.2%	6.1%
CA	4.1%	6.7%
CO	0.2%	0.3%
CT	0.3%	0.5%
DC	0.3%	0.3%
DE	0.3%	0.3%
FL	17.8%	17.0%
GA	8.1%	7.7%
IA	0.1%	0.1%
ID	0.3%	0.3%
IL	1.1%	1.0%
IN	1.8%	1.7%
KS	0.4%	0.3%
KY	1.5%	1.4%
LA	0.4%	0.5%
MA	1.3%	2.5%
MD	4.0%	3.7%
ME	0.0%	0.0%
MI	0.4%	0.3%
MN	0.1%	0.3%
MO	1.4%	1.5%
MS	0.6%	0.5%
MT	0.0%	0.1%
NC	8.5%	8.8%
ND	0.0%	0.0%
NE	0.3%	0.2%
NH	0.2%	0.3%
NJ	0.3%	0.4%
NM	0.2%	0.2%
NV	0.8%	1.2%
NY	0.8%	1.1%
OH	1.7%	1.4%
OK	0.4%	0.4%
OR	1.5%	1.4%
PA	2.1%	2.0%

RI	0.3%	0.3%
SC	0.9%	0.9%
SD	0.1%	0.1%
TN	1.1%	1.1%
TX	11.1%	11.6%
UT	2.1%	2.0%
VA	1.8%	2.0%
VT	0.2%	0.2%
WA	1.7%	1.6%
WI	2.1%	2.1%
WV	0.2%	0.2%
WY	0.1%	0.1%
Total	100.0%	100.0%

RI	0.0%	0.1%
SC	5.0%	4.7%
SD	0.0%	0.0%
TN	3.4%	3.3%
TX	9.2%	8.0%
UT	0.2%	0.4%
VA	5.9%	5.5%
VT	0.0%	0.1%
WA	1.9%	1.9%
WI	0.1%	0.2%
WV	0.6%	0.5%
WY	0.0%	0.0%
Total	100.0%	100.0%

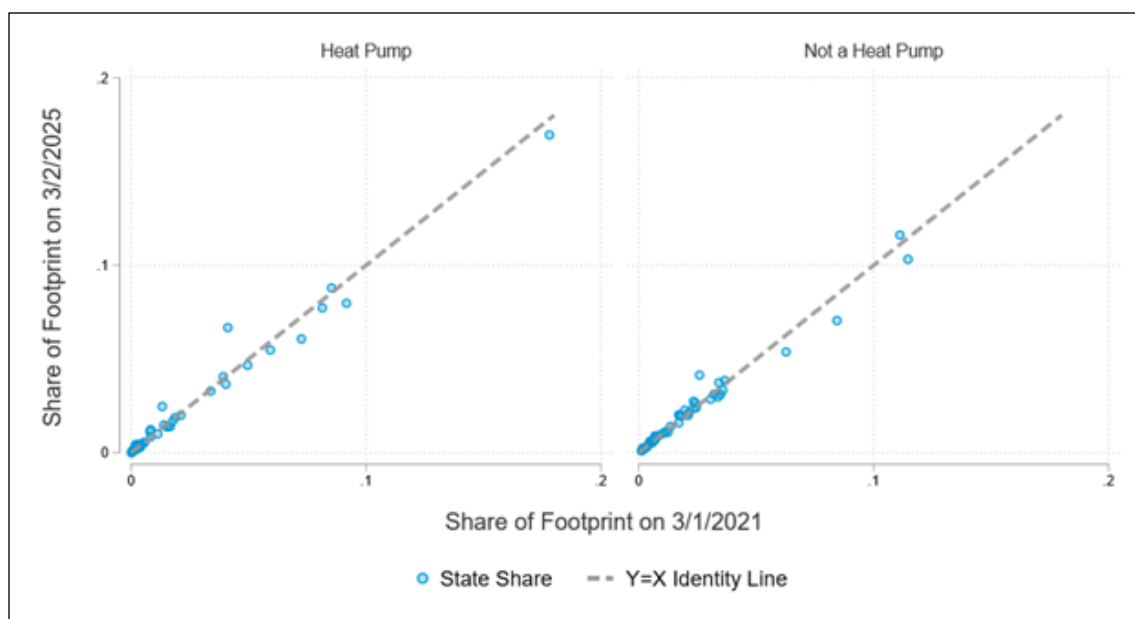
DSA applied a chi-square test of independence to assess whether the distribution of customers across states changed between two periods March 2021 and March 2025. The test was run separately for “Heat Pump” and “Non-Heat Pump” customers. Since the data covers the full ecobee device population, DSA reports the Cramer's V – an effect size measure on a 0-to-1 scale – as the primary indicator of practical difference. Values close to zero indicate that the two distributions are virtually identical and constitute strong evidence of no meaningful change.

Table 5. Test of Independence by HVAC type

HVAC Type	Chi-Square	DF	P-Value	Cramer's V	Interpretation
Non Heat Pumps	12,744.3	48	<0.001	0.0606	Negligible
Non Heat Pumps	5,544.5	48	<0.001	0.0725	Negligible

While the counts are increasing due to the population increase, the p-value of the chi-square test is significant, the **Cramer's V** statistics shows both those differences are not meaningful. Both HVAC groups return Cramer's V values close to 0 (Non-Heat Pump: 0.0606; Heat Pump: 0.0725), indicating that the geographic distribution of customers is virtually unchanged and remain stable between 2021 and 2025. The scatter plots show all states shares clustering tightly along the 45-degree line of no change, providing visual confirmation of this stability.

Figure 7. Share of ecobee device footprint across monitoring periods



Based on the results above, the geographic composition of the customer base is materially stable between March 2021 and March 2025 for both the Heat Pump and Non-Heat Pump customer groups. Given that U.S. climate zones are geographically determined, this finding simultaneously demonstrates stability in climate zone coverage. Based on this analysis, it can be inferred that the 2021 random sample satisfies the VM0008 representativeness criteria for geographic spread and climate zone and remains valid for use in the second monitoring period.

Considerations and Variables for Panel Regression

DSA received from ecobee a comprehensive set of data points, including average daily outdoor temperature, humidity, device's zipcode, self-reported square footage of home and type of residence. While ecobee does not gather income data from users, DSA has access to dwelling locations and some self-reported information regarding home size and type. DSA determines the control and treatment group's income by utilizing the device zip code and assigning each zip code to the 2021 census household income quantiles²³. Given that customers choose to participate in the program voluntarily, it is natural to observe slight variations in home types and locations between the treatment and control groups. To mitigate potential biases stemming from self-selection, DSA incorporates controls for time, weather, and lagged dependent variables in the panel regression.

As demonstrated in Table 6, the customers in the treatment group are slightly more likely to live in detached and larger residences. Nonetheless, both control and treatment groups predominantly reside in similar types of housing. They share more similarities with each other as ecobee thermostat users than with the broader U.S. population.

²³ Please see Section 3.2 – Applicability of Methodology of the PD for full details on how 2021 Census Quintiles were applied to determine the control and treatment groups income.

Table 6: Self-Reported Housing Stock

Housing Type	Control	Treatment
Apt/Condo	9.41%	9.56%
Detached	57.07%	59.89%
Semidetached	15.14%	10.97%
Other/NA	18.38%	19.58%
Total	100%	100%
Mean Sq Ft	2,568	2,665

When dividing the control and treatment group into five climate regions (Table 7) there is significant coverage in all US climate regions, with slight distribution differences between the two groups. This varied distribution of geographies could be the result of weather influencing the results of the panel regression, so extra care has been taken into consideration to control for variances. DSA used weather controls, time fixed effects and lagged dependent variables to control for any bias introduced by the self-selection of the control and treatment groups.

Table 7: Climate Regions

Climate Region	Control	Treatment
Cold	31.40%	34.90%
Dry	12.69%	12.78%
Hot Humid	15.84%	21.23%
Marine	10.95%	4.70%
Mixed Humid	29.12%	26.38%
Total	100.00%	100.00%

Time-fixed effects²⁴ account for variation that is consistent across households but varies across time, like, for example, the state of the national economy or the changing of the seasons. Because the population of customers has a wide geographic footprint, customers are likely to experience very different weather within the same month, so month fixed effects are not sufficient by themselves. Therefore, DSA chose to include weather as an independent variable in their regression models as well. This adjustment allows the analysis to incorporate weather controls while accounting for variations in equipment type and heating/cooling functions. DSA created five (5) separate regression models to analyze impact of the program on the five types of HVAC equipment runtime:

- a) Electric heat pumps:
 - 1) seconds of cooling, 2) seconds of heating, 3) seconds of auxiliary heating
- b) Fossil fuel furnaces:

²⁴ “Pre-existing time dynamic variation” refers to variations of weather across geography. Time-fixed effects can control for the monthly variation that is consistent across geographies, but if treatment and control have slightly different geographies, and those geographies have different weather in the same month, a month fixed effect will not correct for those differences. DSA included weather as independent variable in the model and why the analysis allowed those weather controls to vary by equipment type and by heating and cooling function.

- 4) seconds of cooling and 5) seconds of heating.

$$y_{it} = \beta_t m_t c_i + y_{it-1} m_t + m_t + cdd_{it} + hdd_{it} + h_{it} + d_t + \varepsilon_{it}$$

Where:

- y_{it} is the outcome of interest in seconds for person i on day t ,
- m_t is an indicator variable for year-month,
- c_i is an indicator variable for treatment, so the coefficients of interest are β_t . A separate coefficient is calculated for each year month m_t of the treatment period. The rest of the terms are control variables, which have their own coefficients (which are not notated in order to increase legibility).
- y_{it-1} is the lagged dependent variable, which is the mean of all dependent variable values in the pre-period in the month that day t is in for household i .
- cdd_{it} is a continuous variable for the number of degrees above 60 (anything below is zero) while hdd_{it} is the number of degrees below 60 (anything above is zeroed out),
- h_{it} is humidity,
- d_t is an indicator of day of week, and
- ε_{it} is the error term.

To address the serial correlation within individual observations y_{it} , DSA clusters the standard errors by individual i . This method introduces conservatism into the model by significantly widening the confidence intervals for each coefficient. As a result, it increases the likelihood that DSA will fail to reject the null hypothesis $\beta_t = 0$.

VM0008's performance benchmark aims to ensure that the project activity delivers genuine energy savings rather than results influenced by random variation, advocating for rejecting the null hypothesis at the household level based on changes in annual energy consumption. DSA extends this principle by applying a 95% confidence interval at the aggregate level, enhancing the rigor and conservatism compared to a 90% confidence interval.

In DSA's approach, β_t is calculated for each year and month and must achieve 95% statistical significance to be considered statistically significant; otherwise, the coefficient is set to zero. This approach ensures that measured changes in electricity usage are indeed additional due to the project activity.

To ensure conservative estimates in emission reduction calculations, DSA uses the lower bound of the 95% confidence interval, which is calculated by subtracting 1.96 times the standard error from the point estimate. The point estimate represents the best estimate of eco+'s impact, while the confidence interval indicates the range where DSA is 95% confident the true impact lies. By selecting the lower end of this interval, DSA adopts an extremely conservative stance on the impact of eco+.

Defining Pre-Period and Post-Period for Emission Quantification Analysis

ecobee undertook a pilot study in 2019 and 2020 to assess the results of eco+. During this period, eco+ platform was deployed across the USA to a large pilot group of ecobee thermostats to demonstrate the capabilities of the platform. The pilot included a population of approximately 240,000 ecobee thermostats.

The pre-period was defined as January 1, 2018 to July 14, 2019 (period before eco+ pilot study), and the treatment period defined as March 1, 2021 to October 31, 2023 (period after eco+ full roll out). When reviewing the pre-period, the treatment and control devices have similar HVAC usage patterns. For instance, the control group of non-heat pumps has slightly higher cooling demands (Figure 8) and the control group with heat pumps have higher demand for auxiliary heat when experiencing colder temperatures (Figure 11). The most notable variance between treatment and control group is amongst customers using their heat pump for compressor heating²⁵, where the control group of heat pumps uses more compressor heat than the treatment group of heat pumps using compressor heating.

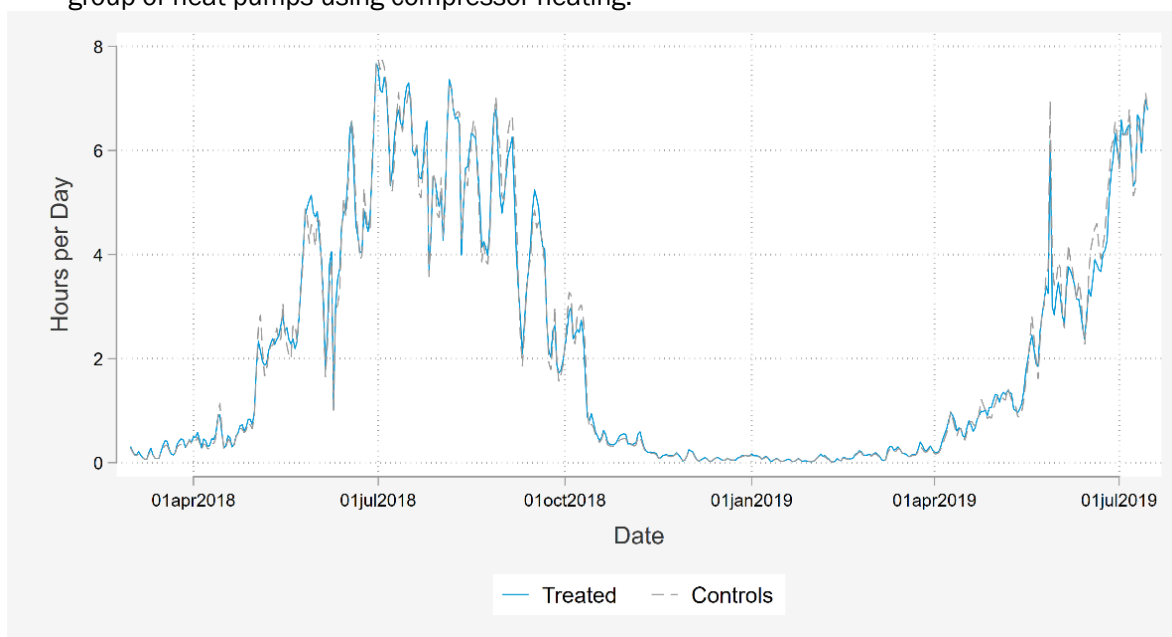


Figure 8: Pre-Period Comparison – Cooling, No Heat Pump

²⁵ “Compressor heating” for heat pump owners refers to the runtime of the heat pump itself, as opposed to runtime of the auxiliary heater component of the heat pump.

