



**Verified Carbon
Standard**

VALIDATION AND VERIFICATION OF IMPROVING ENERGY EFFICIENCY IN HOMES THROUGH SMART THERMOSTAT OPTIMIZATION



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Client	Ecobee Technologies ULC
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Summary:

This project aims to reduce heating and cooling usage in homes by utilizing ecobee smart thermostats with a newly developed optimization software called eco+. This software, offered for free to consumers, enhances energy savings by remotely controlling thermostats to achieve greater efficiency without compromising comfort. By using individual comfort preferences, occupancy patterns, and home-specific data, eco+ optimizes temperature settings in real-time, incorporating features like occupancy sensing, machine learning, geolocation, and humidity control. The primary driver of energy savings is the patented "Adjust for Humidity" feature, which considers both temperature and humidity to manage heating, ventilation, and air conditioning (HVAC) equipment efficiently. This approach substantially reduces electricity and natural gas usage, leading to a measurable decrease in greenhouse gas emissions. The project covers the contiguous United States and is estimated to reduce emissions by approximately 2,815,855 CO₂e over the first crediting period (2021-2028), with an average annual reduction of 402,265 CO₂e per year.

Ecobee Technologies ULC (ecobee) contracted Ruby Canyon Environmental Inc., (RCE) to complete the validation and verification of the Improving energy efficiency in homes through smart thermostat optimization. RCE was acquired by TÜV SÜD America, Inc. (TÜV SÜD) in 2023. 'TÜV SÜD' will be used throughout this report to refer to TÜV SÜD America, Inc. - Ruby Canyon Environmental, Inc. The first crediting period is 3 March 2021 – 2 March 2028. The first reporting period verified is 3 March 2021 – 2 March 2023.

The purpose of the validation is to assess the likelihood that implementation of the GHG-related activities will result in the achievement of GHG outcomes as stated by Ecobee. The validation process aims to confirm the accuracy of the baseline scenario and ensure that the Project adheres to the VCS Program Guide (Version 4.4), the VCS Standard (Version 4.5), and the project methodology (VM0008 for the weatherization of single-family and multi-family buildings (Version 1.1)). Additionally, the validation process confirms that the project plan and GHG calculation methods are materially correct, and that the planned project could reasonably be expected to achieve the claimed emission reductions. The purpose of the verification is to ensure that the GHG assertion is materially correct, that the data provided to TÜV SÜD can be documented and if errors or omissions are detected, they be corrected by Ecobee.

The scope of the validation and verification included an assessment of the Project Description (PD) and Monitoring Report, and any supporting data and documentation needed to confirm that the project proponents meet the requirements of VM0008 and the VCS Standard (Version 4.5). As part of the validation and verification activities, TÜV SÜD reviewed the completeness, conservativeness, and accuracy of the underlying evidence for the Project's assumptions and data sources used.

The validation and verification team's method for assessing the project against the above criteria (including the policy, procedures or requirements used to validate the project description and verify the monitoring report) included creating a validation and verification risk assessment and sampling plan. TÜV SÜD determined which areas of the project contained the highest risk and focused on reviewing evidence to mitigate these risks. The validation and verification were performed through a combination of document and data review, interviews with relevant personnel during the virtual site visit, and several interviews with the project proponents throughout the audit process.

During the validation and verification process, TÜV SÜD issued a total of 64 findings (included in Appendix B):

- 7 Corrective Action Requests
- 0 Non-material Finding
- 8 Additional Document Requests
- 49 Clarification Requests

- 0 Forward Action Request
 - The validation and verification team concludes, to a reasonable level of assurance, that the Project correctly applies the Methodology with noted deviations that were approved by TÜV SÜD. The verification team confirms, to a reasonable level of assurance, that the Project's assertion for the reporting period of 1 March 2021 to 2 March 2023, is 470,665 tCO₂e net emission reductions, which corresponds to 390,652 claimable VCUs after accounting for the VM0008 occupancy applicability condition (17% for this reporting period).

CONTENTS

1	INTRODUCTION	6
1.1	Objective	6
1.2	Scope and Criteria	6
1.3	Reasonableness of Assumptions and Level of Assurance	7
1.4	Summary Description of the Project	7
2	VALIDATION AND VERIFICATION PROCESS	8
2.1	Method and Criteria	8
2.2	Document Review	9
2.3	Interviews	9
2.4	Site Visits	10
2.5	Resolution of Findings	10
3	VALIDATION FINDINGS	11
3.1	Project Details	11
3.2	Project Activity Instances in Grouped Projects	21
3.3	Safeguards	21
3.4	Application of Methodology	32
3.5	Non-Permanence Risk Analysis	57
4	VERIFICATION FINDINGS	57
4.1	Project Implementation Status	57
4.2	Accuracy of Reduction and Removal Calculations	58
4.3	Quality of Evidence to Determine Reductions and Removals	61
5	VALIDATION AND VERIFICATION OPINION	62
5.1	Validation and Verification Summary	62
5.2	Validation Conclusion	62
5.3	Verification conclusion	64
5.4	Ex-ante vs Ex-post ERR Comparison	65
	APPENDIX A: DOCUMENTS REVIEWED	66
	APPENDIX B: LIST OF FINDINGS	68

1 INTRODUCTION

1.1 Objective

The objective of the validation is to assess the Improving energy efficiency in homes through smart thermostat optimization Project activity against the requirements of the VCS Standard, v4.5, which is the basis of the proposed Project Description. The project's eligibility, baseline, monitoring plan, and regulatory compliance was validated to confirm that the Project Description, as submitted, is accurate, reasonable and meets the identified criteria. During the validation, the validation team assessed that 1) the project description and GHG statement are materially correct and meet the methodology requirements, 2) the project meets the eligibility requirements of the GHG program, and 3) the planned project could reasonably be expected to achieve the claimed emission reductions.

The goal of this GHG emission reduction verification is to ensure that the GHG statement made by the Project is materially correct, that the data provided to the verification team can be documented and if errors or omissions are detected, they be corrected by the Project Proponent.

1.2 Scope and Criteria

Validation and verification of the project Improving energy efficiency in homes through smart thermostat optimization. This is the Project's first crediting period from 03 March 2021 to 02 March 2028 and the first reporting period from 03 March 2021 to 02 March 2023. Project boundary includes all thermostats that have the feature of eco+ enabled and that are located within the US.

The scope of the validation includes assessment of the project activity instances implemented as for the data of the PD.

The validation and verification team assessed the Project against the following criteria:

- VCS Standard, Version 4.5 (29 August 2023)
- VCS Program Guide Version 4.4 (29 August 2023)
- VM0008 - Weatherization of Single Family and Multi-Family Buildings – Sectoral Scope 3. V. 1.1 (10 October 2012)
- ISO 14064-3:2019 “Greenhouse gases – Part 3: Specification with guidance for the validation and verification of greenhouse gas statements”
- Improving Energy Efficiency in Homes Through Smart Thermostat Optimization Project Description Document. Version 1.6 dated 19 July 2024.

1.3 Reasonableness of Assumptions and Level of Assurance

As required by ISO 14064-3:2019, validations are no longer conducted to an assurance level. The validation conclusion is based on evaluation of the PD, evidence gathered by the validation team, and interviews with key personnel involved in developing and implementing the project. The validation determined that the Project was in conformance with the VCS Program rules and that assumptions and methods defined in the PD were reasonable and supported a statement about the outcome of future activities.

The validation was conducted with a quantitative materiality threshold of 1%, meeting the VCS Standard requirements for projects: greater than or equal to 300,000 tonnes CO_{2e} per year. Qualitative matters that may be material were also considered.

The verification was conducted to a reasonable level of assurance with a quantitative materiality threshold of 1%, meeting the VCS Standard requirements for projects: greater than or equal to 300,000 tonnes CO_{2e} per year. Qualitative matters that may be material were also considered.

1.4 Summary Description of the Project

The project aims to reduce heating and cooling energy usage in homes using smart thermostats. ecobee manufactures these thermostats and offers a free thermostat optimization software platform called "eco+" to enhance energy savings. The software is available to both existing and new consumers throughout the crediting period.

Prior to the project, energy usage was higher in dwellings without the feature, resulting in increased electricity and gas consumption. The feature reduces electricity and natural gas usage in residential air conditioning and heating units which causes reduction in GHG emissions.

eco+ regulates indoor temperature by controlling HVAC equipment. It uses individual customer preferences, occupancy patterns, and home-specific data for real-time optimization. Features include occupancy sensing, machine learning, geolocation, and continuous adjustment for indoor humidity conditions. The patented "Adjust for Humidity" feature is the primary driver of energy savings.

The "Adjust for Humidity" feature considers thermal comfort and the humidity index (humidex). It automatically adjusts HVAC equipment based on a home's indoor humidity to lower energy consumption while maintaining comfort.

The project boundary covers the contiguous United States. During the first monitoring period (March 03, 2021, to March 02, 2023), emission reductions totalled 390,652 tCO₂.

Estimated total emission reductions over the first crediting period (2021-2028) are approximately 2,815,855 tCO₂, with an annual average of 402,265 tCO₂.

2 VALIDATION AND VERIFICATION PROCESS

2.1 Method and Criteria

The validation/verification team was selected according to TÜV SÜD's GHG Verification Policies & Procedures to ensure team members are qualified to perform validation/verification activities pertaining to the Project. The validation/verification team consisted of the following individuals:

Lead Validator: Diana Xareni Gonzalez Cuevas

Senior Internal Reviewer: Bonny Crews

Team Member: Lara Hughes-Allen

Prior to validation/verification project activities, TÜV SÜD performed a Conflict of Interest Assessment to determine whether any potential conflicts exist with the project developer. No issues were discovered that would affect the impartiality or independence of the validation/verification team.

A validation/verification kick-off conference call was held with Ecobee on 17 January 2024. The purpose of the kick-off conference call was to introduce the Ecobee personnel and the TÜV SÜD validation/verification team, review the validation/verification objectives, process, and VCS requirements, and to confirm the schedule.

TÜV SÜD reviewed the PD and developed the evidence gathering plan that was used throughout the validation/verification of the Project. The evidence gathering plan was based on a risk assessment performed based upon the criteria listed above and evidence provided to TÜV SÜD by Ecobee that pertained to the current crediting/monitoring period. TÜV SÜD developed a sampling plan checklist based on the requirements of the VCS standard 4.5.

Information in the PD was the primary focus of the validation and sampling plan while the monitoring report was reviewed for the verification. TÜV SÜD reviewed the PD and monitoring report for completeness and accuracy and used the PD and monitoring report to determine other relevant documents to review and personnel to interview.

The verification process and sampling plan involved the following independent and objective activities:

- Select a Validation/Verification Team;
- Perform a Conflict of Interest Assessment;
- Conduct a kick-off meeting with ecobee;
- Review the validated Project Description;
- Review the current Monitoring Report;
- Develop a verification plan and risk-based sampling plan;
- Conduct a virtual site visit;
- Review the project information control systems and quality control procedures;

- Review the Project's emission reduction calculations;
- Issue corrective action requests (CARs), additional documentation requests (ADRs), and clarification requests (CRs).
- Conduct a senior independent review;
- Issue a joint validation/verification report and representation; and
- Conduct an exit meeting with ecobee.

2.2 Document Review

The validation/verification activities relied heavily on document review. TÜV SÜD reviewed several versions of the PD and MR and audited underlying evidence, data, records, and supporting documents. TÜV SÜD cross-checked and compared these documents to the VCS program requirements and communicated any deficiencies to ecobee (communicated via the issues log). These documents are listed in Appendix A.