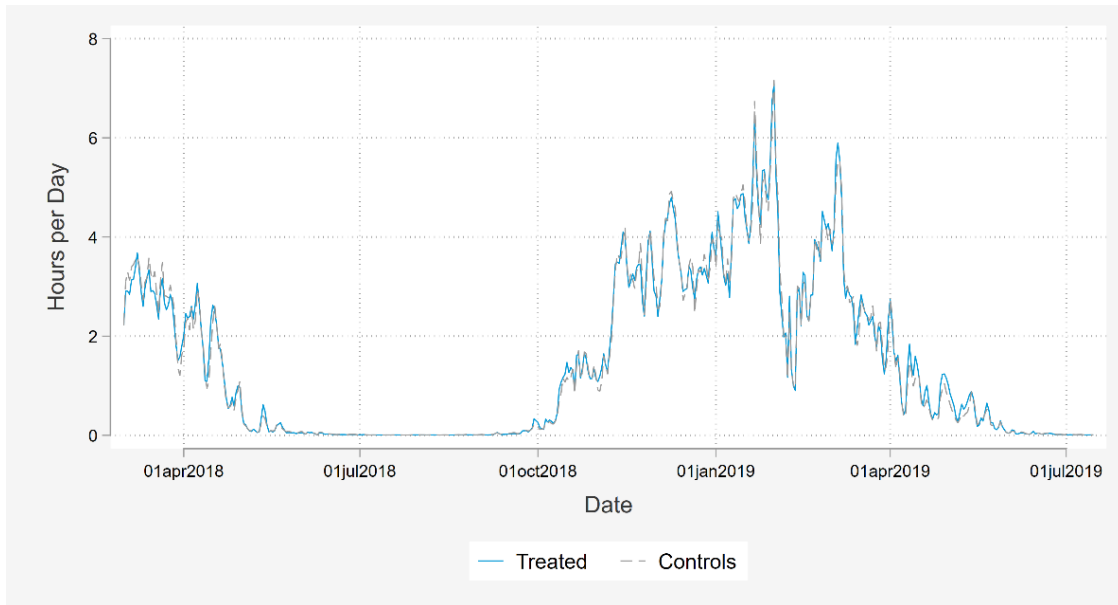


Figure 9: Pre-Period Comparison – Heating, No Heat Pump

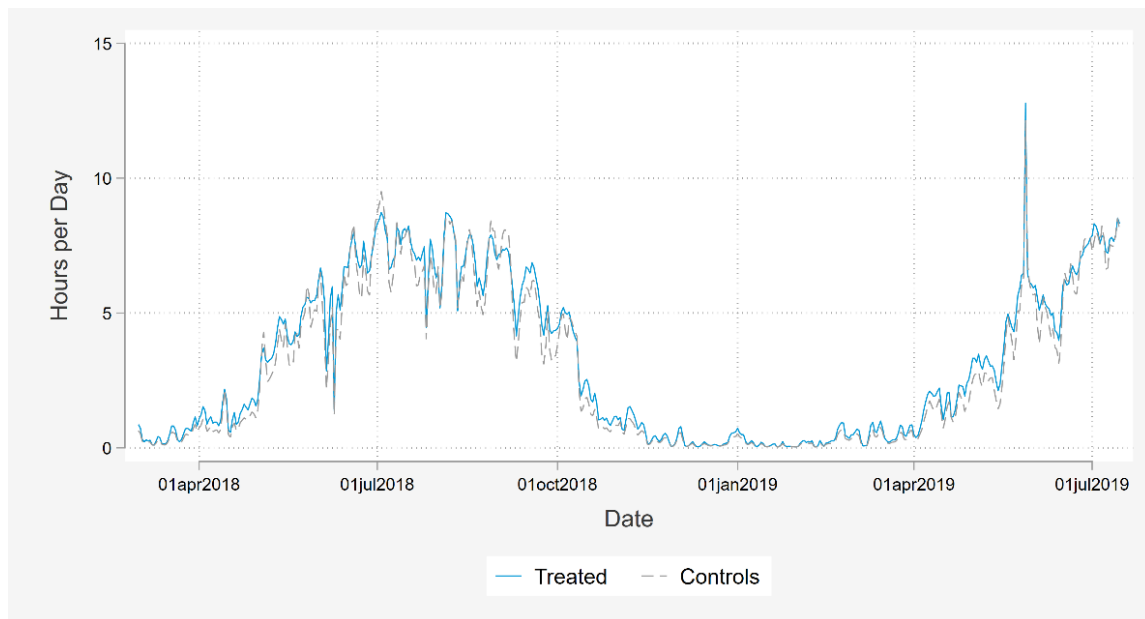


Figure 10: Pre-Period Comparison – Cooling, Heat Pump

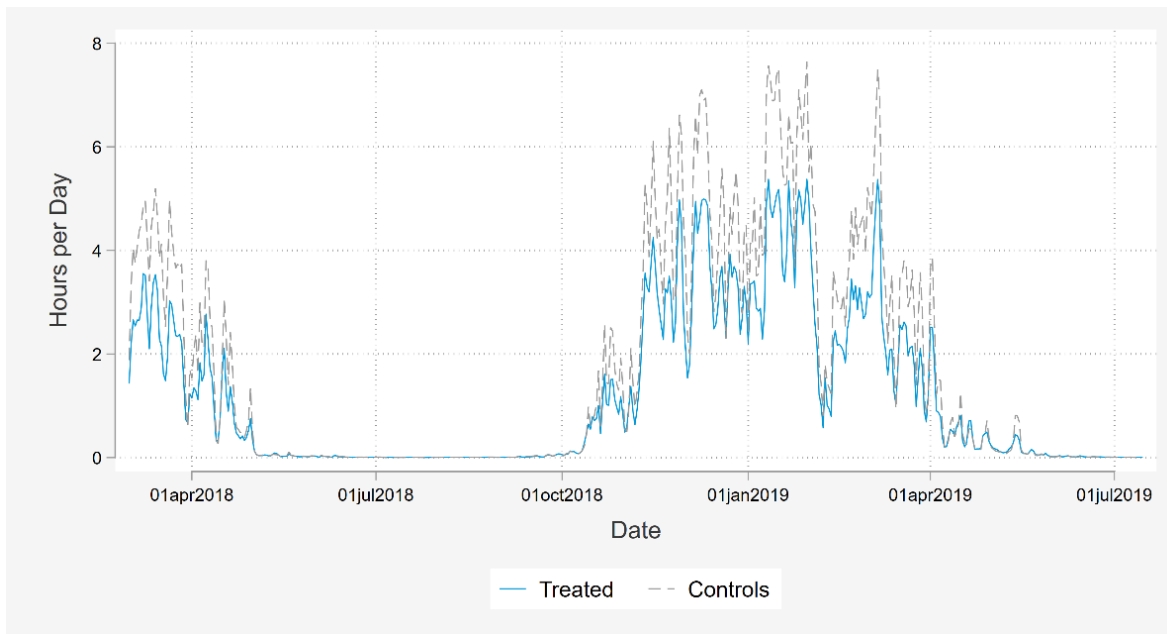


Figure 11: Pre-Period Comparison – Compressor Heating, Heat Pump

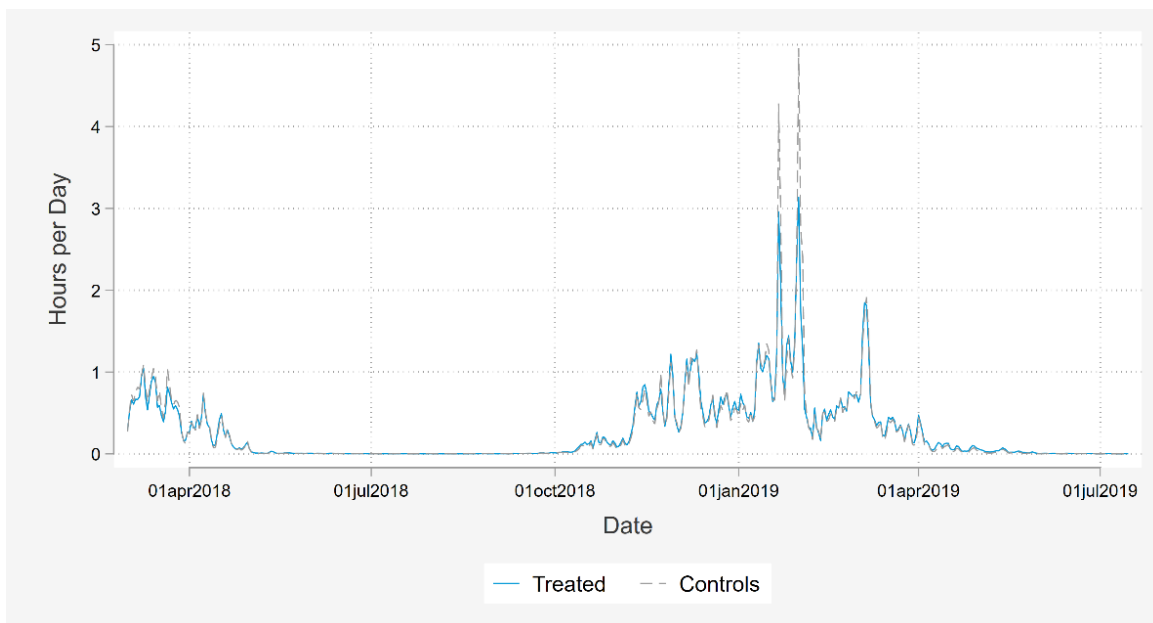


Figure 12: Pre-Period Comparison – Auxiliary Heating, Heat Pump

DSA addresses the differences and variances in these HVAC usage levels by using the lagged dependent variable²⁶. The key observation is that the change between the two groups from pre-

²⁶ In a panel regression analysis, a lagged dependent variable refers to the value of the dependent variable from a previous time period or period of observation. Panel data typically involves observing multiple entities (such as individuals) over multiple time periods. When including a lagged dependent variable in a panel regression model, it is essentially using past values of the dependent variable as an explanatory variable for its current or future values.

period to after the treatment period is solely due to the project activity itself (i.e., the enablement of eco+ and the “Adjust for Humidity” feature).

Figure 13 displays how the average household’s demand for cooling, heating, and auxiliary heating differs between the control and treatment groups of heat pump users over time. These differences fluctuate predictably due to seasonal changes and weather conditions. To ensure accurate comparisons, DSA adjusted for weather effects and used monthly lagged dependent variables instead of annual ones. By analyzing eco+’s impact month by month, DSA could account for seasonal variations—for example, expecting a greater influence on cooling demand in summer compared to winter. This approach provides a nuanced understanding of eco+’s effects across different months.

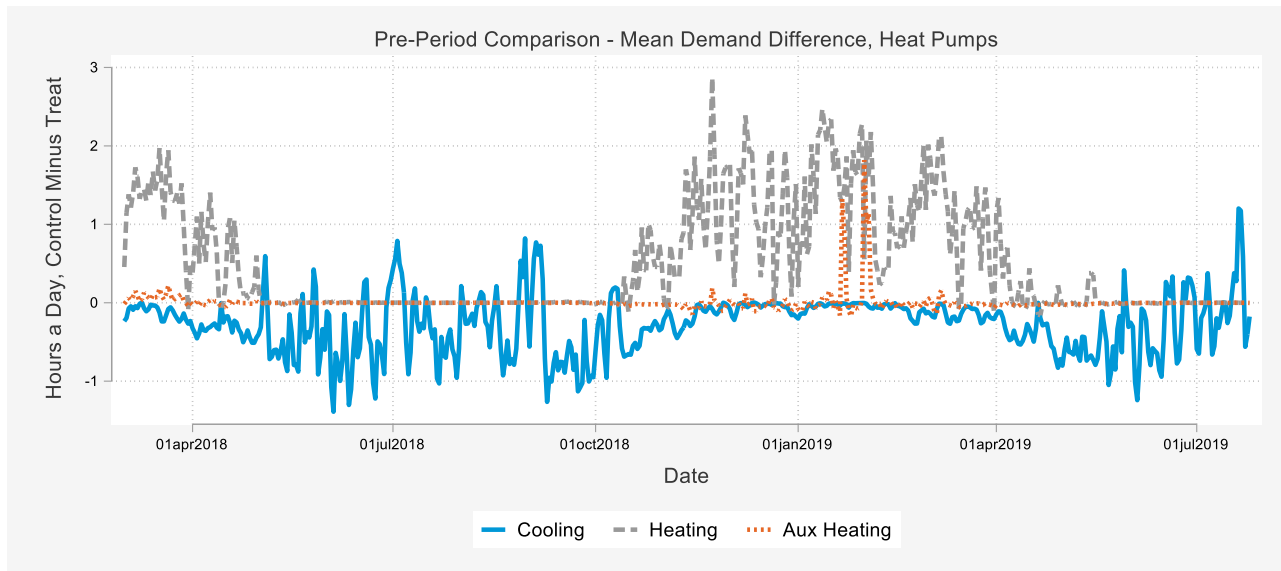


Figure 13: Heat Pump Pre-Treatment Differences

Rationale for including weather controls in regression models

The HVAC equipment runtime is influenced by daily weather conditions. To accurately measure the impact of the treatment (eco+) rather than variations in weather between treated and control groups, DSA incorporated weather controls (CDD, HDD, and humidity) into the regression analysis. Temperature affects cooling runtime differently than heating, and its impact on runtime varies depending on the efficiency of the equipment used (i.e., more efficient heat pumps may require less operation time). Failing to properly model these differences could lead to estimation errors, as weather effects would not be fully accounted for.

Two solutions were considered: 1) integrating heating/cooling and equipment type with temperature controls in a single comprehensive regression; 2) splitting the data into five (5) separate regressions and estimating distinct weather coefficients for each subset of HVAC equipment and its heating and cooling elements. DSA opted for the latter approach due to the large dataset size made available by ecobee.

This was the preferred approach as large dataset minimizes sampling bias and due to varying emission impacts based on fuel type and equipment, it simplifies the calculation of emission estimates of the project activity.

5.1 Baseline Emissions

The baseline emission shall be comprised of dwellings from the Same Building Stock that have not been weatherized. In other words, baseline emission shall be defined as emissions from heating and cooling energy load by dwellings with ecobee devices that did not enable the thermostat optimization platform eco+ and the “Adjust for Humidity” feature.

The regression model is trained on runtime data from both treated ($c=1$) and control ($c=0$) devices.

The equation for calculating baseline average daily runtime (and in turn energy use and emissions) in month m is:

$$Y_{it-1} * m * lag_coeff + cdd * cdd_coeff + hdd * hdd_coeff + h * h_coeff + d * dow_coeff.$$

The first part of the equation is omitted because $c = 0$

The equation for calculating project runtime (and in turn energy and emissions) is the same with the addition of:

$$beta_t * m * c$$

DSA refers to the **$beta_t$** as the treatment coefficient, or the coefficient of interest, as it captures the average difference between the treated and untreated devices in month m . This is the savings, or the eco+ effect

$$y_{it} = \beta_t m_t c_i + y_{it-1} m_t + m_t + cdd_{it} + hdd_{it} + h_{it} + d_t + \varepsilon_{it}$$

Where:

- y_{it} is the outcome of interest in seconds for person i on day t ,
- m_t is an indicator variable for year-month,
- c_i is an indicator variable for treatment, so the coefficients of interest are β_t . A separate coefficient is calculated for each year month m_t of the treatment period. The rest of the terms are control variables, which have their own coefficients (which are not notated in order to increase legibility).
- y_{it-1} is the lagged dependent variable, which is the mean of all dependent variable values in the pre-period in the month that day t is in for household i .
- cdd_{it} is a continuous variable for the number of degrees above 60 (anything below is zero) while hdd_{it} is the number of degrees below 60 (anything above is zeroed out),
- h_{it} is humidity,
- d_t is an indicator of day of week, and
- ε_{it} is the error term.

Baseline Scenario for Category B – Control Approach

The baseline scenario for this project activity is the heating and cooling loads of a home with an ecobee thermostat without eco+ and “Adjust for Humidity”. The “Adjust for Humidity” feature saves energy and reduces emissions through “offsets” of the thermostat setpoints. In the winter or cooler months, the feature lowers heating setpoints and reduces energy used for heating. In the summer or warmer months, the feature increases cooling setpoints and reduces energy used for cooling. An illustration is provided in Section 1.1 (Figures 1, 2, and 3) to demonstrate the feature’s function.

To further elaborate the baseline and project scenario, consider a home with a 75°F (22°C) setpoint in the summer and a 65°F (18°C) thermostat setpoint in the winter. The heating and cooling loads of this home, given the climate and home construction attributes, is the baseline scenario. If the “Adjust for Humidity” feature implements an average offset of 0.5°F, the executed setpoints are changed to 75.5°F (24°C) in the summer and 64.5°F (17.5°C) in the winter. The project scenario is the heating and cooling loads of the home under these executed setpoints made by the “Adjust for Humidity” feature. As the executed setpoints lower the differential between outdoor temperature and setpoint, the heating and cooling loads are lowered.

The baseline scenario is estimated using both the treated thermostats in the pre-period and the control group devices in the pre and post-period. DSA uses telemetry data from 50,000 ecobee devices in the same housing stock on the same day without the “Adjust for Humidity” feature to model the baseline scenario. These devices experience an offset of 0.00°F and thus the heating and cooling loads are what the treated homes heating and cooling load would be in absence of the project activity.

5.2 Project Emissions

The project emissions are defined as emissions from heating and cooling energy load by dwellings with ecobee devices equipped with the thermostat optimization platform eco+ and the “Adjust for Humidity” feature. Project emissions can be estimated by first estimating the values for y_{it} (daily runtime estimates) for all the regression equations. Once emissions are estimated, DSA converts runtime estimates in the same way as described in Section 5.4 of the Monitoring Report to obtain the project emissions estimates.

The regression model is trained on runtime data from both treated ($c=1$) and control ($c=0$) devices.

The equation for calculating baseline average daily runtime (and in turn energy use and emissions) in month m is:

$$Y_{it-1} * m * lag_coeff + cdd * cdd_coeff + hdd * hdd_coeff + h * h_coeff + d * dow_coeff.$$

The first part of the equation is omitted because $c = 0$

The equation for calculating project runtime (and in turn energy and emissions) is the same with the addition of:

$$beta_t * m * c$$

DSA refers to the **beta_t** as the treatment coefficient, or the coefficient of interest, as it captures the average difference between the treated and untreated devices in month *m*. This is the savings, or the eco+ effect

$$y_{it} = \beta_t m_t c_i + y_{it-1} m_t + m_t + cdd_{it} + hdd_{it} + h_{it} + d_t + \varepsilon_{it}$$

Where:

- y_{it} is the outcome of interest in seconds for person *i* on day *t*,
- m_t is an indicator variable for year-month,
- c_i is an indicator variable for treatment, so the coefficients of interest are β_t . A separate coefficient is calculated for each year month m_t of the treatment period. The rest of the terms are control variables, which have their own coefficients (which are not notated in order to increase legibility).
- y_{it-1} is the lagged dependent variable, which is the mean of all dependent variable values in the pre-period in the month that day *t* is in for household *i*.
- cdd_{it} is a continuous variable for the number of degrees above 60 (anything below is zero) while hdd_{it} is the number of degrees below 60 (anything above is zeroed out),
- h_{it} is humidity,
- d_t is an indicator of day of week, and
- ε_{it} is the error term.

Project activity's baseline emission, project emissions and overall emission reductions for second monitoring period 03-March-2023 to 02-March-2025 are available and can be reviewed in the accompanying emission reductions workbook excel sheet called "CO2_Dashboard_V2_Lowerbound_20260409."

5.3 Leakage Emissions

The applied methodology, VM0008 leakage refers to emissions from improper disposal of appliances. It states "when the appliance is not disposed of according to applicable laws and regulations there will be leakage from continued operations. The leakage emission shall be calculated and excluded from emission reductions as described in the methodology". For this project, appliances such as heating/cooling equipment are not being disposed of. The project activity utilizes an energy efficiency enhancement on smart thermostats installed in homes to reduce heating and cooling usage specifically, thus leakage does not need to be considered.

5.4 GHG Emission Reductions and Carbon Dioxide Removals

Regression Model Outputs, and Equations Converting MWh to CO₂ Reduction

The regression model outputs predict the impacts of enrollment of eco+ on HVAC runtime in seconds per day for each of the five heating and cooling scenarios. Please see Appendix D for table of regression output results.

The coefficients of interest, β_t , are the coefficients under the heading “ym#c.complier” in each regression model. The values in the “coefficient” column are the point estimates for the effect of having eco+ on the runtime for each of the five respective variables of interest (1) heat pump/cooling, 2) heat pump/heating, 3) heat pump/aux heating, 4) non-heat pump/cooling, 5) non/heat pump/heating. The table in Appendix D displays the robust clustered standard errors (shown as std.err in the table) of the estimate of each co-efficient. From the point estimates and standard errors, DSA can report the p value of t tests on the null hypothesis. These p values report the probability given the data and regression that the true value of the coefficient is zero (ie., the probability that eco+ has no impact). DSA estimated that 95% of all true co-efficient values (the numbers that the point estimates are estimating) lie within the 95% confidence intervals reported.

Rather than using the point estimate, DSA applies a conservative approach and uses the lower bound of the 95% confidence interval. The lower bounds are calculated by multiplying the standard errors by 1.96 and subtracting that from the point estimates. In the equations below, all instances of β_t represent this lower bound of the point estimates. To further illustrate the coefficients of interest, the first set of regression output results (1/5) in Appendix D are for cooling of non-heat pump treatment group (“ALL, non_heat_pump, compcool”). The “ym#c.complier” coefficients (displayed in negative coefficients) are the impacts of eco+ on cooling measured in seconds of runtime per day. Using September 2021 (“2021m9”) as an example (highlighted in Appendix D), eco+ and “Adjust for Humidity” feature reduced 18 minutes (“-1088.52” seconds or 0.3 hours) of cooling runtime per day on average. The hourly runtime saved is converted to kWh per day which is then converted to CO₂ saved. The coefficient having a p value of “0.000” indicates that the impact of eco+ on cooling runtime is statistically significant, or in other words, the probability that eco+ had an impact is significant.