2.3 Interviews

TÜV SÜD held numerous discussions with the following personnel throughout the verification process:

- Jeanny Do, Energy and Emerging Markets Specialist, ecobee
- Tamara Dzubay, Director of Energy and Emerging Markets, ecobee

Topics discussed included:

- ecobee's process for compiling the PD to meet the VCS Methodology VM0008 weatherization of single-family and multi-family buildings (Version 1.1, 10 October 2012);
- Process for determining that the project was not legally mandated;
- Methods for including relevant SSRs in the Project boundary;
- Ownership structure of the Project;
- Review of documents provided in support of the PD and MR

Personnel interviewed during the virtual site visit:

- Benjamin Dauvin, Staff Embedded Engineer, ecobee
- Adam Noble-Marks, Senior Machine Learning Engineer and Technical Lead, ecobee
- Ryan Crasta, Business Analyst, ecobee
- Pavani Rangavajhula, Engineering Manager for the Data Platform team, ecobee
- Hal Gordon, Ph.D. Consultant, Demand Side Analytics, LLC (DSA)
- Jesse Smith, Partner, DSA

Topics discussed during the site visit:

- Development of the project
- Project start date
- Methods for data collection
- Ownership structure of Project
- How the Project meets applicability conditions of the methodology
- Relevant Project permits
- How HVAC runtime is tracked
- Installation and operation of equipment

- QA/QC procedures for equipment and data
- Calculations of GHG emissions

2.4 Site Visits

The objective of the virtual site inspection, which occurred on 22 March 2024, was to confirm the flow of data from individual ecobee thermostats in homes to ecobee's data platform, confirm that all relevant GHG SSRs were included in the PD and GHG calculations, and confirm that Project personnel were qualified to carry out their respective roles and responsibilities. The site visit activities included an inspection of the technology used, project operations and a review of the Project's information control systems, data handling, and QA/QC activities.

TÜV SÜD interviewed key personnel (see section 2.3) responsible for the day-to-day operation of equipment, data aggregation and compilation, and overall maintenance of the data associated with the Project. A key component of the virtual site visit was discussions with DSA about the data analysis process, data parameters and assumptions, use of marginal emissions rates to estimate CO₂e reduction rates, error identification and mitigation, and the intricacies of the code developed by DSA to analyse ecobee data. TÜV SÜD discussed the process of data collection, transfer to DSA, and storage at length during the virtual site visit.

Please note that an initial validation site visit took place on November 02, 2022 and was conducted in-person at ecobee's headquarter office in Toronto, Ontario, Canada. A subsequent verification site visit took place on April 6, 2023 and was again conducted in-person at ecobee's headquarters. For both in-person site visits, the ecobee personnel that attended and were interviewed by TUV SUD included: - Tamara Dzuaby, Sr. Director, Energy Sales - Jeanny Do, Energy and Emerging Markets Specialist - Ryan Crasta, Business Analyst, - Stuart Richardson, Manager, Strategic Projects - Kevin Trinh, Sr. Data Scientist - Adam Noble-Marks, Sr. Data Scientist - David Bruvelaitis, Manager, Embedded Systems - Pavani Rangavajhula, Manager, Data Platform - Horatiu Negutoiu, Sr. Machine Learning Engineer. These site visits were related to an initial submission of this project using a different methodology (CDM Small-Scale Demand-side energy efficiency activities for specific technologies, version 15.0, dated 12 May 2016 (AMS-II.C.)). This initial submission was not accepted and the Project Proponents migrated to the VM0008 methodology. The TÜV SÜD staff who were present at these two initial site visits did not work on this iteration of the validation and verification of the updated project.

2.5 Resolution of Findings

TÜV SÜD used an Issues Log to request CARs, NMFs, ADRs, and CRs during the validation/verification process. ecobee responded to all requests, which were subsequently closed out.

During the verification/validation process, TÜV SÜD issued a total of 64 findings which include:

- 7 Corrective Action Requests

- 0 Non-material Finding
- 8 Additional Document Requests
- 49 Clarification Requests

2.5.1 Forward Action Requests

No forward action requests were issued.

3 VALIDATION FINDINGS

3.1 Project Details

VCS 3352 is a grouped project under Sectoral Scope 3 (Energy Demand). In March 2021, ecobee provided a free software update called eco+ to existing ecobee thermostat users which reduces the HVAC runtime in participating households. eco+ is also available to new ecobee thermostat users. ecobee thermostat users must opt in to eco+ to receive full functionality. The core energy-saving feature in ecobee's eco+ platform is "Adjust for Humidity," a patented technology that aligns with the principles of thermal comfort and the humidity index, or humidex. Thermal comfort is the sense of warmth or coolness in a given environment, while the humidity index gauges how temperature and humidity together affect this perception.

"Adjust for Humidity" integrates these concepts to fine-tune a home's HVAC settings. By considering both temperature and humidity, the feature finds the optimal thermostat setpoint to balance comfort with energy efficiency. It uses indoor humidex—an index blending temperature and moisture—to adjust the HVAC system, ensuring residents stay comfortable while reducing energy consumption. The feature works continuously throughout the year, making small adjustments to HVAC settings to maintain the desired comfort level while minimizing energy use. This constant monitoring and adjustment provide a more efficient and comfortable home environment.

This project falls under category B of VM0008, efficiency enhancement of the building envelope and central heating and/or cooling system only. ecobee thermostats directly control the heating, ventilation, and air conditioning (HVAC) system. By optimizing run times, the eco+ software update can reduce energy consumption, improving overall efficiency. The software update is a measure to improve the efficiency of the central heating and/or cooling system rather than the building envelope. Its primary effect is on the operational efficiency of the HVAC system, not on the structural or physical components of the building that constitute the building envelope.

TÜV SÜD confirms that the PD provided by the Project Proponent is accurate and complete and provides non-expert readers with enough information to understand the nature of the project, the data analysis used, and any additional important information associated with the project activity.

Item	Evidence gathering activities, evidence checked, and assessment conclusion
Audit history	A contract between ecobee and TÜV SÜD was executed on December 06, 2023. A kick-off meeting was held on 17 January 2024. Data and documentation were provided to TÜV SÜD after the kick off meeting. A virtual site visit took place on 22 March 2024. TÜV SÜD conducted the desktop review between January and June 2024. TÜV SÜD issued several lists of findings, all of which were responded to by ecobee.
Sectoral scope	VCS 3352 is a grouped project under Sectoral Scope 3 (Energy Demand)
AFOLU project category, if applicable	This is not an AFOLU project.
Project activity type	The project activity type is fossil fuel emission reductions from HVAC runtime optimization based on a software optimization upgrade. This upgrade was developed by ecobee and provided at no cost for new and existing users. TÜV SÜD confirmed this during the virtual site visit and through review of the provided data and documentation.
General eligibility of the project to participate in the VCS Program	This project is not excluded under Table 1 of the VCS Standard. Project start date is 3 March 2021, according to section 3.8.1 of the Standard, validation must be completed within 2 years of the project start date. However, Verra provided a deadline extension by 24 July 2024. The project was listed on the project pipeline within three years of the project start date, and the VVB opening meeting took place while the project was listed on the project pipeline as under validation, thus meeting all pipeline listing and validation deadlines set out in the VCS Standard, v4.5.

	The applied methodology, VM0008, is eligible under the VCS Program. This methodology does not have scale and/or capacity limits. TÜV SÜD found no evidence that carrying out the project activity would lead to a violation of any applicable laws in the specified region. The project activity is a software upgrade on new and existing thermostats in private dwellings that were purchased and installed freely and without coercion. Users must opt into the software upgrade and can opt out at any time. Users must sign a contract which explicitly describes the nature of the project activity and indicates ecobee as the sole owner. TÜV SÜD confirms that the methodology used by this project to determine eligibility and emission reductions is robust, conservative, and appropriate.
AFOLU project eligibility, if applicable	This is not an AFOLU project.
Transfer project eligibility, if applicable	This is not a transfer project.
Project design	VCS 3352 is a grouped project and the eligibility criteria for any new instance wishing to participate in the project activity are included in section 1.4.1 of the PD and are summarized here: 3.6.10. The geographic area within which a project activity instance may be developed is the political borders of the United States of America excluding Alaska and Hawaii. TÜV SÜD confirmed that all initial project activity instances are within the defined geographic area by reviewing documentation provided by ecobee. 3.6.11 TÜV SÜD verified that the determination of the baseline scenario and demonstration of additionality are based on initial project activity instances. The baseline scenario is use of an ecobee smart thermostat without enabling the software update, including the 'Adjust for Humidity' feature. Additionally, TÜV SÜD discussed the determination of the baseline scenario with ecobee and DSA during the virtual site visit. ecobee and DSA described the

	process for documentation and analysis of the baseline scenario. 3.6.12 This grouped project incorporates only one project activity. 3.6.13 The baseline scenario is determined using the control method, as specified in VM0008. The designated geographic area is the continental United States. 3.6.14 Additionality of the initial project instances was demonstrated for the contiguous United States. No instances outside of the contiguous United States were included. 3.6.15 The factors relevant to the determination of the baseline scenario and the determination of additionality were determined for the entire grouped project geographic area. Factors such as assessing whether the project activity is mandated by law was done federally and by state as appropriate (see section 3.4.2 of this report). 3.6.16 The project specific eligibility criteria are: • Have ecobee thermostats upgraded with optimization software. • Apply technologies as specified to reduce energy use without lowering service levels. • Execute the Terms of Service for ecobee Remote Applications. • Have a start date no earlier than March 3, 2021. • Comply with VM0008 Section 4 applicability conditions (see section 3.4.2 of this report).
Project ownership	ecobee Technologies, ULC is the sole owner of all carbon offsets generated from the project activity. TÜV SÜD reviewed language in the contract agreement between ecobee and project participants which clearly identified ecobee as the sole owner of all carbon offsets generated from the project activity.
Project start date	The project start date is 3 March 2021. The full roll out of eco+ software was completed by this date. TÜV SÜD confirmed that the start date of the project is accurate by

	reviewing ecobee's Engineering Product Team internal release timeline of eco+ rollout.
Project crediting period	The project's crediting period of 3 March 2021 to 2 March 2028 meets the VCS Standard v4.5 section 3.9.1 requirements, which state that the total project crediting period shall be seven years (twice renewable for up to 21 years).
Project scale	This project is classified as a large project based on the estimated GHG emission reductions (tCO _{2e}). TÜV SÜD confirmed the estimated GHG emission reductions by reviewing the input data used to calculate the emission reductions as well as the code used for the statistical analysis. TÜV SÜD recreated the analysis used by DSA to calculate the estimated GHG emission reductions in the Python Programming Language (Visual Studio Code v.1.88.1; Python v.3.11.9) and confirms that these results are reasonable.
Likelihood of achieving estimated GHG emission reduction or removals	Based on the validation and verification activities, TÜV SÜD considers it likely that the estimated quantity of emission reductions may be achieved by the Project Activity should the assumptions and operational conditions remain the same, including expansion of the project activity after project validation.
Technologies and measures implemented by the project activity	In March 2021, ecobee provided a free software update called eco+ to existing ecobee thermostat users which reduces the HVAC runtime in participating households. eco+ is also available to new ecobee thermostat users. ecobee thermostat users must opt in to eco+ to receive full functionality. The core energy-saving feature in ecobee's eco+ platform is "Adjust for Humidity," a patented technology that aligns with the principles of thermal comfort and the humidity index, or humidex. Thermal comfort is the sense of warmth or coolness in a given environment, while the humidity index gauges how temperature and humidity together affect this perception. "Adjust for Humidity" integrates these concepts to fine-tune a home's HVAC settings. By considering both temperature and humidity, the feature finds the optimal thermostat setpoint to