Converting Seconds of HVAC Run-time into CO₂ Reductions

DSA calculated emissions reductions using average emissions rates from the EPA’s Emissions & Generation Resource Integrated Database (eGRID)²⁷ which reports the total and average CO₂ equivalent emissions from electricity consumption per U.S. state²⁸. In order to create a national average representative of ecobee, DSA weighted each average emissions rate by the percentage of heat pump and non-heat pump customers in the sample (please refer to Appendix C for more details).

This resulted in two average rates: 1) 718 lbs/MWh for heat pump customers and 2) 720 lbs/MWh for non-heat pump customers. These values were used to calculate the estimates for emissions reductions with the below conversion equations, where 718 is used for “CO₂rate” in heat pump equations and 720 is used for “CO₂rate” in the non-heat pump equation.

²⁷ U.S. EPA. Emissions & Generation Resource Integration Database (eGRID). <https://www.epa.gov/egrid>

²⁸ U.S. EPA. Emissions & Generation Resource Integration Database (eGRID). State Output Emission Rates 2022. https://www.epa.gov/system/files/documents/2024-01/egrid2022_summary_tables.pdf

The equations converting seconds of runtime to emissions reductions are the following:

Cooling: Heat Pumps and Non-Heat Pumps:

$$\frac{\beta_{it}}{3600} * days * \frac{kWperdevice}{1000} * \frac{CO_2rate}{2204.6}$$

Where “ β_{it} ” is the predicted change in seconds. Dividing by 3600 puts it in hours per day, and then multiplying it by the number of days in the month translates it to hours per month. “kWperdevice” is 3.21kW per device (weighted average for cooling) and transforms the value to kWh. Dividing it by 1000 converts it to MWh. Dividing by 2204.6²⁹ transforms the value to metric tons per month.

Heating: Non-Heat Pumps:

$$\frac{\beta_{it}}{3600} * days * \frac{furnacesize(kBTU)}{1000} * \frac{117}{2204.6} + \frac{\beta_{it}}{3600} * days * \frac{furnacefan(kW)}{1000} * \frac{CO_2rate}{2204.6}$$

This equation has two components: 1) the furnace (ie., natural gas), 2) furnace fan (ie., electric) There are 117 lbs of CO₂ in every MMBtu of natural gas³⁰.

Heating: Heat-Pumps, Compressors:

$$\frac{\beta_{it}}{3600} * days * \frac{HeatPumpCompressor}{1000} * \frac{CO_2rate}{2204.6}$$

Heating: Heat-Pumps, Auxiliary:

$$\frac{\beta_{it}}{3600} * days * \frac{HeatPumpAuxiliary}{1000} * \frac{CO_2rate}{2204.6}$$

These estimates for carbon abatement for each month are then all summed together to obtain the annual abatement estimate. Each month’s estimates are stored in ERR excel workbook “CO2_Dashboard_V2_LowerBound_20260409” and is provided to the VVB and Verra as an accompanying document.

Please see ERR (“CO2_Dashboard_V2_LowerBound_20260409”) that includes “Heating Conversions Example” tab and “Cooling Conversions Example” tabs providing conversion for both heat pumps and non-heat pumps based on and heating cooling runtime. Baseline and impact calculation have also been included in these tabs.

²⁹ 2204.6 is the number of pounds in a metric ton and value was sourced directly from [U.S Energy Information Administration \(EIA\)](#).

³⁰ Converting reduction in natural gas savings (MMBtu) to CO₂ savings. U.S. Energy Information Administration. Natural gas explained. <https://www.eia.gov/energyexplained/natural-gas/natural-gas-and-the-environment.php#:~:text=About%20117%20pounds%20of%20CO,MMBtu%20of%20distillate%20fuel%20oil.>

Total Emission Reductions using Average Emissions Rate from EPA's Emissions & Generation Resource Integrated Database (eGRID)

The excel workbook "CO2_Dashboard_V2_LowerBound_20260409" contains the project activity's total emission impact sorted by equipment type (heat pump and non-heat pump), crediting year, and emission calculation based on EPA average emission grid factors.

Achieved Emissions Reductions (calculated with average emission rates from eGRID)

Vintage period	Baseline emissions (tCO ₂ e)	Project emissions (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Reduction VCU (tCO ₂ e)	Removal VCU (tCO ₂ e)	Gross Total VCU (tCO ₂ e)	Net Total VCU (tCO ₂ e)
03-Mar-2022 to 31-Dec-2023	5,237,639	5,012,127	0	0	0	225,512	180,410
01-Jan-2024 to 31-Dec-2024	7,514,752	7,220,247	0	0	0	294,505	235,604
01-Jan-2025 to 02-March-2025	3,524,026	3,413,713	0	0	0	110,312	88,250
Gross Total	16,276,417	15,646,088	0	0	0	630,330	504,264
Applicability Condition ³¹ : Occupied Dwelling Discount (20%)	-	-	-	-	-	-	504,264

For projects required to assess permanence risk:

Per VM0008 protocol, as this project activity is a non-AFOLU project there is no requirements to calculate or assess permanence risk associated to the project activity. The AFOLU Non-Permanence Risk Tool is not applicable and tables relevant to non-permanence risk has been removed from this template.

Reporting Ex-Ante Estimated

Ex-ante estimated reductions/removals have been reported in the below table and were pulled directly from the PD Section 1.11: Estimated GHG Emission Reductions and Removals that was submitted in 2023 with the first Monitoring Report. The annual estimated GHG emission reductions were calculated by applying several data inputs to a model that included 1) ecobee's average device growth assumptions until 2028, 2) 'Adjust for Humidity' average enablement assumptions, 3) ecobee's average equipment attach rate (ie., % attached to furnances vs % heat pumps), 4) U.S EPA published eGRID 2022 emissions rates, 5) megawatts usage for heat pump and non-heat pump (furnances) per technical reference manuals, and 6) CO₂ saved for MWh

³¹ VM0008 Applicability Condition states "The Dwelling must be occupied. Vacancy is permitted on an intermittent basis for up to three months, or if the Dwelling is occupied seasonally on an annual basis." ecobee performed a detailed occupancy analysis to determine percentage of dwellings in project activity that meets applicability condition. Based on the analysis, ecobee infers 80% of dwellings in second monitoring period are occupied and not vacant for up to 3 months. Please see ecobee_PDD-VM0008 Section 3.2 "Applicability of Methodology" for full details. To be conservative, the results of the analysis has been factored into total claimed emissions reductions for the second monitoring period as a discount of 20%.

saved per equipment type per device. Using the achieved reductions calculated in 2023, the ex-ante estimated reductions were modelled for the second Monitoring Period (2023-2025) and beyond to 2028.

The difference for the ex-ante estimated reductions calculated in 2023 and the achieved reductions calculated was -16.29% and can be attributed to a few factors:

- 1) Change in eGRID emission factors 2022 and 2023
- 2) Change in device footprint and enablement of Adjust for Humidity during the Monitoring Period
- 3) Change in number of equipment types during the Monitoring Period

The difference between achieved reductions and VCU's issued is a result of the occupancy analysis discount of this monitoring period of 20%.

This estimated emissions model can be shared with the VVB upon request. Please see 'Explanation for the difference' below table for differences between ex-ante estimated and the achieved reductions for the Monitoring Period.

Vintage period	Ex-ante estimated reductions/removals	Achieved reductions/removals	Percent difference	Explanation for the difference	VCU Issued by Vintage
03-Mar-2023 to 31-Dec-2023	278,337	225,512	-18.98%	ecobee's initial model estimated 2023's GHG reduction to be 334,005 tCO ₂ . Estimates were calculated on an annual basis (by end of 31-Dec). As the monitoring period covers early March to end of Dec, ecobee divided 334,005 by 12 months to calculate estimated monthly emission reductions. For vintage period Mar-2023 to Dec-2023 (ie., approx. 10 months) the ex-ante estimated reductions is 278,337 and the reported achieved reductions is 225,512 for a percent difference of -18.98%.	180,410
01-Jan-2024 to 31-Dec-2024	399,069	294,505	-26.20%	ecobee's initial model estimated 2024's GHG reduction to be 399,069 tCO ₂ . The reported achieved reductions is 294,505 tCO ₂ for a percent difference of -26.20%.	235,604
01-Jan-2025 to 02-Mar-2025	75,606	110,312	+45.90%	ecobee's initial model estimated 2025's GHG reduction to be 453,639 tCO ₂ . Estimates were calculated on an annual basis (by end of 31-Dec). As the monitoring period ends in early March, ecobee divided 453,639 by 12 months to calculate estimated monthly emission reductions. For vintage period Jan-2025 to 02-Mar-2025 (ie., approx. 2 months) the ex-ante estimated	88,250

				reductions was 75,606 tCO ₂ and the reported achieved reductions is 110,312 tCO ₂ for a percent difference of +45.90%.	
Gross Total	753,012.5	630,330	-16.29%	The total ex-ante estimated reductions for this monitoring period was added up for a gross total of 753,012.50 tCO ₂ and the reported gross total achieved reductions is 630,330 tCO ₂ for a percent difference of -16.29%.	-
Net Total [Applicability Condition: Occupied Dwelling Discount (20%)]	-	504,264	-	VM0008 Applicability Condition states “The Dwelling must be occupied. Vacancy is permitted on an intermittent basis for up to three months, or if the Dwelling is occupied seasonally on an annual basis.” ecobee performed a detailed occupancy analysis to determine percentage of dwellings in project activity that meets applicability condition. Based on the analysis, ecobee infers 80% of dwellings in second monitoring period are occupied and not vacant for up to 3 months. Please see ecobee_PDD-VM0008 Section 3.2 “Applicability of Methodology” for full details. To be conservative, the results of the analysis has been factored into total claimed emissions reductions for the second monitoring period as a discount of 20%. The claimed reductions for this monitoring period is 630,330 tCO ₂ - 20% = 504,264 tCO ₂ .	504,264

APPENDIX A: CONNECTED LOAD ASSUMPTIONS

Translating HVAC runtime, or changes in runtime, to energy usage and demand requires the project proponent to make an assumption about the size of the HVAC units connected to ecobee thermostats. ecobee collected HVAC unit size and efficiency measurements/assumptions from various technical reference manuals (TRMs), appliance saturation studies, and evaluation reports which are presented in Appendix B.

In these industry sources, air conditioning size information is generally presented in one of three metrics:

a) kW – The main metric of interest as this is a direct parameter in the methodology. This is usually determined by spot measurements of instantaneous power draw or trending measurements of power or current. It may or may not include the power draw of the indoor circulating fan.

b) Tons – A measure of cooling output, or capacity. One ton is the amount of heat required to melt one ton of ice in a 24-hour period (288,000 BTU or 12,000 BTU per hour).

c) Capacity in BTU per Hour – Interchangeable with tons.

Since the metrics of cooling capacity are output measurements, an assumption about the efficiency of the system is required to convert output capacity to the input power requirement. To facilitate this conversion and leverage size ratings in tons or BTU/hour ecobee collects average Seasonal Energy Efficiency Ratio (SEER) values for existing air conditioner stock and uses the values to convert to kW. SEER ratings include the fan power requirements.

ecobee categorized each source from the literature review presented in Appendix B into one of five climate zones and used the results to inform assumed HVAC unit size for each climate zone. Tables 1, 2 and 3 below show the results of the company's research and final assumptions by climate zone.

Table 1: Connected Load Assumption by Climate Zone, Cooling

Climate Zone	Tons	SEER	kW per Device
01 Cold	2.75	10.5	3.10
02 Dry	3.25	10.5	3.48
03 Hot Humid	3.25	10.5	3.60
04 Mixed Humid	2.75	10.5	3.04
05 Marine	2.60	10.5	2.93
Weighted Total	2.78	19.5	3.21

Table 2: Connected Load Assumption by Climate Zone, Heating (Furnace)

Region	Furnace Size (kBtu/hour)	Furnace Fan (kW)
01 Cold	77.7	0.56
02 Dry	60.0	0.56
03 Hot Humid	65.0	0.56
04 Mixed Humid	75.5	0.56
05 Marine	62.5	0.56
Weighted Total	68.4	0.56

Table 3: Connected Load Assumption by Climate Zone, Heating (Heat Pump)

Region Name	Heat Pump Compressor Size (kW)	Heat Pump Auxiliary Size (kW)
01 Cold	3.47	9.53
02 Dry	2.88	7.91
03 Hot Humid	2.42	7.68
04 Mixed Humid	3.02	8.32
05 Marine	3.00	8.25
Weighted Total	3.02	8.52

APPENDIX B: CONNECTED LOAD RESEARCH

Document Name	Document Type	State	Year Effective	Climate Zone	URL	Page/ Table/ Other Source	Size (tons)	SEER for Existing Units
Wisconsin Focus on Energy 2019 Technical Reference Manual	TRM	WI	2019	Cold/Very Cold	https://www.focusonenergy.com/sites/default/files/Focus_on_Energy_2019_TRM-Update.pdf	Pg. 937	2.425	12.1
State of Minnesota Technical Reference Manual for Energy Conservation Improvement Programs version 3.0	TRM	MN	2020	Cold/Very Cold	http://mn.gov/commerce-stat/pdfs/mn-trm-v3.0.pdf	Pg. 42	2.5	11.5
Iowa Energy Efficiency Statewide Technical Reference Manual Version 2.0	TRM	IA	2017	Cold/Very Cold	https://efs.iowa.gov/cs/groups/external/documents/docket/mdax/njq1/~edisp/1645801.pdf	Pg. 121	3	8.6
2019 Illinois Statewide Technical Reference Manual for Energy Efficiency Version 7.0	TRM	IL	2019	Cold/Very Cold	http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Version_7/Final_9-28-18/IL-TRM_Effective_010119_v7.0_Vol_3_Res_092818_Final.pdf	Pg. 79	2.8	9.3
Technical Reference User Manual (TRM) No. 2014-87	TRM	VT	2015	Cold/Very Cold	https://puc.vermont.gov/sites/psbnew/files/doc_library/ev-technical-reference-manual.pdf	Pg. 531 of document	3	
Rhode Island Technical Reference Manual	TRM	RI	2018	Cold/Very Cold	http://www.ripuc.org/eventsactions/docket/4755-NGrid-2018-TRM-RI.pdf	Pg. M-51	2.7	10

For Estimating Savings from Energy Efficiency Measures - 2018 Program Year								
Missouri Technical Reference Manual Volume 3 Residential Measures - Final March 31, 2017	TRM	MO	2017	Mixed-Humid	https://exportmissouri.mo.gov/docs/default-source/default-document-library/mo_trm-2017_vol-3_res_measures_033117_final.pdf?sfvrsn=0	Pg. 120	2.8	10
DC SEU TRM Characterizations	TRM	DC	2017	Mixed-Humid	-	Pg. 87	2.67	
Xcel Deemed Savings Technical Assumptions	Survey	CO	N/A	Cold/Very Cold	https://www.xcelenergy.com/staticfiles/xcel-responsive/Company/Rates%20&%20Regulations/Regulatory%20Filings/CO-DSM-HEAC-Deemed-Savings.pdf	Pg. 4	3	10
The Effect of Residential Equipment Capacity on Energy Use, Demand, and Run-Time	Survey	FL	1997	Hot-Humid	http://www.fsec.ucf.edu/en/publications/html/FSEC-PF-328-97/index.htm	Table 3	3.29	
Analysis of Historical Residential Air-Conditioning Equipment Sizing Using Monitored Data	Survey	WA	1993	Marine	https://digital.library.unt.edu/ark:/67531/m2tad1310394/m2/1/high_res_d/10134448.pdf	Pg. 10	2.635	
Technical Reference Manual for APS Energy Efficiency Programs Program Year 2013	TRM	AZ	2014	Hot-Dry/Mixed-Dry	https://images.edocket.azcc.gov/docketpdf/0000150538.pdf	Pg. 23, Table 3.3	3.75	11
Texas Technical Reference Manual Version 6.0 Volume 2:	TRM	TX	2019	Hot-Humid	http://www.texasenergy.com/images/documents/RegulatoryFilings/DeemedSavings/TRMv6.0%20Vol%20%20Residential%20Measures_Final.pdf	Pg. 2-345	3.7	

Residential Measures Program Year 2019								
Energy Trust of Oregon Seasonal Savings Pilot Evaluation	Survey	OR	2017	Cold/Very Cold	https://www.energytrust.org/wp-content/uploads/2017/12/Energy-Trust-of-Oregon-Nest-Seasonal-Savers-Pilot-Evaluation-FINAL-wSR.pdf	Pg. 6-47	3	12
DSA Research	Field Survey	GA	N/A	Hot-Humid	-	DSA Research	2.9	
DSA Research	Field Survey	NM	N/A	Hot-Dry/Mixed-Dry	-	DSA Research	2.614	
Single-Family Weatherization Baseline Assessment (R5) Final Report Submitted to The Connecticut Energy Efficiency Fund, Connecticut Light and Power, & The United Illuminating Company	Survey	CT	2014	Cold/Very Cold	https://www.energizect.com/sites/default/files/R5-Connecticut%20Weatherization%20Baseline%20Assessment-FINAL%2006-04-14.pdf	Table 6-15 and 6-16	3	10.4
National Grid Rhode Island Residential Appliance Saturation Survey (Study RI2311) Report	Survey	RI	2018	Cold/Very Cold	http://www.ripuc.org/eventsactions/docket/6.%20National%20Grid%20RI2311%20RAS%20Final%20Report%2011OCT2018.pdf	Table 6		10.9
NEEA Residential Stock Assessment II Single-Family Homes Report 2016-2017 Revised 04/2019	Survey	WA	2019	Marine	https://neea.org/img/uploads/Residential-Building-Stock-Assessment-II-Single-Family-Homes-Report-2016-2017.pdf	Table 53		12.2
2018 Pennsylvania Statewide Act 129	Survey	PA	2019	Cold/Very Cold	http://www.puc.state.pa.us/Electric/pdf/Act129/SWE-	Table 90		12.2

Residential Baseline Study					Phase3_Res_Baseline_Study_Rpt021219.pdf			
2017 Residential Programs Evaluation Report	Survey	Ontario	2018	Canada	http://www.ieso.ca/-/media/Files/IESO/Document-Library/conservation/EMV/2017/2017-Residential-Programs-Evaluation-Report.pdf?la=en	Pg. D-206	2.14	
2014 Consumer Program Evaluation Volume 1: Report	TRM	Ontario	2014	Canada	http://www.ieso.ca/-/media/Files/IESO/Document-Library/conservation/EMV/2014/PY2014-IESO-CP-Evaluation-Final-Report.pdf?la=en	Table 3-9	2.167	
Quick Start Energy Efficiency Annual Report Program Year 1 November 2014 – October 2015	TRM	LA	2014	Hot/Humid	https://www.all4energy.org/uploads/1/0/5/6/105637723/entergy-quick-start-energy-efficiency-2014-2015-annual-report.pdf	Pg. 4-2		11.2

APPENDIX C: EPA EGRID EMISSION FACTORS

2022 eGRID Average Emissions Rates

DSA calculated emissions reductions using average emissions rates. DSA used EPA's 2022³² and 2023³³ Emissions & Generation Resource Integrated Database which reports the total and average CO₂ equivalent emissions from electricity by each US state. In order to create a national average representative of eco+, DSA weighted each average emissions rate by the percentage of heat pump and non-heat pump customers in the sample. This resulted in two different average rates. 2022 eGRID averages uses 1) 755 lbs/MWh for heat pump customers and 2) 776 lbs/MWh for non-heat pump customers) while the 2023 eGRID averages uses 3) 717.77lbs/MWh for heat pump customers and 720.20 lbs/MWh for non-heat pump customers.