	balance comfort with energy efficiency. It uses indoor humidex—an index blending temperature and moisture—to adjust the HVAC system, ensuring residents stay comfortable while reducing energy consumption. The feature works continuously throughout the year, making small adjustments to HVAC settings to maintain the desired comfort level while minimizing energy use. This constant monitoring and adjustment provide a more efficient and comfortable home environment.
Implementation schedule of the project activity or activities	The implementation schedule starts with the project start date, as confirmed above. ecobee enrolls new participants on a rolling basis, as long as any new instance meets the eligibility criteria detailed above. ecobee is well positioned to handle the inclusion of new instances on a rolling basis due to their streamlined data collection and transfer process as well as their methods to determine additionality and emission reductions.
Project location	There are over 2.5 million ecobee smart thermostats with eco+ and ‘Adjust for humidity’ across the contiguous United States. TÜV SÜD reviewed the .kml file and geographic coordinates provided by ecobee and found them to be satisfactory. The .kml file encompasses all instances in the project, as described in the VCS Standard v4.5 section 3.11.1.
Conditions prior to project initiation	The conditions prior to project initiation were the use of ecobee thermostats without the eco+ and ‘Adjust for Humidity’ software upgrades. The ecobee thermostat without the software upgrade is a smart thermostat that is designed to lower energy consumption and energy costs for users. The heating and cooling loads of homes are determined based on the thermostat setpoints (e.g., 75 °F in summer and 65 °F in winter). This serves as the reference point for energy consumption and emissions. Users can control the thermostat remotely from a smartphone, tablet, or Apple Watch. ecobee thermostats generate most of their energy savings by prioritizing HVAC runtime based on a users’ schedule (i.e., the temperature is lowered in the winter when residences are not in the dwelling). ecobee thermostats range in price from \$149.99 (ecobee3 lite) to \$249.99 (Smart Thermostat Premium).

Project compliance with applicable laws, statutes and other regulatory frameworks	The project proponent provided evidence and the validation team confirmed that there are no applicable laws, statutes or other regulatory framework that mandate the implementation of project activities (see section 3.4.2 of this report). Implementation of activities do not require a permit and take place in privately owned dwellings.
Double counting and participation under other GHG programs	This project is not receiving or seeking credit for reductions and removals from a project activity under another GHG program. The project proponents have attested that they are not registered and active under any other GHG programs. Based on the project activity, there are limited registries and methodologies available under which it could be registered. The project proponents could use VM0008 and register the project on CSA or ICR. TÜV SÜD did not find any evidence that the project proponent has registered the project under either CSA or ICR. This project was initially submitted to Verra on 24 February 2023 under CDM AMS II-C, “Demand Side Energy Efficiency Activities for Specific Technologies”, Version 15.0. The project was denied registration and the project was put ‘on hold’. Verra and the project proponent have provided TÜV SÜD with the rationale behind the registration denial. TÜV SÜD has confirmed that ecobee has taken into due account the feedback provided by Verra after the denial for registration and that they have substantially updated their analysis and project documentation to conform with VM0008 and the VCS Standard V4.5 (29 August 2023).
No double claiming with emissions trading programs or binding emission limits	Neither project reductions nor project activities are also included in an emissions trading program or binding emission limit.
No double claiming with other forms of environmental credit	The project activity has not sought, received, nor is planning to receive credit from another GHG-related environmental credit system. There is no evidence of double claiming against VCS Standard requirements.
Supply chain (Scope 3) emissions double claiming	Neither the project proponent nor authorized representative is a buyer or seller of a product whose emissions footprint is changed by the project activities.

Sustainable development contributions

The Project Proponent has identified four (4) sustainable development goals (SDGs) that will be positively supported by this project including:

7: Affordable and clean energy

7.3: By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology.

Energy efficiency is considered a form of energy, being the cleanest and most cost-effective. The project activities have enhanced energy efficiency in homes, resulting in significant reductions in GHG emissions. During the first monitoring period, 390,470 tonnes of CO₂e were prevented from being released, with an estimated total prevention of 2.8 million tonnes of CO₂e into the atmosphere. ecobee can assess the impact of project activities on this indicator by tracking the number of participants enrolled in the project.

8: Decent work and economic growth

8.2: Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high value added and labor-intensive sectors

The implementation of this project at ecobee has created highly technical positions, leading to new, highly skilled employment opportunities. The development, operation, and maintenance of eco+ are supported by over 30 full-time equivalents in Data Science, Product Management, and Engineering. This number is projected to increase by dozens more, alongside the retention of the core team for ongoing improvements and maintenance of the software. ecobee can track the impact of the project on this indicator by monitoring employment numbers and hiring trends.

11: Sustainable cities and communities

11.6: By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.

	The project activity is implemented in the U.S., where over 2.5 million ecobee devices with eco+ and ‘Adjust for Humidity’ are present in 62% of U.S. zip codes, including major metropolitan areas. The project reduces energy usage and maximizes HVAC efficiency, decreasing PM2.5 emissions and improving air quality. During the monitoring period, PM2.5 emissions were reduced by over 74,000 lbs, with an estimated prevention of more than 286,000 lbs of PM2.5, further enhancing air quality. ecobee can monitor the impact of the project on this indicator by monitoring the number of participants enrolled in the project, periodically updating the geographic distribution of project participants, and tracking associated reductions in PM2.5 emissions. <i>12: Sustainable consumption and production</i> <i>12.2 By 2030, achieve the sustainable management and efficient use of natural resources.</i> The project activity has substantially reduced energy consumption, cutting electricity use by over 850,000 MWh and natural gas consumption by more than 6,400 mmcf during the monitoring period. It is estimated to further decrease electricity use by more than 3.3 million MWh and natural gas consumption by over 36,000 mmcf. ecobee can track the impact of the project on this indicator by monitoring the number of participants enrolled in the project, periodically updating the geographic distribution of project participants, and tracking associated emission reductions.
Additional information relevant to the project	The applied methodology, VM0008, requires proper disposal and documentation of replaced appliances and heating/cooling equipment. However, for this project, the heating/cooling equipment controlled by the thermostats and the thermostat optimization platform are not being replaced or disposed of. Leakage has been appropriately excluded by the project proponent. No commercially sensitive information has been excluded from the public versions of the project documents. The names, addresses, or other personal information of project participants are not included in any public or private

[REDACTED] document. TÜV SÜD agrees that this is appropriate and conforms to the VCS Program requirements.

3.2 Project Activity Instances in Grouped Projects

During the site visit, the validation/verification team reviewed data management system, data collection, quality assurance procedures and retention of data.

ecobee thermostats with the eco + feature collect data from sensors installed in each equipment. Each user can install the eco+ feature at any time, but data collection starts when the thermostat is installed. All project instances are required to use the feature to be accounted for the project emissions reductions. ecobee showed that only thermostats with the activated feature were being considered and how the feature needs to be accepted and installed by the customer.

- The number of instances per monitoring period changes constantly, since new users are being added or current thermostat owners can deactivate the feature. When running the regression analysis ecobee uses data only for thermostats with the eco + feature.
- Data collection process is conducted automatically using internet connection. All data is collected into ecobee Google Cloud BigQuery. Data includes number of dwellings, thermostat ID, date and hour, seconds of runtime (air conditioning, auxiliary heat equipment, and compressors), temperature, and number of dwellings who opted for eco+. Once data is aggregated, it cannot be edited.
- New activity instances comply with the same requirements as old thermostats with eco+.

Based on the data reviewed, interviews with different personnel and activities conducted during the site visit, the validation/verification team concluded that the procedure to include all activity instances is appropriate. All thermostats with eco+ features are being accounted for and data collected is traceable and accurate.

3.3 Safeguards

3.3.1 Stakeholder Engagement and Consultation

3.3.1.1 Stakeholder Identification

Item	Evidence gathering activities, evidence checked, and assessment conclusion
Stakeholder identification	ecobee contracted an independent carbon consultant to help inform their selection of stakeholder participants. The consultant assessed that the likelihood of any stakeholder group experiencing negative effects related to the implementation of project activities was low. They advised that only industry stakeholders be included in the local stakeholder consultation. The local stakeholder consultation occurred virtually on January 16, 2023 and included seven participants. Three of these participants were also owners and users of ecobee thermostats. During the consultation, ecobee presented

	the project's objectives, the need for carbon financing to realize the project, and the potential benefits of the project. Participants communicated with ecobee using the chat function and asked questions about project design, offset ownership, and emissions calculations. Contact details for follow-up inquiries were provided, but no additional comments or inquiries have been received since the session. ecobee provided TÜV SÜD with the recorded transcript of the entire stakeholder meeting, which was reviewed by TÜV SÜD. A second round of stakeholders consultation took place on June 20, 2024. ecobee conducted informational focus group sessions with 12 selected users. • Participant Criteria: ○ ecobee smart thermostat users based in the United States. ○ Users aware of and with eco+ enabled. ○ Diverse group across age, gender, and region. • Recruitment Process: ○ Between June 13 and June 18, 2024, 667 eco+ enabled users received recruitment emails. ○ A screener survey assessed familiarity with eco+, Adjust for Humidity, and voluntary carbon markets. • Focus Group Sessions: ○ Held virtually on June 20, 2024, at 10:00 am and 2:00 pm EST. ○ Participants engaged in discussions about project objectives, eco+, carbon credits, and more. ○ Chat function allowed questions and input. • Topics Discussed: ○ Familiarity with eco+ and 'Adjust for Humidity'. ○ Opinions on ecobee generating carbon offsets. ○ Clarification on utility demand response programs and energy technologies.
Legal or customary tenure/access rights	This section is not applicable. TÜV SÜD reviewed the stakeholder transcript and attendance sheet to determine that the stakeholders who attended the consultation did not come from groups who hold access rights to territories and resources.
Stakeholder diversity and changes over time	This section is not applicable as the project activity does not affect the social, economic, or cultural diversity of stakeholder groups. The project activity does not impact the social, economic or cultural diversity of the stakeholder group. Stakeholder groups who were

	identified and invited to the consultation session are existing users of ecobee smart thermostats with eco+.
Expected changes in well-being	This section is not applicable. The primary goal of the project is to make subtle changes in HVAC runtime that are undetectable to users but collectively result in a significant reduction in fossil fuel emissions.
Location of stakeholders	TÜV SÜD reviewed the stakeholder transcript and attendance sheet to confirm that the stakeholders who attended the consultation were located throughout the USA.
Location of resources	TÜV SÜD reviewed the stakeholder transcript and attendance sheet to confirm that the stakeholders who attended the consultation do not come from groups that hold customary access rights to resources and territories.

3.3.1.2 Stakeholder Consultation and Ongoing Communication

Item	Evidence gathering activities, evidence checked, and assessment conclusion
Stakeholder engagement process	12 ecobee users were selected for the stakeholder consultation in the form of informational focus group sessions. Participants 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 Between June 13, 2024 – June 18, 2024, 667 randomly selected ecobee users that had eco+ enabled on ecobee thermostat devices received a recruit e-mail inviting interested participants to complete a screener survey. The survey inquired on country, state of residence, age, gender, ecobee products currently in use, level of familiarity of eco+ and Adjust for Humidity and level of familiarity of voluntary carbon markets. A total of 12 eligible ecobee users were selected and confirmed to participant in virtual focus group sessions that were held on June 20, 2024 at 10:00am EST and 2:00pm EST.