State	CO ₂ e Emission Rate (lbs/MWh)	eco+ Heat Pump Customer Share	eco+ Non-HP Customer Share
AL	791.4	4.1%	0.9%
AR	1061.5	0.8%	0.6%
AZ	711.9	6.3%	2.7%
CA	457.5	5.8%	10.6%
CO	1173.1	0.2%	3.1%
CT	523.3	0.4%	1.1%
DC	554.9	0.3%	0.2%
DE	900.8	0.3%	0.2%
FL	818.6	18.2%	4.3%
GA	741.2	7.8%	3.7%
IA	621.6	0.1%	0.6%
ID	248.4	0.3%	0.9%
IL	592.4	1.0%	7.5%
IN	1576.6	1.7%	2.2%
KS	826.2	0.3%	0.7%
KY	1732.3	1.4%	0.5%
LA	820.7	0.4%	1.1%
MA	859.2	2.2%	2.9%
MD	640.5	3.5%	1.8%

³² EPA. Summary Tables 2022. State Output Emission Rates. https://www.epa.gov/system/files/documents/2024-01/egrid2022_summary_tables.pdf

³³ EPA. Summary Tables 2023. State Output Emission Rates. https://www.epa.gov/system/files/documents/2025-01/egrid2023_summary_tables_rev1.pdf

ME	342.7	0.0%	0.2%
MI	1015.7	0.3%	5.2%
MN	773.8	0.2%	2.3%
MO	1517.8	1.6%	2.0%
MS	888.7	0.5%	0.4%
MT	1031.4	0.1%	0.2%
NC	657.1	8.5%	2.3%
ND	1321.4	0.0%	0.1%
NE	1105.7	0.2%	0.3%
NH	306.5	0.3%	0.5%
NJ	488.6	0.3%	3.2%
NM	991.6	0.2%	0.6%
NV	678.7	1.1%	3.6%
NY	491.3	1.1%	3.3%
OH	1162.1	1.4%	2.9%
OK	689.1	0.4%	0.8%
OR	299.1	1.4%	1.4%
PA	714.2	2.0%	2.5%
RI	812.2	0.0%	0.3%
SC	559.9	4.7%	0.9%
SD	326.9	0.0%	0.1%
TN	697.7	3.4%	1.1%
TX	821.9	8.2%	11.7%
UT	1524.3	0.3%	2.1%
VA	590.0	5.6%	1.9%
VT	42.6	0.1%	0.2%
WA	186.0	1.8%	1.6%
WI	1178.4	0.2%	2.1%
WV	1974.3	0.5%	0.2%
WY	1817.6	0.0%	0.1%
Weighted National Avg (lbs/MWh)		755.44	776.42

Source: Device Footprint File provided by ecobee

2023 eGRID Average Emissions Rates

State	CO ₂ e Emission Rate (lbs/MWh)	eco+ Heat Pump Customer Share	eco+ Non-HP Customer Share
AL	714.0	4.1%	0.9%
AR	998.4	0.9%	0.6%
AZ	748.8	6.0%	2.7%
CA	402.5	6.5%	10.4%
CO	1090.4	0.3%	3.1%

CT	540.7	0.5%	1.0%
DC	395.0	0.3%	0.2%
DE	701.3	0.3%	0.2%
FL	808.3	17.7%	4.4%
GA	715.0	7.7%	3.8%
IA	634.0	0.1%	0.6%
ID	313.9	0.4%	1.0%
IL	474.3	1.0%	7.2%
IN	1465.5	1.6%	2.2%
KS	733.2	0.3%	0.7%
KY	1747.0	1.4%	0.5%
LA	790.5	0.5%	1.1%
MA	814.1	2.4%	2.9%
MD	522.1	3.5%	1.8%
ME	316.7	0.0%	0.2%
MI	792.1	0.3%	5.1%
MN	752.2	0.3%	2.3%
MO	1451.8	1.5%	1.9%
MS	828.3	0.5%	0.4%
MT	1063.9	0.1%	0.2%
NC	626.4	8.5%	2.4%
ND	1297.9	0.0%	0.1%
NE	1025.8	0.2%	0.3%
NH	276.2	0.3%	0.6%
NJ	468.9	0.4%	3.2%
NM	772.6	0.2%	0.6%
NV	642.7	1.1%	3.7%
NY	480.3	1.1%	3.2%
OH	1068.2	1.4%	2.9%
OK	648.3	0.5%	0.8%
OR	364.9	1.3%	1.4%
PA	645.6	2.0%	2.6%
RI	840.0	0.1%	0.3%
SC	556.6	4.7%	1.0%
SD	335.6	0.0%	0.1%
TN	656.5	3.3%	1.2%
TX	775.0	8.1%	12.0%
UT	1421.2	0.4%	2.1%
VA	533.5	5.5%	2.0%
VT	52.2	0.1%	0.2%
WA	266.6	1.8%	1.6%
WI	1165.1	0.2%	2.1%
WV	1968.3	0.5%	0.2%

WY	1833.3	0.0%	0.1%
Weighted National Avg (lbs/MWh)	717.77	720.20	

APPENDIX D: REGRESSION MODEL OUTPUTS

```
-----
name: LDV_Regressions
log: F:\Projects\Ecobee\2025 CO2 Offsets\Modified Data\05 Output\LDV
Regression Output
> .log
log type: text
opened on: 21 Apr 2025, 15:58:57
```

non_heat_pumps, compcool1

```
Linear regression                                Number of obs    =    77596021
                                                F(155, 61214)    =     3583.02
                                                Prob > F          =      0.0000
                                                R-squared         =      0.6840
                                                Root MSE         =     7658.4
```

(Std. err. adjusted for 61,215 clusters in dsa_id)

	compcool1	Coefficient	Robust std. err.	t	P> t	[95% conf. interval]	
ym							
2021m4		-132.8972	18.42528	-7.21	0.000	-169.0108	-96.78356
2021m5		-790.7762	37.49363	-21.09	0.000	-864.2639	-717.2886
2021m6		-1914.867	72.63814	-26.36	0.000	-2057.238	-1772.497
2021m7		-4870.011	82.0966	-59.32	0.000	-5030.92	-4709.101
2021m8		-3825.658	85.6778	-44.65	0.000	-3993.587	-3657.729
2021m9		-2055.084	60.96012	-33.71	0.000	-2174.566	-1935.602
2021m10		-826.3664	32.0079	-25.82	0.000	-889.102	-763.6308
2021m11		-6.640075	17.25614	-0.38	0.700	-40.46216	27.18201
2021m12		-122.1458	18.14379	-6.73	0.000	-157.7077	-86.58392
2022m1		-198.4021	15.22321	-13.03	0.000	-228.2396	-168.5645
2022m2		-142.6856	13.95503	-10.22	0.000	-170.0376	-115.3337
2022m3		-69.66055	14.70685	-4.74	0.000	-98.48601	-40.83509
2022m4		-273.6317	22.33979	-12.25	0.000	-317.4177	-229.8456
2022m5		-979.3881	43.48417	-22.52	0.000	-1064.617	-894.159
2022m6		-2735.15	70.96034	-38.54	0.000	-2874.232	-2596.067
2022m7		-5375.716	90.46801	-59.42	0.000	-5553.034	-5198.399
2022m8		-3950.142	90.41243	-43.69	0.000	-4127.351	-3772.933
2022m9		-1882.355	63.55859	-29.62	0.000	-2006.93	-1757.78
2022m10		-646.7668	30.43297	-21.25	0.000	-706.4155	-587.1181
2022m11		-78.18518	17.3578	-4.50	0.000	-112.2065	-44.16384
2022m12		-241.6059	18.3738	-13.15	0.000	-277.6186	-205.5932
2023m1		-193.3014	18.92768	-10.21	0.000	-230.3997	-156.2031
2023m2		-136.6599	15.90473	-8.59	0.000	-167.8332	-105.4866
2023m3		-128.4145	15.74647	-8.16	0.000	-159.2776	-97.55138
2023m4		-84.28633	23.10832	-3.65	0.000	-129.5787	-38.99395
2023m5		-498.8167	42.26258	-11.80	0.000	-581.6514	-415.9819
2023m6		-2660.803	65.16749	-40.83	0.000	-2788.531	-2533.074
2023m7		-4807.947	92.74123	-51.84	0.000	-4989.72	-4626.174

2023m8		-3661.282	91.95733	-39.82	0.000	-3841.519	-3481.045
2023m9		-2064.925	64.1939	-32.17	0.000	-2190.746	-1939.105
2023m10		-677.8826	36.35288	-18.65	0.000	-749.1344	-606.6309
2023m11		-46.14308	19.30907	-2.39	0.017	-83.98892	-8.297248
2023m12		-128.5002	19.76885	-6.50	0.000	-167.2472	-89.75315
2024m1		-282.631	21.07953	-13.41	0.000	-323.9469	-241.315
2024m2		-95.73509	19.28147	-4.97	0.000	-133.5268	-57.94336
2024m3		17.44882	18.05775	0.97	0.334	-17.94443	52.84206
2024m4		78.493	27.87083	2.82	0.005	23.8661	133.1199
2024m5		-576.627	49.78958	-11.58	0.000	-674.2147	-479.0393
2024m6		-1648.403	82.32642	-20.02	0.000	-1809.763	-1487.043
2024m7		-3664.514	103.1378	-35.53	0.000	-3866.664	-3462.363
2024m8		-3307.55	94.49743	-35.00	0.000	-3492.765	-3122.335
2024m9		-1754.756	69.2812	-25.33	0.000	-1890.547	-1618.964
2024m10		-305.3059	40.63031	-7.51	0.000	-384.9414	-225.6703
2024m11		124.0919	22.80613	5.44	0.000	79.39188	168.792
2024m12		-184.9655	19.07657	-9.70	0.000	-222.3556	-147.5753
2025m1		-222.6742	16.45817	-13.53	0.000	-254.9322	-190.4161
2025m2		-162.1255	18.6182	-8.71	0.000	-198.6173	-125.6338
2025m3		74.60234	20.05545	3.72	0.000	35.2936	113.9111
ym#c.pre_compcool1							
2021m3		.517666	.0179817	28.79	0.000	.4824218	.5529101
2021m4		.4689912	.0092969	50.45	0.000	.4507693	.487213
2021m5		.3941146	.0040399	97.56	0.000	.3861964	.4020327
2021m6		.6464348	.0037837	170.85	0.000	.6390188	.6538509
2021m7		.6630951	.0031454	210.81	0.000	.6569301	.6692602
2021m8		.6932551	.0037332	185.70	0.000	.685938	.7005723
2021m9		.5568269	.0039532	140.85	0.000	.5490786	.5645752
2021m10		.4711939	.006173	76.33	0.000	.4590948	.483293
2021m11		.2773411	.0134907	20.56	0.000	.2508993	.3037828
2021m12		.599016	.0315533	18.98	0.000	.5371715	.6608606
2022m1		.4754091	.0383963	12.38	0.000	.4001522	.5506661
2022m2		.4422114	.0237093	18.65	0.000	.395741	.4886817
2022m3		.5537827	.0181348	30.54	0.000	.5182383	.589327
2022m4		.5154909	.0101646	50.71	0.000	.4955683	.5354135
2022m5		.5265189	.0044677	117.85	0.000	.5177621	.5352756
2022m6		.6814493	.0039633	171.94	0.000	.6736813	.6892173
2022m7		.7273495	.0035155	206.90	0.000	.7204591	.7342399
2022m8		.6686695	.0038539	173.50	0.000	.6611158	.6762232
2022m9		.5243951	.0039301	133.43	0.000	.5166921	.5320981
2022m10		.3778509	.0059345	63.67	0.000	.3662192	.3894826
2022m11		.4734299	.0150311	31.50	0.000	.4439689	.5028909
2022m12		.4723712	.0278821	16.94	0.000	.4177221	.5270202
2023m1		.56072	.0573982	9.77	0.000	.4482193	.6732207
2023m2		.6229131	.0316311	19.69	0.000	.560916	.6849102
2023m3		.5638941	.0208646	27.03	0.000	.5229994	.6047888
2023m4		.4444301	.0096548	46.03	0.000	.4255066	.4633536
2023m5		.3992244	.004193	95.21	0.000	.3910061	.4074427
2023m6		.5654632	.0038538	146.73	0.000	.5579097	.5730168
2023m7		.6794762	.0035901	189.26	0.000	.6724396	.6865128
2023m8		.6523478	.004002	163.01	0.000	.6445039	.6601918
2023m9		.5373083	.0042788	125.57	0.000	.5289218	.5456948
2023m10		.4261859	.0064808	65.76	0.000	.4134835	.4388883
2023m11		.3580671	.0145663	24.58	0.000	.329517	.3866171
2023m12		.3159748	.0246951	12.80	0.000	.2675724	.3643772
2024m1		.3820805	.0408556	9.35	0.000	.3020034	.4621577
2024m2		.318151	.0263419	12.08	0.000	.2665209	.3697811

2024m3		.5058252	.0195355	25.89	0.000	.4675356	.5441148
2024m4		.463943	.0097252	47.71	0.000	.4448815	.4830044
2024m5		.5032609	.0050719	99.22	0.000	.4933199	.5132019
2024m6		.6717013	.0044902	149.59	0.000	.6629005	.6805022
2024m7		.6532611	.0038108	171.42	0.000	.6457918	.6607303
2024m8		.6420458	.0042312	151.74	0.000	.6337526	.650339
2024m9		.4903946	.0043381	113.04	0.000	.4818919	.4988974
2024m10		.4546146	.0071866	63.26	0.000	.4405289	.4687003
2024m11		.4795598	.0156137	30.71	0.000	.4489568	.5101628
2024m12		.3926777	.0326503	12.03	0.000	.3286831	.4566724
2025m1		.2678916	.0344885	7.77	0.000	.2002942	.3354891
2025m2		.4952236	.027033	18.32	0.000	.4422388	.5482085
2025m3		.4706352	.0200933	23.42	0.000	.4312522	.5100182
ym#c.complier							
2021m3		-201.0662	19.31523	-10.41	0.000	-238.9241	-163.2083
2021m4		-288.415	28.70258	-10.05	0.000	-344.6721	-232.1578
2021m5		-464.7576	45.91098	-10.12	0.000	-554.7432	-374.7719
2021m6		-702.158	76.64472	-9.16	0.000	-852.3819	-551.9342
2021m7		-1681.583	78.3184	-21.47	0.000	-1835.087	-1528.079
2021m8		-1355.668	83.57442	-16.22	0.000	-1519.474	-1191.862
2021m9		-1084.442	64.41582	-16.84	0.000	-1210.697	-958.1866
2021m10		-409.796	36.24639	-11.31	0.000	-480.839	-338.753
2021m11		-241.2552	19.20834	-12.56	0.000	-278.9036	-203.6068
2021m12		-109.4937	18.52216	-5.91	0.000	-145.7971	-73.19016
2022m1		-85.69115	11.4743	-7.47	0.000	-108.1808	-63.20149
2022m2		-175.9749	12.35339	-14.25	0.000	-200.1876	-151.7622
2022m3		-198.6193	19.68058	-10.09	0.000	-237.1933	-160.0453
2022m4		-232.9756	30.10746	-7.74	0.000	-291.9863	-173.9649
2022m5		-379.3317	51.60146	-7.35	0.000	-480.4707	-278.1927
2022m6		-341.8833	74.80111	-4.57	0.000	-488.4937	-195.2729
2022m7		-1279.485	86.65113	-14.77	0.000	-1449.321	-1109.648
2022m8		-1274.598	86.56254	-14.72	0.000	-1444.26	-1104.935
2022m9		-676.9837	65.74258	-10.30	0.000	-805.8393	-548.128
2022m10		-184.0085	33.20849	-5.54	0.000	-249.0973	-118.9198
2022m11		-139.231	18.1731	-7.66	0.000	-174.8504	-103.6117
2022m12		-50.62799	14.05161	-3.60	0.000	-78.16917	-23.0868
2023m1		-87.69555	15.24268	-5.75	0.000	-117.5712	-57.81986
2023m2		-87.85051	15.72182	-5.59	0.000	-118.6653	-57.0357
2023m3		-149.1082	19.63717	-7.59	0.000	-187.5971	-110.6193
2023m4		-254.3324	29.6377	-8.58	0.000	-312.4224	-196.2424
2023m5		-494.4952	50.29429	-9.83	0.000	-593.0722	-395.9183
2023m6		-280.2067	69.96056	-4.01	0.000	-417.3296	-143.0838
2023m7		-1226.181	88.70696	-13.82	0.000	-1400.047	-1052.315
2023m8		-1234.907	88.73202	-13.92	0.000	-1408.822	-1060.992
2023m9		-567.627	66.83993	-8.49	0.000	-698.6334	-436.6205
2023m10		-186.8523	38.04664	-4.91	0.000	-261.4239	-112.2808
2023m11		-138.6552	19.43024	-7.14	0.000	-176.7385	-100.5718
2023m12		-29.16018	13.9314	-2.09	0.036	-56.46576	-1.854598
2024m1		-51.3783	13.35979	-3.85	0.000	-77.56352	-25.19308
2024m2		-65.44306	16.25519	-4.03	0.000	-97.30328	-33.58283
2024m3		-118.3714	21.31978	-5.55	0.000	-160.1582	-76.58454
2024m4		-202.5645	34.80277	-5.82	0.000	-270.778	-134.351
2024m5		-440.88	59.1681	-7.45	0.000	-556.8497	-324.9104
2024m6		-573.8384	87.01768	-6.59	0.000	-744.3933	-403.2835
2024m7		-1592.767	97.74959	-16.29	0.000	-1784.356	-1401.177
2024m8		-983.7694	92.90702	-10.59	0.000	-1165.867	-801.6714
2024m9		-595.2807	71.94244	-8.27	0.000	-736.2881	-454.2734