	During our review of the stakeholder meeting transcript and recording, TÜV SÜD confirmed that ecobee thoroughly explained the project design and any associated possible negative outcomes or possible obstacles. TÜV SÜD concludes that the stakeholder engagement process meets the VCS program requirements.
Consultation outcome	During our review of the stakeholder meeting transcript and recording, TÜV SÜD confirmed that participants raised questions, added comments, and provided inputs. ecobee addressed these inputs immediately. TÜV SÜD concludes that the consultation outcome meets the VCS program requirements.
Ongoing communication	Stakeholders were provided with the contact details of ecobee team members to enable ongoing communication. No additional comments or concerns have been raised. TÜV SÜD finds it very unlikely that ecobee's ongoing communication process does not meet the VCS program requirements.
Stakeholder input	During our review of the stakeholder meeting transcript and recording, TÜV SÜD confirmed that participants raised questions, added comments, and provided inputs. TÜV SÜD confirms that none of these comments indicated that the stakeholder was opposed to or uncomfortable with the implementation of project activities. TÜV SÜD concludes that the stakeholder input meets the VCS program requirements.

3.3.1.3 Free, Prior, and Informed Consent

Item	Evidence gathering activities, evidence checked, and assessment conclusion
Obtaining consent	This section is not applicable to this project, which is the implementation and distribution of a software upgrade for thermostats in private dwellings.
Outcome of FPIC discussion	Not applicable

3.3.1.4 Grievance Redress Procedure

Item	Evidence gathering activities, evidence checked, and assessment conclusion
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Development process	This section is not applicable to this project. If users wish to discontinue use of the eco+ software, they can do so at any time without constraint. Users can also remove or discontinue use of their ecobee thermostat at any time without constraint.
Grievance redress procedure	Not applicable.

3.3.1.5 Public Comments

Comments received	Actions taken by the project proponent	Evidence gathering activities, evidence checked, and assessment conclusion
During the public comment period (26 July 2022 to 25 August 2022), ecobee received one comment. This comment suggested that this initiative could be part of ecobee's marketing budget and that a decreased cost to consumers associated with reduced energy consumption would drive more sales.	In response to the comment, ecobee explained that it might be helpful to divide the project into two categories: Prior to eco+ and 'Adjust for Humidity': About 1.1 million ecobee smart thermostats were installed before the development of the optimization software. Customers bought these for reasons unrelated to the energy efficiency enhancements, so the project couldn't be part of the marketing budget at that time. With eco+ and 'Adjust for Humidity': Quarterly surveys show that main drivers for purchasing ecobee smart thermostats are mobile access, ease of use, compatibility, and data security, not the incremental energy performance. These	No changes to the project, PDD, or any other documentation resulted from this comment. TÜV SÜD concludes that ecobee's response to this comment is appropriate as this comment poses a clarification question, rather than a concern or suggestion for improvement.

	enhancements are not primary marketing points. ecobee's campaigns, such as the 2021 "BE" campaign and the 2023 Smart Security (eSS) campaign, focus on promoting the entire ecobee ecosystem and brand, not just specific features like eco+ and 'Adjust for Humidity'. These campaigns aim to raise brand awareness and drive overall sales across all ecobee products.	
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3.3.2 Risks to Local Stakeholders and the Environment

3.3.2.1 Management Experience

Based on the strategic analysis and risk assessment, the validation/verification team completed the following evidence gathering activities:

- Examination of the documentation that supports eligibility criteria and baseline scenario;
- Retraced information used for calculation and complete inquiries about data origin;
- Conduct a site visit to assess data collection system, data management system, QA/QC procedures,
- Assess the application of the methodology, and;
- Assess the application of the calculation methods, assumptions and parameters;

As part of the assessment the validation/verification team reviewed the following information:

- Project Description Document;
- Monitoring Report;
- Device characteristics;
- Data used for calculation: Runtime daily data and eco+ feature data;
- Emission quantification codes;
- ecobee emissions reduction workbook;
- Stakeholder consultation documentation;
- Ownership documentation;

Based on the data reviewed and interviews with the ecobee team, the validation/verification team concluded that the management team in charge of the project development is competent. For the statistical analysis ecobee partnered with Demand Side Analytics, LLC ("DSA"). TÜV SÜD issued an

Issues Log of 64 findings, and the PD was able to appropriately respond to all clarification requests and corrective actions.

3.3.2.2 Risk Assessment

Item	Evidence gathering activities, evidence checked, and assessment conclusion
Natural and human-induced risks to stakeholders' wellbeing	TÜV SÜD did not find any evidence of natural and human induced risks to stakeholders' wellbeing. The project activity is improvements of energy efficiency by utilizing a free thermostat optimization platform (eco+ and humidity adjustment). This system reduces a home's incremental energy usage by regulating HVAC equipment. ecobee thermostats are purchased by customers and there's no evidence that the equipment represents a risk to stakeholders.
Risks to stakeholder participation	TÜV SÜD did not find any evidence of risks to stakeholder participation. The project activity is improvements of energy efficiency by utilizing a free thermostat optimization platform (eco+ and humidity adjustment). This system reduces a home's incremental energy usage by regulating HVAC equipment.
Working conditions	TÜV SÜD did not find any evidence of risks related to working conditions. The project activity is improvements of energy efficiency by utilizing a free thermostat optimization platform (eco+ and humidity adjustment). This system reduces a home's incremental energy usage by regulating HVAC equipment. The project is supported by over 30 full-time ecobee employees. ecobee is an Equal Opportunity Employer, and complies with various laws, including the Employment Standards Act, the Accessibility for Ontarians with Disabilities Act, and the Occupational Health and Safety Act.
Safety of women and girls	TÜV SÜD did not find any evidence of risks to the safety of women and girls. The project activity is improvements of energy efficiency by utilizing a free thermostat optimization platform (eco+ and humidity adjustment). This system reduces a home's incremental energy usage by regulating HVAC equipment.

Safety of minority and marginalized groups, including children	TÜV SÜD did not find any evidence of risks to the safety of minority and marginalized groups, including children. The project activity is improvements of energy efficiency by utilizing a free thermostat optimization platform (eco+ and humidity adjustment). This system reduces a home's incremental energy usage by regulating HVAC equipment.
Pollutants (air, noise, discharges to water, generation of waste, release of hazardous materials, and chemical pesticides and fertilizers)	TÜV SÜD did not find any evidence of risks of pollutants related to the project activity. The project activity is improvements of energy efficiency by utilizing a free thermostat optimization platform (eco+ and humidity adjustment). This system reduces a home's incremental energy usage by regulating HVAC equipment. It is very likely that implementation of this project improves local pollutant levels.

3.3.3 Respect for Human Rights and Equity

3.3.3.1 Labor and Work

Item	Evidence gathering activities, evidence checked, and assessment conclusion
Discrimination	TÜV SÜD did not find any evidence of discrimination. The project activity is improvements of energy efficiency by utilizing a free thermostat optimization platform (eco+ and humidity adjustment). This system reduces a home's incremental energy usage by regulating HVAC equipment.
Sexual harassment	TÜV SÜD did not find any evidence of sexual harassment. The project activity is improvements of energy efficiency by utilizing a free thermostat optimization platform (eco+ and humidity adjustment). This system reduces a home's incremental energy usage by regulating HVAC equipment.
Equal pay for equal work	TÜV SÜD did not find any evidence of problems related to equal pay for equal work. The project activity is improvements of energy efficiency by utilizing a free thermostat optimization platform (eco+ and humidity adjustment). This system reduces a home's incremental energy usage by regulating HVAC equipment.

Gender equity in labor and work	TÜV SÜD did not find any evidence of problems related to gender equity in labor and work. The project activity is improvements of energy efficiency by utilizing a free thermostat optimization platform (eco+ and humidity adjustment). This system reduces a home's incremental energy usage by regulating HVAC equipment.
Forced labor	TÜV SÜD did not find any evidence of forced labor. The project activity is improvements of energy efficiency by utilizing a free thermostat optimization platform (eco+ and humidity adjustment). This system reduces a home's incremental energy usage by regulating HVAC equipment.
Child labor	TÜV SÜD did not find any evidence of child labor. The project activity is improvements of energy efficiency by utilizing a free thermostat optimization platform (eco+ and humidity adjustment). This system reduces a home's incremental energy usage by regulating HVAC equipment.
Human trafficking,	TÜV SÜD did not find any evidence of human trafficking. The project activity is improvements of energy efficiency by utilizing a free thermostat optimization platform (eco+ and humidity adjustment). This system reduces a home's incremental energy usage by regulating HVAC equipment.

3.3.3.2 Human Rights

TÜV SÜD did not find any evidence of human rights violations. The project activity is improvements of energy efficiency by utilizing a free thermostat optimization platform (eco+ and humidity adjustment). This system reduces a home's incremental energy usage by regulating HVAC equipment.

3.3.3.3 Indigenous Peoples and Cultural Heritage

TÜV SÜD did not find any evidence of problems related to indigenous peoples and cultural heritage. The project activity is improvements of energy efficiency by utilizing a free thermostat optimization platform (eco+ and humidity adjustment). This system reduces a home's incremental energy usage by regulating HVAC equipment.

3.3.3.4 Property Rights

TÜV SÜD did not find any evidence of problems related to property rights. The project activity is improvements of energy efficiency by utilizing a free thermostat optimization platform (eco+

and humidity adjustment). This system reduces a home's incremental energy usage by regulating HVAC equipment.

3.3.3.5 Benefit Sharing

This project has not implemented any benefit sharing program.

3.3.4 Ecosystem Health

Item	Evidence gathering activities, evidence checked, and assessment conclusion
Impacts on biodiversity and ecosystems	This risk is not applicable to this project. The project activity is improvements of energy efficiency by utilizing a free thermostat optimization platform (eco+ and humidity adjustment). This system reduces a home's incremental energy usage by regulating HVAC equipment. The project activity poses no risks or impacts to the environment, including biodiversity, ecosystems, soil degradation, soil erosion, or water consumption and stress.
Soil degradation and soil erosion	This risk is not applicable to this project. The project activity is improvements of energy efficiency by utilizing a free thermostat optimization platform (eco+ and humidity adjustment). This system reduces a home's incremental energy usage by regulating HVAC equipment. The project activity poses no risks or impacts to the environment, including biodiversity, ecosystems, soil degradation, soil erosion, or water consumption and stress.
Water consumption and stress	This risk is not applicable to this project. The project activity is improvements of energy efficiency by utilizing a free thermostat optimization platform (eco+ and humidity adjustment). This system reduces a home's incremental energy usage by regulating HVAC equipment. The project activity poses no risks or impacts to the environment, including biodiversity, ecosystems, soil degradation, soil erosion, or water consumption and stress.

3.3.4.1 Rare, Threatened, and Endangered species

Risk identified	Evidence gathering activities, evidence checked, and assessment conclusion
Species and habitat	This risk is not applicable to this project. The project activity is improvements of energy efficiency by utilizing a free thermostat optimization platform (eco+ and humidity adjustment). This system reduces a home's incremental energy usage by regulating HVAC equipment.

Areas needed for habitat connectivity	This risk is not applicable to this project. The project activity is improvements of energy efficiency by utilizing a free thermostat optimization platform (eco+ and humidity adjustment). This system reduces a home's incremental energy usage by regulating HVAC equipment.
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3.3.4.2 Introduction of Species

Species introduced	Evidence gathering activities, evidence checked, and assessment conclusion
None	This risk is not applicable to this project. The project activity is improvements of energy efficiency by utilizing a free thermostat optimization platform (eco+ and humidity adjustment). This system reduces a home's incremental energy usage by regulating HVAC equipment.

Existing invasive species	Evidence gathering activities, evidence checked, and assessment conclusion
None	This risk is not applicable to this project. The project activity is improvements of energy efficiency by utilizing a free thermostat optimization platform (eco+ and humidity adjustment). This system reduces a home's incremental energy usage by regulating HVAC equipment.

Evidence gathering activities, evidence checked, and assessment conclusion	
Invasive species	This risk is not applicable to this project. The project activity is improvements of energy efficiency by utilizing a free thermostat optimization platform (eco+ and humidity adjustment). This system reduces a home's incremental energy usage by regulating HVAC equipment.

3.3.4.3 Ecosystem conversion

Risks Identified	Evidence gathering activities and evidence checked
Ecosystem conversion	This risk is not applicable to this project. The project activity is improvements of energy efficiency by utilizing a free thermostat optimization platform (eco+ and humidity adjustment). This system reduces a home's incremental energy usage by regulating HVAC equipment.

3.4 Application of Methodology

3.4.1 Title and Reference

VM0008 Weatherization of Single Family and Multi-Family Buildings v1.1 (10 October 2012).

3.4.2 Applicability

Methodology ID	Applicability condition	Assessment and conclusion
VM0008	The condition of the Dwelling shall be and remain adequate for Project activities according to nationally recognized Weatherization best practice standards. Project activities may not result in a violation of health and safety, environmental, or other relevant regulations.	The project activity is a software upgrade to an existing and new smart thermostats. The project complies with applicability conditions as dwellings involved have HVAC systems, required by local and state building codes. Federal regulations in the USA support the Weatherization Assistance Program (WAP), which provides energy efficiency improvements in low-income households. The WAP lists installing programmable thermostats as a best practice for enhancing residential HVAC efficiency. Smart thermostats, an advanced type of programmable thermostat, meet these best practices by offering Wi-Fi connectivity, remote control, and automated energy management. The project enhances energy efficiency by using ecobee smart thermostats that adjust for indoor humidity, further driving energy savings without affecting comfort. The project requires the dwelling to have an HVAC system, an ecobee smart thermostat, and the 'Adjust for Humidity' feature enabled. TÜV SÜD confirmed the above during the virtual site visit and through a thorough review of the provided data and documentation.

VM0008	The replacement Appliances and mobile homes must replace functioning Appliances, and/or occupied homes.	This applicability condition is not relevant as this project does not involve the replacement of appliances or mobile homes.
VM0008	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.	All ecobee thermostats, except the ecobee 3 lite, have motion sensing capabilities. All ecobee thermostats can record the activation of a temperature set point ('set point hold') and whether this set point was applied on the device itself or from the ecobee thermostat mobile application. ecobee leverages these data (motion detection and records of set point holds applied on the device) to determine occupancy rates. ecobee uses a combined threshold of 288 motion events or 12 set point holds within a three month period to determine continuous occupancy of any Dwelling. This threshold corresponds to 288 five-minute intervals within 24 hours, or approximately 20% of a day. This means the device needs to register motion about three times a day, totaling 270 motion events over 90 days, providing a robust indication of occupancy. The threshold for set point holds is 12 in a three-month period, suggesting regular interaction with the device, equivalent to one adjustment per week. TÜV SÜD concludes that this threshold of 288 motion events or 12 set point holds in any three-month period is a strong indicator of consistent habitation, as regular motion detection or periodic temperature adjustments collectively infer regular occupancy. ecobee will continuously monitor

		occupancy and update the reported emission reductions. This analysis was completed for the current crediting period and 83% of homes in the project activity were found to meet the above criteria for continuous occupancy. The claimed emission reductions will be multiplied by the occupancy rate (83%) to account for the results of this analysis. TÜV SÜD agrees that this is a conservative approach to account for occupancy.
	The capacity of any replacement Appliance or replacement component of a central heating/cooling system shall satisfy the post-retrofit heat load, cooling load and electricity demand ("Energy Load") within the Dwelling.	The project activities do not include replacement of any appliance or replacement of any components of a central heating/cooling system. The project activity is the installation of a software upgrade to existing and new thermostats which enables the thermostat to intelligently adjust temperature settings to reduce energy consumption. This applicability condition is not relevant to this project.
VM0008	In the case of heating/cooling systems that serve multiple Dwellings, all residential Dwellings connected to the system shall be included in the Project.	ecobee thermostats control the HVAC systems of single and independent residential Dwellings. This applicability condition is not applicable to this project. TÜV SÜD confirmed this applicability condition through a thorough review of the provided data and documentation.
VM0008	The project must not be mandated, or regulated by local or federal law or regulation. Energy efficiency and home appliance regulations vary substantially by state, county, and city.	TÜV SÜD did not find any evidence of instances where smart thermostats or technology such as the 'Adjust for Humidity' feature are specifically required. In states and cities with stringent energy efficiency standards for HVAC systems, smart thermostats

		are often encouraged and utilized to help meet these requirements. Below are some examples of the most progressive energy efficiency standards and mandates across the U.S as they relate to the project activity: California – Title 24 Building Energy Efficiency Standards: This is a comprehensive set of regulations which apply to new and newly remodeled residential (and commercial) buildings. Smart thermostats are required in the Title 24 guidelines (see Joint Appendix 5 of Title 24). The required functional specifications relevant to the project activity include: setback capabilities and event responses. Event responses are triggered by price signals and/or Demand Response Signals. Thermostats must have one set of event responses for price signals and a set of event responses for Demand Response Signals. When a Demand Response Signal is received, the thermostat will change the setpoint by either the default number of degrees or the number of degrees specified by the occupant. Similarly, when a price signal exceeds the threshold set by the occupant, the thermostat will adjust accordingly. By default, in response to either type of signal, the OCST will initiate setpoint offsets of +4 °F for cooling and -4 °F for heating relative to the current setpoint. Although Title 24 does mandate the installation of smart thermostats in new and newly remodeled residential
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		buildings and energy savings are generated through the application of setback capabilities and event responses, TÜV SÜD finds that these requirements are sufficiently different from the project activity to conclude that the project activity is not mandated. As a reminder to the reader, the project activity is not the installation of smart thermostats, but the use of the patented "Adjust for Humidity. The "Adjust for humidity" feature is optional and opt-in," feature, which uses indoor humidity measurements to automatically adjust HVAC usage and is available for free only on ecobee smart thermostats. New York City – Chapter 12 of Local Law 77 of 2023 (effective June 10, 2023): This law states that interior spaces intended for human occupancy must have active or passive heating systems that are capable of maintaining the indoor temperature to specified temperatures that depend on the functionality of the room. The minimum temperature of habitable rooms in all buildings is 68°F. Interior spaces intended for human occupancy with air conditioning must have systems that can maintain 78°F at 50% relative humidity when the outdoor temperature is 89°F with a wet bulb temperature of 73°F. Spaces without air conditioning must have mechanical or natural ventilation according to the code's other requirements. TÜV SÜD concludes that although smart thermostats can help achieve these requirements, neither smart thermostats nor the Adjust for
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	Humidity feature are required by this law. Local Law 97: This law sets stringent emission limits, but only on buildings larger than 25,000 square feet in total floor area and two or more buildings on the same tax lot that together exceed 50,000 square feet. This is not applicable to project instances included in this project. Austin, Texas – Ordinance NO. 20160623-099: As of 2016, Austin, Texas requires that all new houses and apartments have smart thermostats installed, although participation in the Austin PowerSaver program is optional for users. This program allows power companies to adjust temperature set points by $\pm$ four degrees (F) at times of heavy electricity demand. Participating customers receive monetary rebates. As a reminder to the reader, the project activity is <i>not</i> the installation of smart thermostats, but the use of the patented “Adjust for Humidity. The “Adjust for humidity” feature is optional and opt-in,” feature, which uses indoor humidity measurements to automatically adjust HVAC usage and is available for free only on ecobee smart thermostats. TÜV SÜD concludes that although the installation of smart thermostats is required in new homes and apartments, the project activity is not mandated by this ordinance. TÜV SÜD acknowledges that this is not a comprehensive list of local or federal law or regulations related to energy efficiency or smart thermostat
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		installation and use. Based on our research we conclude that it is very unlikely that the specific project activity be mandated by any local or federal law. The project activity is <i>not</i> the installation of smart thermostats, but the use of the patented “Adjust for Humidity” feature. This feature, which is optional and opt-in, utilizes indoor humidity measurements to automatically adjust HVAC usage and is available exclusively at no cost on ecobee smart thermostats." TÜV SÜD concludes that the project meets this applicability condition.
	The Dwelling must meet or exceed the performance benchmark as calculated for the Same Building Stock.	As evidenced by data and analysis, dwellings exceeding this performance benchmark would, with 90% certainty, not have happened without the intervention created by the Project.
VM0008	The methodology is applicable to weatherizing whole buildings, replacing mobile homes or implementing individual energy efficiency measures within existing Dwellings of Category A, B, C, or D:	This project is applicable under Category B – Efficiency enhancement of the Building Envelope and Central Heating and/or cooling system only.
VM0008	This methodology does not cover fuel switching	This criterion is not applicable as the project does not involve fuel switching.
VM0008	In the case of “replacement” of a mobile home, the word “retrofit” shall be read to mean replacement throughout the methodology.	This criterion is not applicable as the project does not involve the replacement mobile homes.
VM0008	The methodology may be applied in any geographic region, provided appropriate data exist to establish the level of performance benchmark for the	This project activity is applied to the contiguous United States. TÜV SÜD has determined that this is an appropriate geographic region and appropriate data are available to establish a

	Same Building Stock of a Project's geographic region.	performance benchmark. ecobee establishes the level of performance benchmark using data collected directly from users of its thermostats, who are widely dispersed throughout the contiguous United States.
	When conducting sampling for the project, the minimum number of dwellings or appliances to be sampled is determined by taking the square root of the total number included in the project. If the control group approach is used, the size of the control group should also be the square root of the total number of dwellings, with a maximum of 100 dwellings. In an sampling approach, the following conditions must be met: 1. The sample shall be statistically valid, and may be one of the following: a. simple random sampling b. systematic sampling c. stratified sampling within the same building stock d. cluster sampling. 2. The sample must be representative of the population. 3. The data must be sourced from approved	The total number of devices in the project is 2.5 million, resulting in a square root sample size of 1,581, which exceeds the maximum of 100 dwellings. Due to the availability of a large amount of data, a larger sample was used to minimize potential sampling errors. The sampling process involved computer-generated random selection based on specified criteria, utilizing both stratified and simple random sampling methods. Stratification was based on equipment type and the presence of the 'Adjust for Humidity' feature, with a random sample drawn from these strata. The sample is representative of the population, as filters applied to both treatment and control groups ensured inclusivity of devices from various regions and types across the United States. Data from ecobee devices, capturing HVAC equipment runtime at 5-minute intervals, is securely stored and processed in Google Cloud BigQuery tables. Bias in the sample was actively avoided by including dwellings dispersed across the five climate regions of the USA, various dwelling types, and different HVAC equipment types.

	sources, such as certified energy auditors or nationally recognized data sources.	
	4. Actions that could introduce bias to the sample must be avoided. Sampling should include dwellings dispersed geographically, and for each defined building stock, sampling should occur based on criteria like region, dwelling type, and income.	