2024m10		-220.614	44.9965	-4.90	0.000	-308.8073	-132.4208
2024m11		-111.5301	24.35861	-4.58	0.000	-159.2731	-63.78719
2024m12		-14.07914	14.72873	-0.96	0.339	-42.94748	14.7892
2025m1		-23.12501	9.709621	-2.38	0.017	-42.1559	-4.094128
2025m2		-96.10035	15.03796	-6.39	0.000	-125.5748	-66.62592
2025m3		-113.7139	22.7875	-4.99	0.000	-158.3774	-69.05031
dow							
Monday		-89.67867	4.116166	-21.79	0.000	-97.74637	-81.61097
Tuesday		-166.5602	4.604691	-36.17	0.000	-175.5854	-157.535
Wednesday		-189.1871	4.612945	-41.01	0.000	-198.2285	-180.1457
Thursday		-156.361	4.436704	-35.24	0.000	-165.0569	-147.665
Friday		-189.5316	4.046047	-46.84	0.000	-197.4619	-181.6013
Saturday		-141.6059	2.629816	-53.85	0.000	-146.7603	-136.4514
outdoor_humidity		13.8088	.8018109	17.22	0.000	12.23725	15.38035
cdd60		799.7521	3.712434	215.43	0.000	792.4757	807.0284
hdd60		17.85091	.5664374	31.51	0.000	16.74069	18.96113
_cons		-1050.544	48.25296	-21.77	0.000	-1145.12	-955.9677

```

name: LDV_Regressions
log: F:\Projects\Ecobee\2025 CO2 Offsets\Modified Data\05 Output\LDV

```

Regression Output

```
> .log
```

```
log type: text
```

```
resumed on: 21 Apr 2025, 16:12:38
```

```
non_heat_pumps, auxheat1
```

Linear regression

```

Number of obs      = 77596021
F(155, 61214)      = 2779.15
Prob > F            = 0.0000
R-squared           = 0.6656
Root MSE           = 5506.2

```

(Std. err. adjusted for 61,215 clusters in dsa_id)

		Robust					
auxheat1		Coefficient	std. err.	t	P> t	[95% conf. interval]	
ym							
2021m4		642.6007	31.02634	20.71	0.000	581.789	703.4124
2021m5		1146.444	47.06771	24.36	0.000	1054.191	1238.697
2021m6		1414.089	46.96023	30.11	0.000	1322.047	1506.131
2021m7		1479.572	44.23125	33.45	0.000	1392.878	1566.265
2021m8		1496.514	45.23888	33.08	0.000	1407.846	1585.182
2021m9		1434.783	50.69157	28.30	0.000	1335.428	1534.139
2021m10		1235.827	44.68316	27.66	0.000	1148.248	1323.406
2021m11		-119.4448	50.88739	-2.35	0.019	-219.1842	-19.70536
2021m12		-425.6241	62.43398	-6.82	0.000	-547.9949	-303.2534
2022m1		-1223.914	68.30634	-17.92	0.000	-1357.795	-1090.034
2022m2		-807.9486	66.16847	-12.21	0.000	-937.6389	-678.2582
2022m3		-327.6188	42.41489	-7.72	0.000	-410.7521	-244.4855
2022m4		545.1602	42.40958	12.85	0.000	462.0373	628.2831
2022m5		1301.88	53.73089	24.23	0.000	1196.567	1407.192
2022m6		1373.47	47.05386	29.19	0.000	1281.244	1465.695
2022m7		1430.811	44.7475	31.98	0.000	1343.105	1518.516

2022m8		1479.11	45.26376	32.68	0.000	1390.393	1567.827
2022m9		1381.904	50.15434	27.55	0.000	1283.601	1480.206
2022m10		1051.777	44.69555	23.53	0.000	964.1738	1139.381
2022m11		847.818	54.33422	15.60	0.000	741.3228	954.3132
2022m12		-195.2178	71.81578	-2.72	0.007	-335.9769	-54.45863
2023m1		358.4576	64.79233	5.53	0.000	231.4645	485.4508
2023m2		-18.31886	63.46799	-0.29	0.773	-142.7163	106.0786
2023m3		172.0217	49.98413	3.44	0.001	74.05264	269.9907
2023m4		768.6286	42.27175	18.18	0.000	685.7758	851.4813
2023m5		1338.961	45.82074	29.22	0.000	1249.152	1428.769
2023m6		1449.407	45.3685	31.95	0.000	1360.484	1538.329
2023m7		1441.591	44.07993	32.70	0.000	1355.194	1527.988
2023m8		1476.517	45.00476	32.81	0.000	1388.307	1564.726
2023m9		1510.78	51.7479	29.20	0.000	1409.354	1612.206
2023m10		1132.687	46.01223	24.62	0.000	1042.503	1222.871
2023m11		110.3273	54.38896	2.03	0.043	3.724789	216.9298
2023m12		-215.2367	67.41793	-3.19	0.001	-347.376	-83.09739
2024m1		-41.61948	75.58481	-0.55	0.582	-189.7659	106.5269
2024m2		-123.0979	66.72077	-1.84	0.065	-253.8707	7.675031
2024m3		125.3601	49.861	2.51	0.012	27.63242	223.0878
2024m4		951.1654	43.15604	22.04	0.000	866.5794	1035.751
2024m5		1356.292	45.35225	29.91	0.000	1267.401	1445.183
2024m6		1444.638	43.77479	33.00	0.000	1358.84	1530.437
2024m7		1479.087	43.4188	34.07	0.000	1393.986	1564.188
2024m8		1510.771	43.44349	34.78	0.000	1425.621	1595.92
2024m9		1514.233	43.63146	34.71	0.000	1428.715	1599.75
2024m10		1118.349	45.37983	24.64	0.000	1029.404	1207.293
2024m11		519.2551	58.12801	8.93	0.000	405.3241	633.1862
2024m12		-673.3707	79.82855	-8.44	0.000	-829.8349	-516.9065
2025m1		-423.9426	88.4628	-4.79	0.000	-597.33	-250.5553
2025m2		-657.7495	77.63278	-8.47	0.000	-809.91	-505.589
2025m3		57.42737	54.78098	1.05	0.295	-49.94351	164.7982
ym#c.pre_auxheat1							
2021m3		.4477263	.0042493	105.36	0.000	.4393975	.456055
2021m4		.4043418	.0060663	66.65	0.000	.3924518	.4162318
2021m5		.51214	.0250227	20.47	0.000	.4630955	.5611845
2021m6		.4774438	.0948812	5.03	0.000	.2914764	.6634112
2021m7		.6884512	.112105	6.14	0.000	.4687251	.9081773
2021m8		.5676992	.1639377	3.46	0.001	.2463808	.8890176
2021m9		.3399713	.0972985	3.49	0.000	.1492659	.5306767
2021m10		.2790891	.0074068	37.68	0.000	.2645718	.2936064
2021m11		.4750036	.004774	99.50	0.000	.4656465	.4843608
2021m12		.5272811	.0052295	100.83	0.000	.5170312	.5375309
2022m1		.6169523	.0045533	135.50	0.000	.6080278	.6258768
2022m2		.7807511	.0064694	120.68	0.000	.768071	.7934312
2022m3		.5094293	.0047568	107.10	0.000	.500106	.5187526
2022m4		.5551462	.0072618	76.45	0.000	.540913	.5693794
2022m5		.501219	.0329177	15.23	0.000	.4367003	.5657377
2022m6		.6360261	.0915594	6.95	0.000	.4565695	.8154827
2022m7		.6566995	.1307598	5.02	0.000	.40041	.912989
2022m8		.5424085	.1775382	3.06	0.002	.1944332	.8903838
2022m9		.3430189	.0938315	3.66	0.000	.1591088	.526929
2022m10		.376893	.0085219	44.23	0.000	.36019	.3935961
2022m11		.4168364	.0046917	88.85	0.000	.4076407	.4260321
2022m12		.6302317	.0057048	110.47	0.000	.6190502	.6414132
2023m1		.4405439	.0039383	111.86	0.000	.4328249	.4482628
2023m2		.6595752	.00595	110.85	0.000	.6479131	.6712372

2023m3		.5065544	.0050292	100.72	0.000	.4966972	.5164116
2023m4		.3659067	.0054053	67.69	0.000	.3553123	.3765011
2023m5		.396695	.0210702	18.83	0.000	.3553973	.4379927
2023m6		.5771122	.0858984	6.72	0.000	.4087511	.7454733
2023m7		.6990578	.119025	5.87	0.000	.4657684	.9323472
2023m8		.5586649	.1674697	3.34	0.001	.2304237	.886906
2023m9		.3967361	.1069784	3.71	0.000	.187058	.6064141
2023m10		.3321933	.0080485	41.27	0.000	.3164182	.3479683
2023m11		.398072	.0046198	86.17	0.000	.3890172	.4071268
2023m12		.4674834	.0051916	90.05	0.000	.4573079	.4776589
2024m1		.5229842	.0044799	116.74	0.000	.5142036	.5317647
2024m2		.571345	.0058645	97.42	0.000	.5598505	.5828394
2024m3		.4184134	.0046304	90.36	0.000	.4093378	.427489
2024m4		.3619171	.0059713	60.61	0.000	.3502134	.3736208
2024m5		.3257489	.0186043	17.51	0.000	.2892844	.3622134
2024m6		.3016221	.0712884	4.23	0.000	.1618967	.4413476
2024m7		.3752718	.1425196	2.63	0.008	.095933	.6546106
2024m8		.2507725	.1177076	2.13	0.033	.0200652	.4814798
2024m9		.155294	.0313161	4.96	0.000	.0939143	.2166737
2024m10		.2461098	.0067421	36.50	0.000	.2328953	.2593243
2024m11		.3446681	.0045997	74.93	0.000	.3356526	.3536836
2024m12		.5630242	.0060104	93.68	0.000	.5512439	.5748046
2025m1		.5977996	.004975	120.16	0.000	.5880487	.6075505
2025m2		.6941493	.0066807	103.90	0.000	.6810552	.7072434
2025m3		.3946154	.0047513	83.05	0.000	.3853029	.403928
ym#c.complier							
2021m3		-513.2404	40.216	-12.76	0.000	-592.0639	-434.417
2021m4		-296.4072	27.69661	-10.70	0.000	-350.6926	-242.1218
2021m5		-46.22068	16.54034	-2.79	0.005	-78.6398	-13.80156
2021m6		26.86594	7.799392	3.44	0.001	11.57911	42.15277
2021m7		35.59244	7.685025	4.63	0.000	20.52977	50.65511
2021m8		18.7935	7.882696	2.38	0.017	3.343394	34.24361
2021m9		-2.27846	9.651876	-0.24	0.813	-21.19616	16.63924
2021m10		-222.4671	21.43948	-10.38	0.000	-264.4885	-180.4457
2021m11		-484.362	45.37614	-10.67	0.000	-573.2994	-395.4247
2021m12		-627.1546	54.66709	-11.47	0.000	-734.3022	-520.0069
2022m1		-716.5396	68.25768	-10.50	0.000	-850.3248	-582.7544
2022m2		-232.3486	63.04355	-3.69	0.000	-355.9141	-108.7831
2022m3		-300.2326	42.6865	-7.03	0.000	-383.8983	-216.5669
2022m4		-342.0249	33.203	-10.30	0.000	-407.1028	-276.9469
2022m5		-122.2567	17.08893	-7.15	0.000	-155.751	-88.76232
2022m6		-14.96848	12.1387	-1.23	0.218	-38.76036	8.823392
2022m7		-1.839512	9.123149	-0.20	0.840	-19.72091	16.04189
2022m8		23.07007	7.70215	3.00	0.003	7.973837	38.16631
2022m9		-4.012653	9.740204	-0.41	0.680	-23.10348	15.07817
2022m10		-207.5388	25.68602	-8.08	0.000	-257.8835	-157.1941
2022m11		-686.347	49.22487	-13.94	0.000	-782.8279	-589.8661
2022m12		-605.8028	62.76722	-9.65	0.000	-728.8267	-482.7789
2023m1		-908.7181	61.91589	-14.68	0.000	-1030.073	-787.3628
2023m2		-631.5306	59.48034	-10.62	0.000	-748.1122	-514.9489
2023m3		-638.0459	50.64363	-12.60	0.000	-737.3076	-538.7843
2023m4		-311.032	29.45151	-10.56	0.000	-368.7571	-253.307
2023m5		-119.5451	15.56444	-7.68	0.000	-150.0515	-89.03879
2023m6		-25.27556	9.851216	-2.57	0.010	-44.58397	-5.967152
2023m7		21.03001	6.015186	3.50	0.000	9.24023	32.81979
2023m8		14.93659	6.966018	2.14	0.032	1.283175	28.59001
2023m9		-18.14151	11.37456	-1.59	0.111	-40.43569	4.152665

2023m10		-215.7625	24.52359	-8.80	0.000	-263.8288	-167.6962
2023m11		-483.9454	46.47019	-10.41	0.000	-575.0271	-392.8637
2023m12		-553.1027	54.32711	-10.18	0.000	-659.584	-446.6214
2024m1		-677.1744	70.13173	-9.66	0.000	-814.6328	-539.716
2024m2		-528.2169	57.6936	-9.16	0.000	-641.2965	-415.1373
2024m3		-474.2989	45.06833	-10.52	0.000	-562.633	-385.9649
2024m4		-327.303	30.61019	-10.69	0.000	-387.2991	-267.307
2024m5		-107.8567	16.0558	-6.72	0.000	-139.3261	-76.38731
2024m6		10.14879	9.635647	1.05	0.292	-8.737101	29.03469
2024m7		26.18147	7.388355	3.54	0.000	11.70027	40.66266
2024m8		1.472532	7.326118	0.20	0.841	-12.88668	15.83174
2024m9		-36.54303	9.097599	-4.02	0.000	-54.37435	-18.71171
2024m10		-189.5702	24.24696	-7.82	0.000	-237.0943	-142.0461
2024m11		-539.3523	49.26241	-10.95	0.000	-635.9067	-442.7978
2024m12		-489.6878	65.3371	-7.49	0.000	-617.7487	-361.627
2025m1		-814.6945	82.51196	-9.87	0.000	-976.4181	-652.9708
2025m2		-476.4789	68.90197	-6.92	0.000	-611.5269	-341.4308
2025m3		-418.4467	47.1225	-8.88	0.000	-510.807	-326.0865
dow							
Monday		10.17065	2.40057	4.24	0.000	5.465525	14.87577
Tuesday		-61.50397	2.39142	-25.72	0.000	-66.19116	-56.81678
Wednesday		-39.95528	2.457941	-16.26	0.000	-44.77285	-35.13771
Thursday		-31.85623	2.481348	-12.84	0.000	-36.71968	-26.99278
Friday		-17.32219	2.356125	-7.35	0.000	-21.9402	-12.70418
Saturday		56.41745	1.664901	33.89	0.000	53.15424	59.68066
outdoor_humidity		-15.10642	.3189555	-47.36	0.000	-15.73157	-14.48126
cdd60		.6187115	.7397674	0.84	0.403	-.8312347	2.068658
hdd60		406.1258	1.746766	232.50	0.000	402.7022	409.5495
_cons		-467.2473	47.92554	-9.75	0.000	-561.1815	-373.3131

```

-----
name: LDV_Regressions
log: F:\Projects\Ecobee\2025 CO2 Offsets\Modified Data\05 Output\LDV
Regression Output
> .log
log type: text
resumed on: 21 Apr 2025, 16:26:30
heat_pumps, compcool1

```

```

Linear regression
Number of obs      = 29486071
F(155, 23685)     = 1905.35
Prob > F           = 0.0000
R-squared          = 0.6822
Root MSE          = 8959.3

```

(Std. err. adjusted for 23,686 clusters in dsa_id)

		Robust					
compcool1		Coefficient	std. err.	t	P> t	[95% conf. interval]	
ym							
2021m4		-205.5882	60.67091	-3.39	0.001	-324.5071	-86.66932
2021m5		-2457.244	114.566	-21.45	0.000	-2681.8	-2232.687
2021m6		-2577.187	181.9747	-14.16	0.000	-2933.869	-2220.505
2021m7		-4875.539	212.2751	-22.97	0.000	-5291.612	-4459.466