3.4.3 Project Boundary

The project boundary encompasses the contiguous United States, where more than 2.5 million ecobee smart thermostats equipped with eco+ and 'Adjust for Humidity' are installed across 62% of US zip codes. Based on the information provided to TÜV SÜD, this project boundary is appropriate.

The GHG sources, sinks, and reservoirs applicable to this project are:

Source		Gas	Included?	Justification/Explanation
Baseline	Grid electricity consumption by heating/cooling systems or other electric appliances	CO ₂	Yes	Only CO ₂ emissions from grid connected electricity generation shall be accounted for.
		CH ₄	No	
		N ₂ O	No	
		Other	No	
	Fossil fuel consumption by heating systems	CO ₂	Yes	Only CO ₂ emissions from fossil fuel combustion shall be accounted for.
		CH ₄	No	
		N ₂ O	No	
		Other	No	
	Emissions from wood combustion for heat	CO ₂	No	Not applicable.
		CH ₄	No	
		N ₂ O	No	

Source	Gas	Included?	Justification/Explanation
Project	Other	No	Only CO ₂ emissions from grid connected electricity generation shall be accounted for.
	CO ₂	Yes	
	CH ₄	No	
	N ₂ O	No	
	Other	No	Only CO ₂ emissions from fossil fuel combustion shall be accounted for.
	CO ₂	Yes	
	CH ₄	No	
	N ₂ O	No	
	Other	No	Not applicable.
	CO ₂	No	
	CH ₄	No	
	N ₂ O	No	
	Other	No	
Leakage	CO ₂	No	Not applicable.
	HFC	No	
	CH ₄	No	
	N ₂ O	No	
	Other	No	

The inclusion of these GHG emission sources conforms to VM0008 and the project activity. Since the project activity is a reduction in GHG emissions associated with reduced HVAC runtime, the exclusion of any sinks or reservoirs is appropriate.

3.4.4 Baseline Scenario

The baseline scenario for this project is the continued use of ecobee thermostats without the eco+ and 'Adjust for Humidity' software upgrades. The ecobee thermostat without the software upgrade is a smart thermostat that is designed to lower energy consumption and energy costs for users. Users can control the thermostat remotely from a smartphone, tablet, or Apple Watch. ecobee thermostats generate the majority of their energy savings by prioritizing HVAC runtime based on a user's schedule (i.e., the temperature is lowered in the winter during times when residences are typically not in the dwelling). ecobee thermostats range in price from \$149.99 (ecobee3 lite) to \$249.99 (Smart Thermostat Premium). According to their website,

ecobee thermostats (without the 'Adjust for Humidity' software upgrade) can save users up to 26% on their heating and cooling costs.

The Eco+ and Adjust for Humidity software upgrades are compatible with: Smart Thermostat Premium, Smart Thermostat Enhanced, SmartThermostat with voice control, ecobee3, ecobee3 lite, and ecobee 3. eco+ and the 'Adjust for Humidity' feature are not compatible with older thermostats (Smart SI). These software upgrades are provided at no cost to existing and new ecobee thermostat customers. These features are advertised on the ecobee website as a way to automatically save energy and associated costs without compromising comfort.

Baseline is the control groups usage in the performance period adjusted for any differences between the treatment and control devices in the pre-upgrade period.

3.4.5 Additionality

This project falls under category B described in VM0008. Category B projects demonstrate additionality using the Performance Method described in the Protocol. The percentage savings in the energy load for each dwelling in the project, both pre- and post-retrofit, must be equal to or greater than the performance benchmark. This benchmark exceeds average performance and indicates a percentage savings in energy consumption that dwellings are unlikely to achieve with 90% certainty without the project's implementation. Average performance is determined by the annual average percentage savings in weather-normalized energy consumption for dwellings from the same building stock, based on data from the most recent three years.

ecobee hired Demand Side Analytics, LLC (DSA) to complete the additionality analysis for this project. Rather than utilize equations 1 and 2, as indicated in the Protocol, DSA's additionality analysis uses a statistical approach to identify any potential energy saving related to customers use of the eco+ software. The model developed by DSA employs a panel regression using lagged dependent variables and clustered standard errors to simultaneously identify additionality and assess the impacts of the eco+ software on HVAC runtime. In this context, panel data is simply the repeated measurement of certain variables associated with individual objects. A simple example of a panel analysis is a survey that collects information on the income, age, and education level of 1,000 people in a city every year from 2020 to 2025. Lagged dependent variables are the past values of the dependent variables (the variable being predicted) included as independent variables in the regression equation. This is often done to help inform how past results might affect current outcomes. For example, including lagged dependent variables in the regression equation allows researchers to analyze how past crop yields affect the current year's yield. If it is found that higher crop yields in the previous years are associated with higher yields in the current year, it suggests that there may be persistent factors influencing crop production, such as soil fertility or farming techniques. Conversely, if past yields have no significant impact on the current year's yield, it may indicate that other factors, such as weather conditions or pest infestations, are driving crop outcomes more strongly in the short term. Clustered standard errors are a way to deal with correlated

observations within groups of data. In statistical analysis, when observations within the same group are more similar to each other than to those in different groups, the standard errors of the estimates may be biased. Clustered standard errors adjust for this by clustering observations into groups and computing standard errors within these clusters. Clustered standard errors help to correct for the fact that data points within the same group (or cluster) might be more alike than those in different groups, making sure that our statistical analysis accurately reflects the true variability in the data. Clustered standard errors can also be appropriate when the treatment and control groups are very similar to each other, but there are clusters within each group that are more similar to themselves than to clusters in the other group. DSA clusters the standard errors by person, which is common in panel data analysis where observations are repeated for the same individuals over time. Clustering standard errors by person accounts for the potential correlation in outcomes within individuals, recognizing that individuals may exhibit consistent characteristics or responses across multiple observations. Simply put, individuals are likely to exhibit substantial variability in their heating and cooling preferences compared to each other. Clustering standard errors by person helps account for this variability.

The panel regression estimates the impact of the treatment (use of eco+ and 'Adjust for Humidity') on the independent variable (HVAC runtime). DSA's approach requires statistically significant results at a 95% confidence level, which is more stringent than the 90% benchmark described in the Protocol. This ensures that any observed changes in electricity usage are truly additional and not merely coincidental fluctuations.

Inclusion of the six independent variables makes this a more conservative and appropriate approach compared to including only a variable for control versus treatment group. Consider the following example: I want to use linear regression to understand the effect of vehicle age on the cost of a vehicle. If I were to perform a linear regression using vehicle cost as the independent variable and vehicle age as the only dependent variable, I would likely be overestimating the coefficient related to vehicle age. This is because the variable 'vehicle age' also inherently includes variables such as total mileage. In this case, mileage is indirectly affecting the price because older cars tend to have higher miles. In a linear regression with only one variable (vehicle age), the estimated parameter for this variable will be higher for age compared to a linear regression which includes age and mileage. This is because the influence of mileage on vehicle age will be removed and accounted for separately.

Listed below are the dependent and independent variables that DSA has included in the linear regression analysis. These independent variables must be included, in addition to control versus treatment, because they also affect the dependent variables. It is intuitive that HVAC runtime is affected by variables like temperature and humidity. By including variables in addition to control versus treatment, DSA is ensuring that the result of the regression analysis is applicable mostly to control versus treatment, rather than other variables.

The dependent variables for heat pump (electricity) owners used in this analysis are:

- 1) seconds of cooling

- 2) seconds of heating
- 3) seconds of auxiliary heating

The dependent variables for non-heat pump (fossil fuel) customers are:

- 1) seconds of cooling
- 2) seconds of auxiliary heating

The independent variables are:

- 1) year/month fixed effects (vector)
- 2) treatment (1 or 0), mean seconds the appliance is on for Dwelling *i* in the month that day *t* is in the pre-period (lagged dependent variable)
- 3) the number of degrees above 60°F that the outside temperature registers (temperatures below 60 are represented as zero) (continuous variable)
- 4) the number of degrees below 60°F that the outside temperature registers (temperatures above 60 are represented as zero) (continuous variable)
- 5) humidity (continuous variable)
- 6) day of week fixed effects (vector)

Five regressions were calculated separately for: 1) cooling/heat pump, 2) heating/heat pump, 3) aux heat/heat pump, 4) cooling/no heat pump, and 5) heating/no heat pump

These methods enable DSA to accurately quantify the specific effects of the eco+ software on customer behavior and energy consumption, isolating the impact of the software from other variables and providing a clear picture of its effectiveness. This comprehensive approach ensures that the measured outcomes are robust and reflective of the true influence of the eco+ software. DSA used Stata software to complete the analysis. TÜV SÜD concludes that the approach employed by ecobee to determine additionality is robust and conservative as it relates to the implementation of the project activity. TÜV SÜD agrees that the methods for determining additionality as specified in VM0008 are not appropriate for this project activity. TÜV SÜD reviewed the regression code created and provided by DSA and found it to be logical and appropriate. TÜV SÜD recreated the code and analysis used to quantify GHG emission reductions in the Python Programming Language and found ecobee's quantification results to be reasonable. The reanalysis was done in Python because Stata is a niche statistical software package and the validation and verification team are not familiar enough with it to complete any independent analysis. Stata is also not open source.

Geographic scope

According to VM0008, each performance benchmark must be calculated relative to each Same Building Stock and a specific geographical boundary as identified in the PD. DSA categorized eco+ users and control group members into four housing stock categories: apartment/condo, detached, semidetached, and other/not applicable. ecobee thermostat users self-report their housing type. Between the treatment and control group, the percentage of each group within the categories is relatively similar except for 'semidetached'. In the control group, 15.14% of

respondents self-identify as having semidetached housing, while only 10.97% of respondents in the treatment group self-identify as having semidetached housing (see table 1 in the PD).

DSA uses ecobee thermostat user zip codes to categorize members of the control and treatment group into one of five climate regions: cold, dry, hot humid, marine, and mixed humid. Between the treatment and control group, the percentage of each group within the categories is relatively similar except for 'hot humid' and 'marine'. 15.84% of the control group reside in the hot humid climate, while 21.23% of the treatment group fall within this climate region. 10.95% of the control group reside in the marine climate, while only 4.70% of the treatment group reside in the marine climate (see table 2 in the PD). To account for inconsistencies in geographic distribution between the control and treatment groups, DSA includes weather variables as independent variables in their model.

Data Selection and Use

The data used to determine additionality are primary data collected directly on ecobee thermostats. ecobee thermostats collect information about HVAC system runtime, which is the basis of the additionality analysis, every five minutes. VM0008 requires that data used to determine additionality and GHG reductions to come from an approved source, i.e., a certified energy auditor, or a nationally recognized data source. Thermostat telemetry data are listed as an approved data source in the National Renewable Energy Laboratory report: 'Smart Thermostat evaluation protocol'. As in VM0008, this report encourages the use of utility meter data to analyze whole-home consumption savings from any energy optimization program. The authors of the report argue that the use of utility meter accounts for all energy impacts from optimization programs and secondary effects, such as appliance use. Unlike telemetry runtime data, this method doesn't require converting smart thermostat HVAC runtime to energy, making it likely to provide more accurate savings estimates. However, the authors of the report also acknowledge the impracticalities of collecting utility meter data and instances where thermostat program optimization saving might be undetectable in meter data. In these instances, thermostat telemetry data are acknowledged as a reasonable and appropriate data source.

ecobee argues that collecting meter data for all Dwellings is not feasible due to the large number project participants (control group and treatment group) and the logistical challenge of obtaining utility data from all users. Additionally, ecobee argues that collecting utility data for the whole home is not appropriate for this project as the eco+ feature only incrementally lowers HVAC runtimes associated with heating and cooling. This feature does not affect other appliances and any energy savings might be undetectable on a utility bill. For example, energy usage might be higher for homes that experience cold, dark winters due to the increased need to have lights turned and residents spending more time indoors compared to other seasons. In this example, it is possible that it would be difficult to quantify the small energy savings associated with eco+ compared to the larger, seasonal increase in energy usage for the whole dwelling. During the virtual site visit, TÜV SÜD reviewed the data collection process as it pertains to the thermostats themselves, as well as relevant QA/QC procedures, data handling,

and data transfer to DSA. TÜV SÜD finds that the methods employed by ecobee and DSA fulfill this criteria. Based on the information reviewed during the virtual site visit and the review of data and documentation provided to TÜV SÜD, TÜV SÜD finds it very unlikely that the data used to determine additionality and the impacts of the eco+ software on HVAC runtime could be manipulated or coerced by any party.

Stewart, James I., Carly Olig, Sepideh Shahinfard, Ken Agnew, Stefanie Wayland, Zachary Horvath, Jason Lai. 2023. Smart Thermostat Evaluation Protocol: Dec 2016 – May 2023. Golden, CO: National Renewable Energy Laboratory. NREL/SR-5R00-86175. <https://www.nrel.gov/docs/fy23osti/86175.pdf>.

Data Maintenance

The data used to determine additionality and calculated GHG reductions are stored in a separate repository, as allowed in the Protocol. These data are stored in a Google Cloud BigQuery table known as Interval Status Messages (ISM). Prior to storage, the data undergo a preprocessing and validation step to identify and reconcile any outliers or suspicious data (refer to the PD for additional details). These processes are managed by ecobee's Data Platform and Data Engineering team members. This process was discussed at length during the virtual site visit and TÜV SÜD has determined that these processes conform to the requirements described in the Protocol.

Conclusion Regarding Additionality

After completing a thorough review of the data, the code used to carry out the panel regression analysis, and assessing the assumptions made to complete the additionality assessment, TÜV SÜD finds that ecobee's process for determining additionality is robust and appropriate to the project activities.

3.4.6 Quantification of GHG Emission Reductions and Carbon Dioxide Removals

This project utilizes the control group approach (3) to calculate emission reductions and related monitoring parameters. This approach is applicable to category B projects as outlined in the Protocol. ecobee defined the control group as ecobee thermostat users who declined the eco+ and 'Adjust for Humidity' software upgrade and ecobee thermostat users who accepted the software upgrade, but have not enabled any of the features of the upgrade. The control group consists of 51,282 ecobee thermostat users, which surpasses the Protocols sample size requirement. In this case, the baseline scenario is the HVAC runtime related to heating and cooling needs of dwellings with ecobee thermostats that did not enable eco+ and the 'Adjust for Humidity' feature. The baseline emissions are emissions from heating and cooling in dwellings with ecobee thermostats who have not enabled eco+ and the 'Adjust for Humidity' feature. As described extensively above, there are differences in the characteristics of the control group compared to the treatment group. This is not surprising as the two groups were not randomly assigned, members of the control group chose not to enable the eco+ and 'Adjust for Humidity' feature. These differences include slightly lower likelihood for control group

dwellings to be detached homes, lower percentage of control group dwellings in the cold climate region and the hot humid climate region, among others (see PDD).

The project emissions are emissions from heating and cooling in dwellings with ecobee thermostats and the eco+ and 'Adjust for Humidity' feature enabled.

To address inherent differences in HVAC runtime between dwellings with and without heat pumps, separate regressions are performed for five categories: 1) cooling/heat pump, 2) heating/heat pump, 3) auxiliary heat/heat pump, 4) cooling/no heat pump, and 5) heating/no heat pump. The outcome variable (dependent variable) is daily energy usage, with key predictors including year-month indicators, treatment indicators, lagged dependent variables, degree-days above and below 60 degrees, humidity, and day of the week. The lagged dependent variable accounts for baseline seasonal patterns in each household. The analysis controls for weather variations by estimating separate coefficients for hot and cold degree-days and uses fixed effects to control for broader time-variant changes. Performing five separate regression analyses likely reduces uncertainty in the model estimates compared to assessing HVAC runtime using only one linear regression. The effect of temperature on equipment runtime differs for cooling and heating; for example, higher temperatures typically increase the runtime for cooling systems, while more efficient heat pumps might require less runtime overall. Failing to accurately account for these differences could result in higher uncertainty. Implementing these separate regressions also allows DSA to accurately estimate emissions (baseline and project) depending on the heating source (fossil fuel versus electricity) of the dwellings. ecobee reports that approximately 77% of dwellings in the project have fossil fuel as a heating source and 23% have electricity as a heating source. The heating source is determined at the device level based on the wiring configuration and confirmed by the customer.

To address serial correlation in individual energy consumption data, DSA clusters standard errors by person, which increases confidence intervals and makes it harder to reject the null hypothesis that there is no effect. VM0008's benchmark requires rejecting the null hypothesis based on annual energy consumption changes, but DSA uses daily energy changes with a more stringent 95% confidence interval, enhancing the rigor of their analysis. For each month and year, the effect of the eco+ and 'Adjust for Humidity' features must be 95% statistically significant or those months and years are set to zero, and no emission reductions will be reported. This ensures that only instances where there are significant reductions in HVAC runtime are considered. VM0008's benchmark reflects savings unlikely to occur without the project with 90% certainty, while DSA's 95% confidence level ensures measured changes are additional. To ensure a conservative emission reduction calculation, DSA uses the lower bound of the 95% confidence interval, derived by subtracting 1.96 times the standard error from the point estimate, thus providing a conservative estimate of eco+'s impact.

Once the baseline and project runtimes have been determined, DSA calculates emissions reductions using the EPA's Emissions & Generation Resource Integrated Database (eGRID). The eGRID database provides the total and average emissions from electricity consumption by state. DSA used the state annual CO₂ equivalent total output emission rate (lb/MWh) to

calculate a weighted national average CO₂ equivalent (lbs/MWh) for heat pump users and non-heat pump users. The weighted average was calculated by multiplying the percentage of eco+ users (heat pump and non-heat pump separately) in each state, by the respective state annual CO₂e total output emission rate (lbs/MWh). TÜV SÜD recalculated the weighted average for heat pump users and non-heat pump users and got the same result. Given that ecobee thermostats are widespread throughout the contiguous US, TÜV SÜD agrees that this approach is appropriate. This approach is used for the baseline and project emissions.

The weighted national average CO₂ equivalent (lbs/MWh) for heat pump users and non-heat pump users was used to convert HVAC runtime to emission reductions. Emission reductions were calculated separately for heating for non-heat pumps, heat pumps-compressor, and heat pumps-auxiliary as well as cooling. Total VCU's are calculated by simply subtracting the estimated project emissions from the baseline emissions. Note that HVAC malfunctions were not specifically accounted for during runtime determination, as these issues are independent of the eco+ intervention and are expected to occur at similar rates in both the treatment and control groups. By using a control group, ecobee ensures that any impact from HVAC malfunctions is evenly distributed across both groups, preventing bias in estimating the effect of the Adjust for Humidity intervention. This approach maintains the validity of the impact estimate, as malfunctions do not disproportionately affect the treated group. TÜV SÜD agrees that this approach is appropriate and conservative.

Data preparation and analysis are done using Stata, a general-purpose statistical software package (similar to SPSS, SAS, Minitab, or gretl) that has both a command line and a graphical user interface. Stata is not open source and is closer to a macro language than a true programming language like Python.

TÜV SÜD carefully reviewed the data and code provided by ecobee. The data reviewed included daily runtime data, which included the runtime of different cooling and heating types, cooling and heating setpoints, and outdoor and indoor temperatures and humidities. TÜV SÜD also reviewed the inputs and results for the regression analysis. For a subset of these data, TÜV SÜD used Python to assess descriptive statistics that summarize the central tendency, dispersion, and shape of the dataset's distribution. The code provided by ecobee was reviewed to identify inconsistencies and discrepancies between the code and the methods described in the PDD and during the virtual site visit. ecobee was able to answer any questions raised during the review of the data and code. TÜV SÜD carefully reviewed the approach employed by Demand Side Analytics to ensure that it is appropriate, robust, and conservative. TÜV SÜD recreated DSAs analysis in Python to assess the impacts of any assumptions and limitations on the potential emissions reductions and number of credits to be issued. The analysis developed by TÜV SÜD is not a perfect match to the analysis developed by DSA. This is to be expected and is due to differences between Stata and Python and the Python libraries implemented and their relevant assumptions and constraints. TÜV SÜD determined that the results from our Python analysis are within an acceptable level of assurance when compared to the DSA analysis results.

In applied methodology, VM0008, leakage refers to the proper disposal and documentation of replaced appliances and heating/cooling equipment. However, for this project, the heating/cooling equipment controlled by the thermostats and the thermostat optimization platform are not being replaced or disposed of. Leakage has been appropriately excluded by the project proponent.

TÜV SÜD confirms that all relevant assumptions and data are listed in the project description, including their references and sources. TÜV SÜD confirms that all data and parameter values used in the project description are considered reasonable in the context of the project and are in conformance with the VCS Program rules. TÜV SÜD confirms that all estimates of the baseline emissions can be replicated using the data and parameter values provided in the project description.

3.4.7 Methodology Deviations

There is a methodology deviation listed in the PD related to data source. Section 8 of the Protocol stipulates that electricity and fuel bills be collected for both the control and treatment groups annually throughout the crediting period. As described in section 3.6 of the PD, ecobee argues that this approach faces feasibility challenges due to the large number of project dwellings (control and treatment groups) and the logistical difficulty of obtaining utility data from all users. Furthermore, ecobee asserts that collecting utility data for the entire home is inappropriate for this project because the eco+ feature only marginally reduces HVAC runtimes related to heating and cooling. This effect does not impact other appliances, and any energy savings may be imperceptible on a utility bill. For instance, homes experiencing cold, dark winters might have higher energy usage due to increased lighting needs and residents spending more time indoors compared to other seasons. In such cases, quantifying the modest energy savings associated with eco+ relative to the overall seasonal increase in energy usage becomes challenging.

During the virtual site visit, TÜV SÜD reviewed the data collection system, the telemetry data obtained from the thermostats, and quality control and quality assurance process. The likelihood of transcription errors is low, since all data is collected automatically, and unintentional errors are avoided by protecting the database. The verification team concluded that this process was reliable and could be traceable.

This deviation is described extensively above and in section 3.6 of the PDD. VM0008 does not specify any criteria or specifications for permitted methodology deviations. TÜV SÜD confirms that the methodology deviation employed by ecobee does not negatively impact the conservativeness of the quantification of GHG emission reductions because it accounts only for electricity savings that come from the heating and cooling systems. Based on the project activity, these methods are appropriate.

The second methodology deviation is related to the process by which ecobee thermostat users are separated into the control and treatment groups. In VM0008, section 8 (3. Control group

approach), the protocol states that participants shall not have the ability to “opt-in” to the control group. As described above, participants are not randomly assigned to either group. ecobee thermostat users can opt in to the software update (treatment group) or decline to enable the update (control group). In this way, participants are technically opting into the control group by declining the software update. Because the two groups self-select, there are some differences in the characteristics of the control group and treatment group, as described above. TÜV SÜD concludes that ecobee has appropriately controlled for these differences between the two groups in their analysis.