2021m8	-3204.395	215.5903	-14.86	0.000	-3626.965	-2781.824
2021m9	-2269.838	157.4915	-14.41	0.000	-2578.532	-1961.145
2021m10	-1587.148	102.9909	-15.41	0.000	-1789.016	-1385.279
2021m11	-258.9241	68.04205	-3.81	0.000	-392.2908	-125.5573
2021m12	-455.7499	74.12147	-6.15	0.000	-601.0327	-310.4671
2022m1	-332.4508	63.33098	-5.25	0.000	-456.5835	-208.318
2022m2	-368.2777	58.52216	-6.29	0.000	-482.9849	-253.5705
2022m3	-181.5141	59.95309	-3.03	0.002	-299.026	-64.00216
2022m4	-279.3006	80.09186	-3.49	0.000	-436.2858	-122.3154
2022m5	-2520.36	134.1654	-18.79	0.000	-2783.333	-2257.388
2022m6	-3238.66	187.9436	-17.23	0.000	-3607.041	-2870.278
2022m7	-4439.138	236.676	-18.76	0.000	-4903.038	-3975.238
2022m8	-2464.37	230.5932	-10.69	0.000	-2916.347	-2012.392
2022m9	-1483.855	174.4296	-8.51	0.000	-1825.748	-1141.962
2022m10	-1188.609	96.37439	-12.33	0.000	-1377.509	-999.7091
2022m11	-170.2539	72.9393	-2.33	0.020	-313.2196	-27.28816
2022m12	-545.9467	62.41868	-8.75	0.000	-668.2914	-423.6021
2023m1	-446.5595	64.18212	-6.96	0.000	-572.3605	-320.7584
2023m2	-299.5296	61.88841	-4.84	0.000	-420.8348	-178.2243
2023m3	-51.87037	65.79279	-0.79	0.430	-180.8285	77.08772
2023m4	-18.22794	88.31627	-0.21	0.836	-191.3335	154.8776
2023m5	-1625.275	134.1825	-12.11	0.000	-1888.281	-1362.268
2023m6	-3145.204	185.3702	-16.97	0.000	-3508.542	-2781.867
2023m7	-3496.414	246.9959	-14.16	0.000	-3980.542	-3012.287
2023m8	-2272.389	242.2074	-9.38	0.000	-2747.131	-1797.647
2023m9	-1615.351	179.6621	-8.99	0.000	-1967.5	-1263.202
2023m10	-1002.494	109.4121	-9.16	0.000	-1216.949	-788.0391
2023m11	-245.1966	71.10485	-3.45	0.001	-384.5667	-105.8265
2023m12	-459.9819	67.18673	-6.85	0.000	-591.6722	-328.2916
2024m1	-638.2623	67.3122	-9.48	0.000	-770.1986	-506.3261
2024m2	-274.1733	65.55989	-4.18	0.000	-402.6749	-145.6718
2024m3	47.40109	74.20515	0.64	0.523	-98.04577	192.8479
2024m4	240.5575	101.9547	2.36	0.018	40.71988	440.3952
2024m5	-1692.051	169.6669	-9.97	0.000	-2024.609	-1359.493
2024m6	-1482.162	221.7898	-6.68	0.000	-1916.884	-1047.44
2024m7	-2052.089	268.9228	-7.63	0.000	-2579.195	-1524.983
2024m8	-2067.536	251.9429	-8.21	0.000	-2561.36	-1573.711
2024m9	-1854.188	192.0871	-9.65	0.000	-2230.691	-1477.685
2024m10	-259.3574	127.6644	-2.03	0.042	-509.5879	-9.126936
2024m11	205.5811	88.23628	2.33	0.020	32.63228	378.5298
2024m12	-462.1816	70.40051	-6.57	0.000	-600.1712	-324.1921
2025m1	-369.9577	65.19741	-5.67	0.000	-497.7488	-242.1666
2025m2	-333.879	70.62406	-4.73	0.000	-472.3067	-195.4513
2025m3	298.6079	77.81427	3.84	0.000	146.0869	451.1288
ym#c.pre_compcool1						
2021m3	.6334431	.0247946	25.55	0.000	.5848441	.6820421
2021m4	.4987483	.0088551	56.32	0.000	.4813917	.5161048
2021m5	.5059103	.0051509	98.22	0.000	.4958143	.5160063
2021m6	.615916	.0055193	111.59	0.000	.6050977	.6267343
2021m7	.667151	.0058197	114.64	0.000	.6557439	.678558
2021m8	.6531783	.006637	98.41	0.000	.6401693	.6661873
2021m9	.5063167	.0055713	90.88	0.000	.4953966	.5172369
2021m10	.4946383	.006942	71.25	0.000	.4810316	.5082451
2021m11	.2482158	.0127933	19.40	0.000	.2231401	.2732915
2021m12	.6567833	.0431349	15.23	0.000	.5722361	.7413305
2022m1	.4333679	.0432392	10.02	0.000	.3486162	.5181195
2022m2	.41496	.0211278	19.64	0.000	.3735482	.4563719

2022m3		.6236979	.0248916	25.06	0.000	.5749088	.6724871
2022m4		.5485512	.0096814	56.66	0.000	.5295749	.5675275
2022m5		.59759	.0060784	98.31	0.000	.585676	.609504
2022m6		.6873386	.0063261	108.65	0.000	.674939	.6997382
2022m7		.7100425	.0067562	105.10	0.000	.6968	.723285
2022m8		.6102889	.0068151	89.55	0.000	.5969309	.6236469
2022m9		.4700222	.0057176	82.21	0.000	.4588154	.481229
2022m10		.375138	.0064131	58.50	0.000	.362568	.3877081
2022m11		.4317299	.0131363	32.87	0.000	.4059818	.457478
2022m12		.4663958	.0247045	18.88	0.000	.4179734	.5148182
2023m1		.4781712	.0413055	11.58	0.000	.3972098	.5591326
2023m2		.5857442	.0238361	24.57	0.000	.5390238	.6324646
2023m3		.6879247	.0292675	23.50	0.000	.6305585	.7452908
2023m4		.5310107	.0101606	52.26	0.000	.5110954	.5509261
2023m5		.4575702	.0058864	77.73	0.000	.4460324	.4691079
2023m6		.5753869	.0061256	93.93	0.000	.5633803	.5873935
2023m7		.6681587	.0069846	95.66	0.000	.6544684	.681849
2023m8		.6393267	.0075125	85.10	0.000	.6246017	.6540516
2023m9		.4944782	.0063	78.49	0.000	.4821299	.5068266
2023m10		.4039775	.0070917	56.96	0.000	.3900773	.4178777
2023m11		.3261838	.0116803	27.93	0.000	.3032897	.349078
2023m12		.3631326	.0233482	15.55	0.000	.3173686	.4088965
2024m1		.2969445	.0408374	7.27	0.000	.2169005	.3769885
2024m2		.2857574	.0185293	15.42	0.000	.2494388	.322076
2024m3		.5800961	.0287422	20.18	0.000	.5237595	.6364327
2024m4		.4926636	.0108828	45.27	0.000	.4713326	.5139945
2024m5		.5826861	.0071574	81.41	0.000	.568657	.5967151
2024m6		.6555237	.0068783	95.30	0.000	.6420417	.6690057
2024m7		.6392921	.0073478	87.01	0.000	.62489	.6536941
2024m8		.6138967	.0075935	80.84	0.000	.5990129	.6287804
2024m9		.4651854	.0065049	71.51	0.000	.4524354	.4779354
2024m10		.4204544	.0083577	50.31	0.000	.4040728	.4368361
2024m11		.5018446	.0158591	31.64	0.000	.4707598	.5329294
2024m12		.3762639	.0337111	11.16	0.000	.310188	.4423398
2025m1		.2193393	.035371	6.20	0.000	.1500098	.2886688
2025m2		.4839201	.0247022	19.59	0.000	.4355022	.5323379
2025m3		.5119539	.0287834	17.79	0.000	.4555365	.5683713
ym#c.complier							
2021m3		-309.0682	57.87652	-5.34	0.000	-422.5099	-195.6265
2021m4		-621.6076	81.56676	-7.62	0.000	-781.4837	-461.7316
2021m5		-736.0003	113.8709	-6.46	0.000	-959.1946	-512.8059
2021m6		-1591.452	158.2931	-10.05	0.000	-1901.716	-1281.187
2021m7		-1871.048	167.9696	-11.14	0.000	-2200.279	-1541.816
2021m8		-1540.218	173.7666	-8.86	0.000	-1880.811	-1199.624
2021m9		-891.1311	144.3673	-6.17	0.000	-1174.1	-608.1619
2021m10		-346.7674	98.43696	-3.52	0.000	-539.7102	-153.8247
2021m11		-82.82883	48.24059	-1.72	0.086	-177.3835	11.72581
2021m12		11.2769	54.17744	0.21	0.835	-94.91435	117.4682
2022m1		77.45864	33.16561	2.34	0.020	12.45192	142.4654
2022m2		41.35366	38.51045	1.07	0.283	-34.1293	116.8366
2022m3		-178.8128	58.76453	-3.04	0.002	-293.995	-63.6305
2022m4		-418.681	85.75156	-4.88	0.000	-586.7596	-250.6025
2022m5		-398.659	129.2933	-3.08	0.002	-652.0822	-145.2358
2022m6		-767.8212	168.3075	-4.56	0.000	-1097.715	-437.9277
2022m7		-1208.715	187.0793	-6.46	0.000	-1575.403	-842.0279
2022m8		-1103.501	184.6983	-5.97	0.000	-1465.521	-741.4803
2022m9		-728.4353	155.8029	-4.68	0.000	-1033.819	-423.0517

2022m10		42.39543	87.98051	0.48	0.630	-130.052	214.8429
2022m11		-24.39045	62.22551	-0.39	0.695	-146.3564	97.57554
2022m12		19.32703	38.10921	0.51	0.612	-55.36946	94.02352
2023m1		26.97678	41.06006	0.66	0.511	-53.50356	107.4571
2023m2		-53.05829	53.24828	-1.00	0.319	-157.4283	51.31176
2023m3		-174.7358	63.6396	-2.75	0.006	-299.4735	-49.99812
2023m4		-644.7569	91.16047	-7.07	0.000	-823.4373	-466.0765
2023m5		-556.971	127.1074	-4.38	0.000	-806.1096	-307.8324
2023m6		-880.3507	162.0261	-5.43	0.000	-1197.932	-562.7691
2023m7		-1240.459	197.5722	-6.28	0.000	-1627.713	-853.2052
2023m8		-884.3299	200.5858	-4.41	0.000	-1277.491	-491.1689
2023m9		-598.1226	161.6758	-3.70	0.000	-915.0177	-281.2276
2023m10		-53.37869	101.2349	-0.53	0.598	-251.8055	145.0481
2023m11		10.02927	58.06797	0.17	0.863	-103.7877	123.8462
2023m12		59.29286	42.24464	1.40	0.160	-23.50935	142.0951
2024m1		43.92083	38.46838	1.14	0.254	-31.47966	119.3213
2024m2		-10.28821	44.58663	-0.23	0.818	-97.68087	77.10445
2024m3		-208.8782	73.50817	-2.84	0.004	-352.959	-64.79752
2024m4		-487.5851	103.8488	-4.70	0.000	-691.1354	-284.0347
2024m5		-595.3225	161.2165	-3.69	0.000	-911.3172	-279.3279
2024m6		-755.9407	201.5392	-3.75	0.000	-1150.971	-360.9109
2024m7		-1480.878	220.0022	-6.73	0.000	-1912.096	-1049.659
2024m8		-616.1976	213.5776	-2.89	0.004	-1034.823	-197.5718
2024m9		-675.2099	173.3376	-3.90	0.000	-1014.963	-335.457
2024m10		-250.3683	119.7949	-2.09	0.037	-485.174	-15.56257
2024m11		84.81797	81.05872	1.05	0.295	-74.06231	243.6983
2024m12		108.7338	50.67869	2.15	0.032	9.400328	208.0673
2025m1		121.63	33.26643	3.66	0.000	56.4257	186.8344
2025m2		5.07526	56.78086	0.09	0.929	-106.2189	116.3694
2025m3		-76.59571	72.44436	-1.06	0.290	-218.5913	65.39989
dow							
Monday		-142.8418	8.781706	-16.27	0.000	-160.0545	-125.6291
Tuesday		-304.3789	9.642854	-31.57	0.000	-323.2796	-285.4783
Wednesday		-399.7806	9.798838	-40.80	0.000	-418.9869	-380.5742
Thursday		-342.0589	9.335521	-36.64	0.000	-360.3571	-323.7607
Friday		-326.7764	8.336333	-39.20	0.000	-343.1162	-310.4367
Saturday		-185.7721	4.841531	-38.37	0.000	-195.2618	-176.2824
outdoor_humidity		36.52268	1.440239	25.36	0.000	33.69972	39.34564
cdd60		773.9793	5.431435	142.50	0.000	763.3333	784.6252
hdd60		23.30178	1.308716	17.81	0.000	20.73662	25.86695
_cons		-2362.137	104.3056	-22.65	0.000	-2566.582	-2157.691

```

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name: LDV_Regressions
log: F:\Projects\Ecobee\2025 CO2 Offsets\Modified Data\05 Output\LDV
Regression Output
> .log
log type: text
resumed on: 21 Apr 2025, 16:33:00
heat_pumps, auxheat1

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Linear regression
Number of obs      = 29486071
F(155, 23685)     = 2235.48
Prob > F           = 0.0000
R-squared          = 0.2819

```

Root MSE = 3570.8

(Std. err. adjusted for 23,686 clusters in dsa_id)

auxheat1	Coefficient	Robust std. err.	t	P> t	[95% conf. interval]	
ym						
2021m4	485.6166	28.93156	16.79	0.000	428.9089	542.3244
2021m5	658.5056	37.76084	17.44	0.000	584.4919	732.5193
2021m6	556.3564	39.55802	14.06	0.000	478.8201	633.8926
2021m7	503.0208	39.40673	12.76	0.000	425.7811	580.2606
2021m8	501.2009	39.38099	12.73	0.000	424.0117	578.3902
2021m9	647.2531	39.48639	16.39	0.000	569.8572	724.6489
2021m10	639.3074	37.44363	17.07	0.000	565.9155	712.6994
2021m11	-147.1106	43.941	-3.35	0.001	-233.2378	-60.98346
2021m12	-104.2702	50.68534	-2.06	0.040	-203.6167	-4.923687
2022m1	-500.7524	93.62136	-5.35	0.000	-684.2563	-317.2486
2022m2	-108.3081	76.94509	-1.41	0.159	-259.1254	42.50922
2022m3	79.81809	40.83261	1.95	0.051	-.2164387	159.8526
2022m4	419.2916	37.68363	11.13	0.000	345.4293	493.1539
2022m5	633.7613	38.51117	16.46	0.000	558.2769	709.2456
2022m6	532.1575	39.57012	13.45	0.000	454.5975	609.7175
2022m7	441.5472	39.38703	11.21	0.000	364.3461	518.7483
2022m8	505.3753	39.42107	12.82	0.000	428.1075	582.6431
2022m9	627.5035	39.66059	15.82	0.000	549.7661	705.2408
2022m10	550.1383	37.89657	14.52	0.000	475.8586	624.418
2022m11	86.63873	51.17887	1.69	0.090	-13.67515	186.9526
2022m12	489.3201	74.24676	6.59	0.000	343.7917	634.8485
2023m1	-491.7774	62.8113	-7.83	0.000	-614.8916	-368.6632
2023m2	-81.97037	61.66956	-1.33	0.184	-202.8467	38.90593
2023m3	-139.6212	48.10648	-2.90	0.004	-233.9129	-45.32936
2023m4	476.5334	37.26488	12.79	0.000	403.4918	549.575
2023m5	693.5003	39.35995	17.62	0.000	616.3523	770.6484
2023m6	626.6286	39.78697	15.75	0.000	548.6436	704.6136
2023m7	450.5639	39.50425	11.41	0.000	373.1331	527.9948
2023m8	478.409	39.63601	12.07	0.000	400.7199	556.0981
2023m9	643.0692	39.8365	16.14	0.000	564.9871	721.1513
2023m10	625.5829	39.53441	15.82	0.000	548.0929	703.0729
2023m11	-8.933232	50.00059	-0.18	0.858	-106.9376	89.07114
2023m12	-325.4035	62.05137	-5.24	0.000	-447.0282	-203.7788
2024m1	230.8245	92.575	2.49	0.013	49.37156	412.2775
2024m2	-299.2701	64.26033	-4.66	0.000	-425.2244	-173.3157
2024m3	145.0092	45.21272	3.21	0.001	56.38936	233.629
2024m4	514.0764	41.28785	12.45	0.000	433.1495	595.0032
2024m5	647.0854	41.35226	15.65	0.000	566.0323	728.1384
2024m6	532.162	39.81655	13.37	0.000	454.119	610.205
2024m7	470.6539	39.47442	11.92	0.000	393.2815	548.0263
2024m8	526.0897	41.31967	12.73	0.000	445.1005	607.0789
2024m9	674.4719	41.61861	16.21	0.000	592.8967	756.047
2024m10	609.8438	40.25365	15.15	0.000	530.9441	688.7435
2024m11	189.4036	52.10996	3.63	0.000	87.26469	291.5424
2024m12	-253.4611	83.51503	-3.03	0.002	-417.1559	-89.76625
2025m1	-5.006427	131.8579	-0.04	0.970	-263.4564	253.4436
2025m2	84.09956	94.76105	0.89	0.375	-101.6382	269.8373
2025m3	136.6029	50.4401	2.71	0.007	37.73711	235.4688
ym#c.pre_auxheat1						

2021m3		.3541314	.0143935	24.60	0.000	.3259193	.3823436
2021m4		.3457452	.0247707	13.96	0.000	.297193	.3942974
2021m5		.6130402	.0840689	7.29	0.000	.4482597	.7778207
2021m6		.7205895	.1526165	4.72	0.000	.4214513	1.019728
2021m7		.7303459	.0517258	14.12	0.000	.62896	.8317319
2021m8		.6730784	.035606	18.90	0.000	.6032883	.7428684
2021m9		.3606336	.1162642	3.10	0.002	.1327483	.5885189
2021m10		.1775551	.0183145	9.69	0.000	.1416575	.2134526
2021m11		.2827422	.0154994	18.24	0.000	.2523624	.313122
2021m12		.3393957	.0171109	19.84	0.000	.3058572	.3729343
2022m1		.5648378	.0157785	35.80	0.000	.533911	.5957646
2022m2		.6665195	.0236486	28.18	0.000	.6201668	.7128723
2022m3		.3346349	.0139944	23.91	0.000	.307205	.3620648
2022m4		.3688831	.0264161	13.96	0.000	.3171059	.4206603
2022m5		.4654222	.0755883	6.16	0.000	.3172643	.6135801
2022m6		.7943546	.1351604	5.88	0.000	.5294316	1.059278
2022m7		.550607	.0474056	11.61	0.000	.4576891	.643525
2022m8		.5681805	.0547336	10.38	0.000	.4608991	.6754619
2022m9		.3021554	.1019944	2.96	0.003	.1022398	.502071
2022m10		.1732542	.0201991	8.58	0.000	.1336628	.2128457
2022m11		.2447042	.0140978	17.36	0.000	.2170717	.2723367
2022m12		.4194696	.0197908	21.20	0.000	.3806784	.4582608
2023m1		.2395266	.0110539	21.67	0.000	.2178603	.261193
2023m2		.4113215	.0184609	22.28	0.000	.375137	.447506
2023m3		.2700884	.0152114	17.76	0.000	.240273	.2999039
2023m4		.1597599	.0165712	9.64	0.000	.1272793	.1922406
2023m5		.2350599	.0405408	5.80	0.000	.1555974	.3145225
2023m6		.3883138	.0757457	5.13	0.000	.2398474	.5367803
2023m7		.6433613	.0592112	10.87	0.000	.5273036	.7594191
2023m8		.570361	.0548247	10.40	0.000	.4629011	.6778209
2023m9		.2109266	.1068665	1.97	0.048	.0014614	.4203919
2023m10		.065245	.0122946	5.31	0.000	.0411469	.0893432
2023m11		.1569963	.0145483	10.79	0.000	.1284807	.1855118
2023m12		.2002904	.0134358	14.91	0.000	.1739553	.2266254
2024m1		.3772407	.0129726	29.08	0.000	.3518136	.4026678
2024m2		.2851211	.0153369	18.59	0.000	.2550599	.3151824
2024m3		.1526276	.0130452	11.70	0.000	.1270581	.1781971
2024m4		.1204265	.0177054	6.80	0.000	.0857227	.1551302
2024m5		.2853652	.1488957	1.92	0.055	-.00648	.5772104
2024m6		.5417989	.0453188	11.96	0.000	.4529712	.6306266
2024m7		.8226325	.0336595	24.44	0.000	.7566577	.8886073
2024m8		.9418819	.1629578	5.78	0.000	.6224741	1.26129
2024m9		.1156759	.0476139	2.43	0.015	.0223496	.2090022
2024m10		.0400696	.0095382	4.20	0.000	.0213742	.058765
2024m11		.0998212	.0082952	12.03	0.000	.0835621	.1160803
2024m12		.3010958	.0170176	17.69	0.000	.2677402	.3344514
2025m1		.5081072	.0160559	31.65	0.000	.4766366	.5395777
2025m2		.5042767	.021218	23.77	0.000	.4626881	.5458653
2025m3		.1564493	.011064	14.14	0.000	.1347631	.1781356
ym#c.complier							
2021m3		66.06233	44.72183	1.48	0.140	-21.59533	153.72
2021m4		-38.0359	28.85574	-1.32	0.187	-94.59501	18.5232
2021m5		-41.01762	9.943814	-4.12	0.000	-60.50813	-21.5271
2021m6		-36.4357	3.834198	-9.50	0.000	-43.95097	-28.92042
2021m7		-25.66903	3.642068	-7.05	0.000	-32.80771	-18.53034
2021m8		-30.75745	3.366843	-9.14	0.000	-37.35668	-24.15822
2021m9		-32.59716	4.010614	-8.13	0.000	-40.45822	-24.7361

2021m10	-7.557923	12.69441	-0.60	0.552	-32.43978	17.32393
2021m11	16.83515	48.24209	0.35	0.727	-77.72244	111.3927
2021m12	-43.62558	62.45166	-0.70	0.485	-166.0348	78.78368
2022m1	-345.7746	107.3299	-3.22	0.001	-556.148	-135.4012
2022m2	-108.3127	89.11459	-1.22	0.224	-282.983	66.35762
2022m3	-18.95727	48.55165	-0.39	0.696	-114.1216	76.20708
2022m4	-40.94897	34.40814	-1.19	0.234	-108.3911	26.4932
2022m5	-39.38765	11.12681	-3.54	0.000	-61.19691	-17.57838
2022m6	-49.80464	4.359791	-11.42	0.000	-58.35011	-41.25917
2022m7	-39.2255	3.776641	-10.39	0.000	-46.62796	-31.82304
2022m8	-31.39633	3.443128	-9.12	0.000	-38.14509	-24.64758
2022m9	-36.95788	4.052958	-9.12	0.000	-44.90194	-29.01382
2022m10	.8743139	15.45141	0.06	0.955	-29.41143	31.16006
2022m11	-70.71995	54.21428	-1.30	0.192	-176.9834	35.54351
2022m12	-186.6925	83.81713	-2.23	0.026	-350.9795	-22.40556
2023m1	-32.46669	73.33995	-0.44	0.658	-176.2177	111.2843
2023m2	-35.35742	70.16796	-0.50	0.614	-172.8911	102.1763
2023m3	68.5434	55.45969	1.24	0.217	-40.16115	177.248
2023m4	34.73591	20.29277	1.71	0.087	-5.03922	74.51104
2023m5	-21.92282	6.216761	-3.53	0.000	-34.10807	-9.737572
2023m6	-41.61825	3.885885	-10.71	0.000	-49.23483	-34.00166
2023m7	-46.90808	4.362563	-10.75	0.000	-55.45899	-38.35718
2023m8	-47.40853	4.140267	-11.45	0.000	-55.52372	-39.29334
2023m9	-42.66104	4.259509	-10.02	0.000	-51.00995	-34.31213
2023m10	-40.93876	15.70415	-2.61	0.009	-71.71991	-10.15761
2023m11	-16.15787	43.60197	-0.37	0.711	-101.6205	69.30478
2023m12	-47.08386	65.0235	-0.72	0.469	-174.5341	80.36637
2024m1	-455.2233	102.3617	-4.45	0.000	-655.8588	-254.5878
2024m2	51.67574	67.61476	0.76	0.445	-80.85353	184.205
2024m3	56.20798	43.9052	1.28	0.200	-29.84902	142.265
2024m4	7.920638	24.6668	0.32	0.748	-40.42788	56.26915
2024m5	-18.04941	7.534526	-2.40	0.017	-32.81756	-3.281253
2024m6	-39.61002	6.055159	-6.54	0.000	-51.47852	-27.74152
2024m7	-41.14664	4.168139	-9.87	0.000	-49.31646	-32.97682
2024m8	-58.87018	13.09654	-4.50	0.000	-84.54023	-33.20013
2024m9	-56.38989	12.11622	-4.65	0.000	-80.13846	-32.64133
2024m10	-1.193383	14.47255	-0.08	0.934	-29.56052	27.17375
2024m11	49.19579	44.77113	1.10	0.272	-38.5585	136.9501
2024m12	-4.087281	91.75856	-0.04	0.964	-183.9399	175.7654
2025m1	-342.5302	145.0826	-2.36	0.018	-626.9015	-58.15892
2025m2	-56.26554	102.8871	-0.55	0.584	-257.9309	145.3998
2025m3	91.51526	47.77569	1.92	0.055	-2.128161	185.1587
dow						
Monday	-30.75699	1.548959	-19.86	0.000	-33.79305	-27.72093
Tuesday	-27.16581	1.734274	-15.66	0.000	-30.5651	-23.76652
Wednesday	.7305384	1.962761	0.37	0.710	-3.116599	4.577676
Thursday	-18.43554	2.114541	-8.72	0.000	-22.58018	-14.29091
Friday	-6.971644	2.070753	-3.37	0.001	-11.03045	-2.912835
Saturday	29.75789	1.393244	21.36	0.000	27.02704	32.48874
outdoor_humidity	-.6146961	.2581834	-2.38	0.017	-1.120752	-.10864
cdd60	32.07413	.5896759	54.39	0.000	30.91833	33.22993
hdd60	177.5759	2.470093	71.89	0.000	172.7344	182.4174
_cons	-1047.097	46.66085	-22.44	0.000	-1138.555	-955.6386

```

name: LDV_Regressions
log: F:\Projects\Ecobee\2025 CO2 Offsets\Modified Data\05 Output\LDV
Regression Output
> .log
log type: text
resumed on: 21 Apr 2025, 16:39:07
heat_pumps, compheat1

```

```

Linear regression
Number of obs      = 29486071
F(155, 23685)      = 650.50
Prob > F           = 0.0000
R-squared          = 0.5516
Root MSE          = 7846.2

```

(Std. err. adjusted for 23,686 clusters in dsa_id)

	compheat1	Coefficient	Robust std. err.	t	P> t	[95% conf. interval]	
	ym						
	2021m4	581.9397	67.56595	8.61	0.000	449.5061	714.3732
	2021m5	993.4795	88.44357	11.23	0.000	820.1244	1166.835
	2021m6	1199.544	95.22819	12.60	0.000	1012.891	1386.198
	2021m7	1255.51	96.36395	13.03	0.000	1066.631	1444.39
	2021m8	1275.821	96.26953	13.25	0.000	1087.126	1464.515
	2021m9	1177.548	96.09191	12.25	0.000	989.2018	1365.894
	2021m10	890.3124	92.32413	9.64	0.000	709.3512	1071.274
	2021m11	263.1174	120.9167	2.18	0.030	26.11301	500.1218
	2021m12	-323.0762	123.8937	-2.61	0.009	-565.9159	-80.23652
	2022m1	-1296.227	186.0583	-6.97	0.000	-1660.914	-931.5413
	2022m2	742.0067	157.8708	4.70	0.000	432.5697	1051.444
	2022m3	93.44204	100.1353	0.93	0.351	-102.8295	289.7136
	2022m4	584.0383	94.39288	6.19	0.000	399.0222	769.0544
	2022m5	1302.914	94.72003	13.76	0.000	1117.256	1488.571
	2022m6	1146.126	96.22571	11.91	0.000	957.5173	1334.734
	2022m7	1242.675	96.32449	12.90	0.000	1053.873	1431.477
	2022m8	1254.51	96.25419	13.03	0.000	1065.846	1443.175
	2022m9	1130.634	96.1144	11.76	0.000	942.2431	1319.024
	2022m10	924.0601	97.84918	9.44	0.000	732.2694	1115.851
	2022m11	691.001	122.5039	5.64	0.000	450.8855	931.1165
	2022m12	860.3068	164.9846	5.21	0.000	536.9263	1183.687
	2023m1	287.9509	164.6555	1.75	0.080	-34.78431	610.6862
	2023m2	932.0879	143.9237	6.48	0.000	649.9883	1214.188
	2023m3	362.1308	120.7276	3.00	0.003	125.497	598.7645
	2023m4	787.1981	95.49665	8.24	0.000	600.0185	974.3777
	2023m5	1137.517	95.16914	11.95	0.000	950.9799	1324.055
	2023m6	1152.615	96.63932	11.93	0.000	963.1961	1342.035
	2023m7	1224.841	96.22852	12.73	0.000	1036.227	1413.455
	2023m8	1224.333	96.1753	12.73	0.000	1035.823	1412.843
	2023m9	1198.405	97.09832	12.34	0.000	1008.086	1388.724
	2023m10	825.179	96.90223	8.52	0.000	635.2444	1015.114
	2023m11	381.6534	125.2392	3.05	0.002	136.1765	627.1304
	2023m12	849.6759	158.9758	5.34	0.000	538.0732	1161.279
	2024m1	157.0789	195.7893	0.80	0.422	-226.6806	540.8385
	2024m2	1591.639	163.505	9.73	0.000	1271.159	1912.119
	2024m3	627.6746	120.7042	5.20	0.000	391.0866	864.2625
	2024m4	920.4798	100.6552	9.14	0.000	723.1891	1117.771
	2024m5	1175.663	97.38734	12.07	0.000	984.7773	1366.548

2024m6		1143.858	97.15346	11.77	0.000	953.4308	1334.285
2024m7		1247.088	96.66175	12.90	0.000	1057.625	1436.551
2024m8		1237.247	96.47252	12.82	0.000	1048.154	1426.339
2024m9		1202.693	97.54212	12.33	0.000	1011.504	1393.881
2024m10		979.7526	99.61938	9.83	0.000	784.4922	1175.013
2024m11		654.3815	132.5147	4.94	0.000	394.6443	914.1188
2024m12		530.3909	195.6305	2.71	0.007	146.9425	913.8393
2025m1		628.2948	278.1285	2.26	0.024	83.14507	1173.445
2025m2		525.649	201.6381	2.61	0.009	130.4255	920.8726
2025m3		654.0299	130.9986	4.99	0.000	397.2642	910.7956
ym#c.pre_compheat1							
2021m3		.4393512	.0059392	73.98	0.000	.42771	.4509924
2021m4		.4458342	.0103337	43.14	0.000	.4255794	.466089
2021m5		.5493461	.0331946	16.55	0.000	.4842827	.6144096
2021m6		.3228192	.0971913	3.32	0.001	.132318	.5133205
2021m7		.714166	.074442	9.59	0.000	.568255	.860077
2021m8		.2282524	.1380237	1.65	0.098	-.0422829	.4987877
2021m9		.2905747	.0573601	5.07	0.000	.1781452	.4030042
2021m10		.2536451	.0105339	24.08	0.000	.232998	.2742922
2021m11		.4880075	.0067707	72.08	0.000	.4747366	.5012785
2021m12		.4472773	.0061642	72.56	0.000	.4351951	.4593595
2022m1		.6694011	.0074332	90.06	0.000	.6548316	.6839707
2022m2		.7572593	.0103705	73.02	0.000	.7369325	.7775862
2022m3		.4528093	.0064033	70.72	0.000	.4402585	.4653601
2022m4		.5753794	.0131555	43.74	0.000	.5495937	.6011651
2022m5		.5282892	.0541091	9.76	0.000	.4222319	.6343464
2022m6		.2969978	.1046075	2.84	0.005	.0919605	.5020352
2022m7		.481276	.2516671	1.91	0.056	-.0120076	.9745597
2022m8		.250037	.134403	1.86	0.063	-.0134015	.5134754
2022m9		.2080488	.0554233	3.75	0.000	.0994155	.3166821
2022m10		.3881669	.0115549	33.59	0.000	.3655184	.4108153
2022m11		.3952294	.0062273	63.47	0.000	.3830235	.4074353
2022m12		.5152356	.0077561	66.43	0.000	.5000332	.530438
2023m1		.4709845	.0062437	75.43	0.000	.4587464	.4832225
2023m2		.6195408	.009068	68.32	0.000	.6017668	.6373147
2023m3		.4774261	.0072994	65.41	0.000	.4631188	.4917334
2023m4		.3472965	.0107994	32.16	0.000	.3261289	.368464
2023m5		.3959696	.0353547	11.20	0.000	.3266721	.4652671
2023m6		.1977089	.0463491	4.27	0.000	.1068616	.2885562
2023m7		.5204765	.158803	3.28	0.001	.2092125	.8317405
2023m8		.2006817	.1186037	1.69	0.091	-.0317892	.4331525
2023m9		.2500989	.052807	4.74	0.000	.1465938	.353604
2023m10		.2975921	.0115314	25.81	0.000	.2749898	.3201944
2023m11		.3686712	.0066665	55.30	0.000	.3556046	.3817379
2023m12		.4526435	.0071256	63.52	0.000	.4386769	.4666101
2024m1		.5209264	.0071591	72.76	0.000	.5068941	.5349587
2024m2		.5749909	.0096603	59.52	0.000	.5560561	.5939258
2024m3		.3579962	.0067246	53.24	0.000	.3448155	.3711768
2024m4		.3308313	.0106357	31.11	0.000	.3099847	.3516779
2024m5		.3323092	.0373323	8.90	0.000	.2591354	.4054829
2024m6		.3289991	.1124195	2.93	0.003	.1086497	.5493485
2024m7		.7040061	.2365586	2.98	0.003	.240336	1.167676
2024m8		.2001817	.1059087	1.89	0.059	-.0074062	.4077696
2024m9		.1667165	.0456019	3.66	0.000	.0773339	.2560991
2024m10		.2544909	.0106561	23.88	0.000	.2336043	.2753775
2024m11		.2729071	.0058735	46.46	0.000	.2613947	.2844195
2024m12		.4958309	.0083225	59.58	0.000	.4795184	.5121434

2025m1	.5746084	.009271	61.98	0.000	.5564366	.5927801
2025m2	.6342215	.0115531	54.90	0.000	.6115768	.6568663
2025m3	.3289843	.0066834	49.22	0.000	.3158844	.3420843
ym#c.complier						
2021m3	-666.5271	100.9793	-6.60	0.000	-864.453	-468.6013
2021m4	-361.0456	64.07018	-5.64	0.000	-486.6273	-235.4639
2021m5	-181.7627	31.64957	-5.74	0.000	-243.7979	-119.7275
2021m6	-30.45298	13.74713	-2.22	0.027	-57.39825	-3.507719
2021m7	12.2186	8.473768	1.44	0.149	-4.390527	28.82773
2021m8	3.207955	7.664621	0.42	0.676	-11.81519	18.2311
2021m9	-30.58041	11.94995	-2.56	0.011	-54.00307	-7.157751
2021m10	-212.8078	41.84881	-5.09	0.000	-294.8342	-130.7815
2021m11	-814.5297	126.9861	-6.41	0.000	-1063.431	-565.6287
2021m12	-831.5463	134.7808	-6.17	0.000	-1095.725	-567.3672
2022m1	-648.3434	206.0041	-3.15	0.002	-1052.125	-244.5621
2022m2	-593.7215	179.2793	-3.31	0.001	-945.1205	-242.3225
2022m3	-498.9051	108.8554	-4.58	0.000	-712.2686	-285.5415
2022m4	-393.2669	80.45722	-4.89	0.000	-550.9682	-235.5656
2022m5	-305.9469	37.13762	-8.24	0.000	-378.739	-233.1548
2022m6	-36.7771	13.28518	-2.77	0.006	-62.81691	-10.7373
2022m7	-8.683662	8.93032	-0.97	0.331	-26.18766	8.820338
2022m8	2.778571	7.156826	0.39	0.698	-11.24927	16.80641
2022m9	-40.97562	12.4451	-3.29	0.001	-65.36881	-16.58243
2022m10	-324.5808	57.27357	-5.67	0.000	-436.8406	-212.3209
2022m11	-594.6518	122.8651	-4.84	0.000	-835.4753	-353.8284
2022m12	-826.6914	176.5585	-4.68	0.000	-1172.757	-480.6254
2023m1	-684.505	168.8405	-4.05	0.000	-1015.443	-353.5667
2023m2	-680.6118	150.2837	-4.53	0.000	-975.1774	-386.0461
2023m3	-640.9823	126.5014	-5.07	0.000	-888.9332	-393.0314
2023m4	-328.4438	65.51619	-5.01	0.000	-456.8597	-200.0278
2023m5	-143.0315	27.9366	-5.12	0.000	-197.7891	-88.27399
2023m6	-53.87122	17.55532	-3.07	0.002	-88.28077	-19.46166
2023m7	-11.67645	7.964223	-1.47	0.143	-27.28684	3.933939
2023m8	-10.04315	7.581704	-1.32	0.185	-24.90378	4.817472
2023m9	-48.78997	17.60004	-2.77	0.006	-83.28718	-14.29276
2023m10	-127.6843	45.76713	-2.79	0.005	-217.3908	-37.97774
2023m11	-462.0266	120.8466	-3.82	0.000	-698.8937	-225.1595
2023m12	-681.0842	161.9953	-4.20	0.000	-998.6054	-363.563
2024m1	-147.222	202.52	-0.73	0.467	-544.1743	249.7303
2024m2	-739.3354	169.1096	-4.37	0.000	-1070.801	-407.8698
2024m3	-581.6556	115.3398	-5.04	0.000	-807.7289	-355.5822
2024m4	-340.61	68.38492	-4.98	0.000	-474.6488	-206.5711
2024m5	-139.5313	29.56333	-4.72	0.000	-197.4773	-81.58525
2024m6	-4.632098	12.83769	-0.36	0.718	-29.7948	20.5306
2024m7	8.716069	10.24615	0.85	0.395	-11.36704	28.79918
2024m8	-4.866035	10.51582	-0.46	0.644	-25.47772	15.74565
2024m9	-36.68734	15.5658	-2.36	0.018	-67.19731	-6.177379
2024m10	-219.4751	52.51188	-4.18	0.000	-322.4017	-116.5484
2024m11	-528.5097	120.5579	-4.38	0.000	-764.8108	-292.2086
2024m12	-899.3311	198.9094	-4.52	0.000	-1289.206	-509.4559
2025m1	-518.5983	283.2989	-1.83	0.067	-1073.882	36.68564
2025m2	-646.311	206.5981	-3.13	0.002	-1051.257	-241.3654
2025m3	-620.0295	126.1805	-4.91	0.000	-867.3513	-372.7076
dow						
Monday	9.358355	4.625082	2.02	0.043	.2928984	18.42381
Tuesday	-18.17822	5.046817	-3.60	0.000	-28.07031	-8.28614

Wednesday		-68.12643	5.195793	-13.11	0.000	-78.31052	-57.94234
Thursday		-80.50651	5.458335	-14.75	0.000	-91.2052	-69.80783
Friday		-112.136	5.039321	-22.25	0.000	-122.0134	-102.2586
Saturday		-46.4887	3.354646	-13.86	0.000	-53.06402	-39.91338
outdoor_humidity		-17.35631	.6202701	-27.98	0.000	-18.57208	-16.14054
cdd60		-16.55038	1.308282	-12.65	0.000	-19.1147	-13.98606
hdd60		603.8593	6.091191	99.14	0.000	591.9202	615.7985
_cons		359.6621	112.5836	3.19	0.001	138.991	580.3331

APPENDIX E: VINTAGE YEAR TABLES

The following tables capture the detailed emission reductions of the project activity per vintage year, climate and equipment type (heat pump or non-heat pump).

Table 1. eGRID - January 2023 to December 2023 – Non-Heat Pump – All Climate Region

Ecobee Eco+ Co2 Offsets									
Table 1: Menu options									
Climate Zone Region	All								
Heat Pump	No								
Year	2023								
Month	Electric CO2 Rate Basis	Average Device	Metric Tons CO2 Saved	Metric Tons CO2 Baseline	Metric Tons CO2 Project	Pct Reduction	MWh Saved	MMBtu Saved	PM2.5 Avoided
1	eGRID 2022	1,943,984	51,602	877,803	826,201	5.9%	10,644	901,693	926
2	eGRID 2022	1,974,166	31,066	772,224	741,157	4.0%	7,215	537,497	627
3	eGRID 2022	2,004,881	37,595	671,272	633,677	5.6%	11,302	633,397	983
4	eGRID 2022	2,035,257	20,170	315,902	295,731	6.4%	13,136	292,891	1,142
5	eGRID 2022	2,056,619	13,769	219,989	206,219	6.3%	23,253	105,147	2,022
6	eGRID 2022	2,093,918	3,028	284,967	281,939	1.1%	7,982	4,088	694
7	eGRID 2022	2,133,820	21,888	491,010	469,122	4.5%	62,151	-	5,405
8	eGRID 2022	2,177,192	22,515	462,284	439,769	4.9%	63,931	-	5,560
9	eGRID 2022	2,218,049	9,132	285,468	276,336	3.2%	25,931	-	2,255
10	eGRID 2022	2,261,065	14,907	286,018	271,111	5.2%	9,009	221,112	783
11	eGRID 2023	2,289,066	30,576	588,851	558,275	5.2%	10,355	512,396	901
12	eGRID 2023	2,341,144	34,358	804,042	769,684	4.3%	5,162	615,621	449
Year		Average Devices	Metric Tons CO2 Saved	Metric Tons CO2 Baseline	Metric Tons CO2 Project	Pct Reduction	MWh Saved	MMBtu Saved	PM2.5 Avoided
2023		2,127,430	290,608	6,059,829	5,769,220	4.8%	250,069	3,823,841	21,747
		Per Thermostat Results	Metric Tons CO2 Saved	Metric Tons CO2 Baseline	Metric Tons CO2 Project	Pct Reduction	kWh Saved	MMBtu Saved	PM2.5 Avoided
			0.137	2.848	2.712	4.8%	117.55	1.80	0.01

Table 2. eGRID - January 2023 to December 2023 – Heat Pump – All Climate Region

Ecobee Eco+ Co2 Offsets									
Table 1: Menu options									
Climate Zone Region Heat Pump Year	All								
	Yes								
	2023								
Month	Electric CO2 Rate Basis	Average Device	Metric Tons CO2 Saved	Metric Tons CO2 Baseline	Metric Tons CO2 Project	Pct Reduction	MWh Saved	MMBtu Saved	PM2.5 Avoided
1	eGRID 2022	543,917	1,723	87,895	86,172	2.0%	5,028	-	437
2	eGRID 2022	555,694	1,733	76,215	74,482	2.3%	5,057	-	440
3	eGRID 2022	568,618	2,189	70,539	68,351	3.1%	6,387	-	555
4	eGRID 2022	582,410	3,450	54,266	50,816	6.4%	10,068	-	876
5	eGRID 2022	594,066	2,227	75,295	73,067	3.0%	6,499	-	565
6	eGRID 2022	610,734	3,621	117,600	113,978	3.1%	10,568	-	919
7	eGRID 2022	628,807	5,512	183,570	178,058	3.0%	16,085	-	1,399
8	eGRID 2022	648,394	3,479	181,312	177,833	1.9%	10,152	-	883
9	eGRID 2022	665,868	2,210	122,607	120,398	1.8%	6,448	-	561
10	eGRID 2022	681,956	358	66,987	66,629	0.5%	1,045	-	91
11	eGRID 2023	700,378	1,294	67,592	66,299	1.9%	3,974	-	346
12	eGRID 2023	719,659	2,218	93,704	91,486	2.4%	6,813	-	592
Year	Average Devices		Metric Tons CO2 Saved	Metric Tons CO2 Baseline	Metric Tons CO2 Project	Pct Reduction	MWh Saved	MMBtu Saved	PM2.5 Avoided
2023		625,042	30,013	1,197,582	1,167,569	2.5%	88,125	-	7,664
		Per Thermostat Results	Metric Tons CO2 Saved	Metric Tons CO2 Baseline	Metric Tons CO2 Project	Pct Reduction	kWh Saved	MMBtu Saved	PM2.5 Avoided
			0.048	1.916	1.868	2.5%	140.99	-	0.01

Table 3. eGRID - January 2024 to December 2024 – Non-Heat Pump – All Climate Region

Ecobee									
Eco+ CO2 Offsets									
Table 1: Menu options									
Climate Zone Region	All								
Heat Pump	No								
Year	2024								
Month	Electric CO2 Rate Basis	Average Device	Metric Tons CO2 Saved	Metric Tons CO2 Baseline	Metric Tons CO2 Project	Pct Reduction	MWh Saved	MMBtu Saved	PM2.5 Avoided
1	eGRID 2023	2,375,162	42,615	1,278,449	1,235,834	3.3%	7,836	754,752	681
2	eGRID 2023	2,400,442	31,278	818,255	786,976	3.8%	6,580	548,864	572
3	eGRID 2023	2,433,396	32,509	630,084	597,575	5.2%	9,680	552,976	842
4	eGRID 2023	2,475,508	23,925	372,894	348,969	6.4%	11,985	377,034	1,042
5	eGRID 2023	2,483,063	13,511	258,850	245,339	5.2%	23,216	111,675	2,019
6	eGRID 2023	2,416,399	8,516	401,683	393,167	2.1%	26,068	-	2,267
7	eGRID 2023	2,596,922	32,858	556,885	524,027	5.9%	100,582	-	8,747
8	eGRID 2023	2,647,692	19,167	516,952	497,784	3.7%	58,672	-	5,102
9	eGRID 2023	2,679,522	12,230	309,371	297,142	4.0%	32,795	28,568	2,852
10	eGRID 2023	2,742,298	16,064	289,001	272,936	5.6%	11,916	229,345	1,036
11	eGRID 2023	2,787,723	40,762	638,525	597,763	6.4%	10,517	703,332	915
12	eGRID 2023	2,839,223	33,700	1,176,624	1,142,924	2.9%	4,951	604,514	431
Year		Average Devices	Metric Tons CO2 Saved	Metric Tons CO2 Baseline	Metric Tons CO2 Project	Pct Reduction	MWh Saved	MMBtu Saved	PM2.5 Avoided
2024		2,573,113	307,135	7,247,572	6,940,436	4.2%	304,800	3,911,059	26,506
		Per Thermostat Results	Metric Tons CO2 Saved	Metric Tons CO2 Baseline	Metric Tons CO2 Project	Pct Reduction	kWh Saved	MMBtu Saved	PM2.5 Avoided
			0.119	2.817	2.697	4.2%	118.46	1.52	0.01

Table 4. eGRID - January 2024 to December 2024 – Heat Pump – All Climate Region

Ecobee									
Eco+ Co2 Offsets									
Table 1: Menu options									
Climate Zone Region	All								
Heat Pump	Yes								
Year	2024								
Month	Electric CO2 Rate Basis	Average Device	Metric Tons CO2 Saved	Metric Tons CO2 Baseline	Metric Tons CO2 Project	Pct Reduction	MWh Saved	MMBtu Saved	PM2.5 Avoided
1	eGRID 2023	733,585	4,461	166,298	161,837	2.7%	13,702	-	1,192
2	eGRID 2023	746,078	2,413	90,192	87,778	2.7%	7,413	-	645
3	eGRID 2023	762,178	2,742	68,755	66,013	4.0%	8,422	-	732
4	eGRID 2023	783,075	3,264	68,270	65,006	4.8%	10,026	-	872
5	eGRID 2023	792,320	2,602	119,704	117,102	2.2%	7,992	-	695
6	eGRID 2023	779,415	2,950	180,043	177,093	1.6%	9,060	-	788
7	eGRID 2023	846,386	8,662	235,632	226,970	3.7%	26,605	-	2,314
8	eGRID 2023	869,990	2,237	220,718	218,481	1.0%	6,870	-	597
9	eGRID 2023	887,558	3,308	147,245	143,937	2.2%	10,160	-	884
10	eGRID 2023	913,199	1,030	91,569	90,539	1.1%	3,164	-	275
11	eGRID 2023	932,750	2,236	87,322	85,086	2.6%	6,868	-	597
12	eGRID 2023	954,030	4,121	151,854	147,733	2.7%	12,656	-	1,101
Year	Average Devices		Metric Tons CO2 Saved	Metric Tons CO2 Baseline	Metric Tons CO2 Project	Pct Reduction	MWh Saved	MMBtu Saved	PM2.5 Avoided
2024	833,380		40,027	1,627,603	1,587,576	2.5%	122,941	-	10,691
		Per Thermostat Results	Metric Tons CO2 Saved	Metric Tons CO2 Baseline	Metric Tons CO2 Project	Pct Reduction	kWh Saved	MMBtu Saved	PM2.5 Avoided
			0.048	1.953	1.905	2.5%	147.52	-	0.01

Table 5. eGRID - January 2025 to March 2025³⁴ – Non-Heat Pump – All Climate Region

Ecobee

Eco+ Co2 Offsets

Table 1: Menu options

Climate Zone Region

All

Heat Pump

No

Year

2025

Month	Electric CO2 Rate Basis	Average Device	Metric Tons CO2 Saved	Metric Tons CO2 Baseline	Metric Tons CO2 Project	Pct Reduction	MWh Saved	MMBtu Saved	PM2.5 Avoided	
1	eGRID 2023	2,876,369	61,752	1,774,093	1,712,341	3.5%	9,383	1,105,819	816	
2	eGRID 2023	2,898,314	30,911	1,214,837	1,183,925	2.5%	9,131	526,248	794	
3	eGRID 2023	2,945,119	33,357	737,329	703,972	4.5%	10,252	565,433	892	
4	-	-	-	-	-	-	-	-	-	
5	-	-	-	-	-	-	-	-	-	
6	-	-	-	-	-	-	-	-	-	
7	-	-	-	-	-	-	-	-	-	
8	-	-	-	-	-	-	-	-	-	
9	-	-	-	-	-	-	-	-	-	
10	-	-	-	-	-	-	-	-	-	
11	-	-	-	-	-	-	-	-	-	
12	-	-	-	-	-	-	-	-	-	
Year	Average Devices		Metric Tons CO2 Saved	Metric Tons CO2 Baseline	Metric Tons CO2 Project	Pct Reduction	MWh Saved	MMBtu Saved	PM2.5 Avoided	
2025			2,906,601	126,021	3,726,259	3,600,238	3.4%	28,766	2,197,500	2,502
		Per Thermostat Results	Metric Tons CO2 Saved	Metric Tons CO2 Baseline	Metric Tons CO2 Project	Pct Reduction	kWh Saved	MMBtu Saved	PM2.5 Avoided	
			0.043	1.282	1.239	3.4%	9.90	0.76	0.00	

³⁴ The second monitoring period of project activity will only be claiming emission reductions for 03-March-2023 to 02-March-2025.

Table 6. eGRID - January 2025 to March 2025³⁵ – Heat Pump – All Climate Region

Ecobee									
Eco+ Co2 Offsets									
Table 1: Menu options									
Climate Zone Region	All								
Heat Pump	Yes								
Year	2025								
Month	Electric CO2 Rate Basis	Average Device	Metric Tons CO2 Saved	Metric Tons CO2 Baseline	Metric Tons CO2 Project	Pct Reduction	MWh Saved	MMBtu Saved	PM2.5 Avoided
1	eGRID 2023	971,122	1,349	264,068	262,719	0.5%	4,144	-	360
2	eGRID 2023	984,081	1,819	153,235	151,416	1.2%	5,587	-	486
3	eGRID 2023	1,002,924	3,169	91,955	88,786	3.4%	9,734	-	846
4	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-
Year	Average Devices		Metric Tons CO2 Saved	Metric Tons CO2 Baseline	Metric Tons CO2 Project	Pct Reduction	MWh Saved	MMBtu Saved	PM2.5 Avoided
2025	986,043		6,337	509,258	502,921	1.2%	19,464	-	1,693

³⁵ The second monitoring period of project activity will only be claiming emission reductions for 01-March-2021 to 02-March-2023.

APPENDIX F: ATTESTATION LETTER FROM ECOBEE'S EVP

ecobee

Dear Verra Secretariat
secretariat@verra.org

Good Morning;

As a means of introduction, I am the Executive Vice President, ecobee Energy, and have been with the company 15 years and since the launch of our industry leading ecobee Smart Thermostat.

I, Chris Carradine, can attest that to the best of my knowledge the eco+ software will remain free to all our customers who own and are using ecobee thermostats throughout the crediting period and any subsequent crediting period renewals. If this were to change at any point during the crediting period or crediting period renewals, the project will cease to claim Verified Emissions Reductions as of the date that the software stopped being offered for free.

I trust that this addresses any concerns the Verra Secretariat might have in this regard.

Regards,



Chris Carradine
Executive Vice President
ecobee

APPENDIX G: ATTESTATION LETTER FROM ECOBEE'S VP, ENGINEERING

RE: Attestation of Data Integrity — Internal Data Collection and Data Sources

To Whom It May Concern,

I, Jean-Luc Dery, Vice President of Engineering at ecobee Technologies ULC hereby formally attest to the integrity, authenticity, and accuracy of the internal data collected and data sources utilized by the Company in connection with its operations, reporting obligations, and submissions to regulatory bodies, auditors, or other authorized parties.

Authority & Capacity: I make this attestation as a duly authorized officer with direct oversight of the Company's processing of internally generated data.

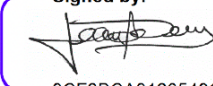
Attestation of Data Integrity: I hereby attest and affirm, to the best of my knowledge and belief, that: (a) internal data has been gathered through controlled, validated, and auditable mechanisms ensuring completeness and accuracy; (b) all referenced data sources are genuine and authoritative, verified through established data governance and QA processes; (c) the data has not been subject to unauthorized alteration, manipulation, corruption, or tampering at any stage of its lifecycle; (d) access is governed by strict role-based controls, authentication protocols, and audit logging; and (e) all pipelines and source systems are subject to ongoing monitoring, automated validation, and periodic technical audits.

Robustness of Systems: ecobee's data engineering infrastructure meets enterprise-grade standards, incorporating end-to-end encryption, checksum validation, redundancy controls, version-controlled schemas, and immutable audit logs—reviewed regularly in accordance with industry best practices and applicable regulatory requirements.

Limitation: This attestation reflects my personal knowledge as of the date hereof and is made in good faith for the specific purpose for which it has been requested. It does not constitute a legal warranty beyond what is expressly stated.

I declare that the statements herein are true, accurate, and complete to the best of my knowledge. I remain available for further clarification or documentation upon request.

Respectfully submitted,

Signed by:

9CF3BCA9120549C...

Name: Jean-Luc Dery
Title: VP Engineering
Date: 6/8/2026