The third methodology deviation is related to determination of additionality and calculation of GHG emission reductions. Rather than using equations 1 and 2 as indicated in the Protocol, DSA’s additionality analysis employs a statistical approach to identify potential energy savings related to customers’ use of the eco+ software. The model developed by DSA uses a panel regression with lagged dependent variables and clustered standard errors to simultaneously identify additionality and assess the impacts of the eco+ software on HVAC runtime.

Analyzing households individually and then averaging the results would converge to the same outcome as a panel regression because both methods aim to capture the average effect across all households. In a panel regression, data from all households is pooled, generating a single estimate of the average effect across the population. This process is statistically equivalent to conducting individual regressions and then averaging the outcomes, as both approaches ultimately capture the same population-level effect. Due to statistical principles like the law of large numbers, the average of individual estimates will stabilize around the pooled estimate, particularly as the sample size grows. The panel regression approach also accounts for both within-household and between-household variations, which helps reduce the variance of the estimate and aligns with most econometric practices. The choice to use a panel regression is practical: it is more computationally efficient, reduces complexity, and provides results that are consistent with widely accepted methods in econometric research. Ultimately, both the panel regression and the averaged individual results would capture the same insight, confirming that a panel regression is a streamlined and statistically sound method for estimating average effects across households.

This process was described extensively above and based on a careful review of the input data, analysis, and results, TÜV SÜD agrees that this approach is appropriate and conservative.

3.4.8 Monitoring Plan

TÜV SÜD confirmed the suitability of the implemented monitoring system by reviewing data collected as inputs into all methodology equations. Due to the nature of this project type, all data collection is done automatically from the telemetry system. Monitored parameters are obtained from each thermostat. TÜV SÜD reviewed QA/QC procedures applied during the collection process to confirm that all data is being gathered and accounted for accurately. TÜV SÜD reviewed this information and found the implemented monitoring system to be suitable and concluded that data monitored is robust and accurate for the purposes of calculating emission reductions.

TÜV SÜD concludes the monitoring plan adheres to all requirements of the Methodology. The tables below contain the data and parameters that are monitored and/or measured during the project crediting period and reporting period. TÜV SÜD reviewed section 5.1 and 5.2 of the project description and confirmed that ex-ante values were included.

DATA AND PARAMETERS AVAILABLE AT VALIDATION

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. 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	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 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	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. 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
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 November 29, 2023 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/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	1/0
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 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	cdd_{it} is the number of degrees above 60 °F, hdd_{it} is the number of degrees below 60 °F, and h_{it} is relative humidity. These variables are <i>outdoor</i> temperature and humidity.

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, DSA allows for maximum flexibility in estimating the impact of disparate weather. This is important because it helps to control for 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 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	The potential impact of eco+ is calculated 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
Source of data	ecobee thermostats
Value applied	Annual number of homes who have opted into eco+
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

The data source of several parameters to be monitored deviate from the protocol. ecobee does not collect mean electricity consumed by the sample group Dwellings in Building Stock *b* in year *y* nor mean electricity consumed by the control group Dwellings in Building Stock *b* in year *y* from electricity bills. These data come from thermostat telemetry data. TÜV SÜD agrees that this is appropriate. Fuel type is determined at the thermostat level based on the wiring needs that are specific to each fuel type. TÜV SÜD concludes that these deviations are appropriate to the project and conservative.

The monitoring plan meets the criteria of the VCS Standard v4.5. Emission reductions will continue to be monitored using the same methods described extensively above. TÜV SÜD agrees that this is appropriate.

3.5 Non-Permanence Risk Analysis

This project results in the reduction of GHG emissions, notably CO₂ related to the combustion of fossil fuel for heating and cooling of dwellings. Since removals are not a part of the project activities, the project proponents have correctly abstained from completing a non-permanence risk analysis.

4 VERIFICATION FINDINGS

4.1 Project Implementation Status

The Project's start date is 3 March 2021, and the crediting period is seven years from 3 March 2021 to 2 March 2028. TÜV SÜD is verifying the monitoring period of 3 March 2021 to 2 March 2023 which is within the crediting period. There were no material discrepancies between project implementation and the project description during this monitoring period.

ecobee implemented the monitoring plan described in the PD during the monitoring period. The Project Proponent obtained, recorded and compiled all required monitored data and parameters according to the schedule described in the monitoring plan. There was no data gaps or missing data during the monitoring period. There were no material discrepancies between the monitoring system and the monitoring plan described in the PD. There were deviations in the monitoring requirements set up in the methodology VM008, they were described in section 3.4 above.

The Project has not participated in nor been rejected by any other GHG programs. The Project is not included in an emissions trading program or any other mechanism that includes GHG allowance trading. TÜV SÜD found no evidence that the Project has received or sought any other form of environmental credit, and it has not become eligible to do so within the time frame of the monitoring period.

TÜV SÜD reviewed the Project's sustainable development contributions (SDG) and confirmed contributions to SDG 7 - 'Ensure access to affordable, reliable, sustainable and modern energy for all'; SDG 8 - 'Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all'; SDG 11 - 'Make cities and human settlements inclusive, safe, resilient and sustainable'; and, SDG12 - Ensure sustainable consumption and production patterns.

For this monitoring period, ecobee achieved the emissions reductions by reducing the runtime of HVAC systems in dwellings where smart thermostats with eco+ feature is installed. The project relies on data recovered from each smart thermostat with access to internet.

Project data for this monitoring period includes number of houses, presence or absence of eco+ feature, runtime of HVAC systems, degrees above or below 60F, and relative humidity, and

indicators of absence or presence of heat pumps in each dwelling. TÜV SÜD observed no discrepancies between the monitoring system operations and Project Description or the Monitoring Plan except as described in the methodology deviations.

TÜV SÜD verified that the Project has been implemented as described in the Project Description and confirmed that the Project meets the requirements of the VCS Standard

Implementation Status	Assessment steps, evidence checked, & conclusion:
Project implementation	ecobee fully rolled out the eco+ software update on March 3, 2021. Based on the evidence reviewed by TÜV SÜD, the project has been implemented as described in the project description. New project instances are enrolled on a rolling basis.
Monitoring plan	The monitoring plan meets the criteria of the VCS Standard v4.5. Emission reductions will continue to be monitored using the same methods described extensively above. TÜV SÜD agrees that this is appropriate. TÜV SÜD did not find any material misstatements between the actual monitoring system, and the monitoring plan set out in the project description and the applied methodology.
AFOLU-specific project implementation	This is not an AFOLU project.

4.2 Accuracy of Reduction and Removal Calculations

Emissions reduction calculation is described in Section 3.4.6 of this report. TÜV SÜD reviewed the inputs used for the panel regression. Raw data is automatically measured electronically at each dwelling and stored in Google Cloud BigQuery, using telemetry systems in each thermostat.

After the Project Proponent revised the emission reduction calculations based on corrective action request made during the validation and verification, TÜV SÜD confirmed that the calculation is accurate.

TÜV SÜD reviewed ecobee's code used for the statistical analysis to ensure the appropriateness of the calculation and to confirm that the inputs and applied emission factors were correct. Most parameters are estimated using own data, and when factors were used these were conservative and appropriate. TÜV SÜD confirmed there were no transcription or transposition

errors by manually re-calculating a subset of the total emission reductions and comparing these values to ecobee's assertion and monitoring report. There is a low risk of manual transposition errors as all project data is automatically recorded by a data acquisition and handling system in each thermostat. TÜV SÜD found the GHG emission reduction calculations to be in conformance with VM0008, and free of material misstatement. The deviations made to the methodology are extensively described in section 3.4 above and in the PDD. These were approved by TÜV SÜD.

The table below lists a description for how each data and parameter used to calculate the GHG emission reductions was reviewed.

Data and Parameter	Accuracy GHG emission reductions and removals, including accuracy of spreadsheet formulae, conversions and aggregations, and consistent use of the data and parameters	Methods and formulae set out in the project description for calculation baseline emissions, project emissions and leakage have been followed	The appropriateness of any default values used in the monitoring report
Compressor Cooling _{it} (Y _{it} in cooling regression)	TÜV SÜD reviewed the data collection system and quality controls applied to collected data. Its usage was consistent.	TÜV SÜD confirmed that the measured value was used in the panel regression.	N/A; this is a measured value.
Auxiliary Heat _{it} (Y _{it} in heating regression)	TÜV SÜD reviewed the data collection system and quality controls applied to collected data. Its usage was consistent.	TÜV SÜD confirmed that the measured value was used in the panel regression.	N/A; this is a measured value.
Compressor Heat _{it} (Y _{it} in heating regression)	TÜV SÜD reviewed the data collection system and quality controls applied to collected data. Its usage was consistent.	TÜV SÜD confirmed that the measured value was used in the panel regression.	N/A; this is a measured value.
Standard Deviation	TÜV SÜD reviewed the code used in the panel regression as well as the inputs and outputs.	TÜV SÜD confirmed that the estimated value was calculated appropriately using the panel regression.	NA. The value is calculated.
m _t (month)	TÜV SÜD reviewed the data collection system and quality controls applied to collected data. Its usage was consistent.	TÜV SÜD confirmed that the value 1/0 was used.	N/A; binary value.
c _i (complier or non-complier)	TÜV SÜD reviewed the data collection system and quality controls applied to collected data. Its usage was consistent.	TÜV SÜD confirmed that the value 1/0 was used.	N/A; binary value.
y _{it-1} (lagged dependent variables)	TÜV SÜD reviewed the data collection system and quality controls applied to collected data. Its usage was consistent.	TÜV SÜD confirmed that the measured value was used in the panel regression.	N/A; binary value.
cdd _{it} (cold degree days) hdd _{it} (hot degree days) & h _{it} (humidity)	TÜV SÜD reviewed the code used in the panel regression as well as the inputs and outputs.	TÜV SÜD confirmed that the estimated value was used for calculation.	N/A; this is a measured value.
d _t	Confirmed appropriate usage of the dummy value to consider weekday or weekends.	Confirmed appropriate usage of the dummy value to consider weekday or weekends.	N/A; this is a value given by the thermostat.

Number of fuel type	Confirmed appropriate use of the indicator for having a heat pump or not.	TÜV SÜD confirmed the project proponent appropriately assigned the correct indicator.	N/A; binary value.
Number of Dwellings in Building Stock b	TÜV SÜD confirmed that all dwellings were accounted appropriately.	TÜV SÜD confirmed the project proponent appropriately assigned the correct indicator.	Confirmed that the default values were appropriate for calculating emissions from electricity use based on facility location.

TÜV SÜD concluded that the stated emission reductions have been quantified correctly in accordance with the monitoring plan and applied methodology.

4.3 Quality of Evidence to Determine Reductions and Removals

The Project Proponent provided adequate documentation for the emission reduction calculations as well as its information control systems and data management processes. TÜV SÜD reviewed the Project's PDD and Monitoring Report, applicable measured data, and all emission reduction calculations. RCE confirmed that the monitoring report contained enough information for a reader to reproduce the emission reduction calculations.

As described in section 3.4, TÜV SÜD performed recalculations of emission reductions from a sub data set of raw data, checked all functionality of the Project code for calculation and reviewed inputs and outputs. TÜV SÜD found the information provided to be transparently documented and in accordance with the Project Description and requirements of VM0008.

TÜV SÜD interviewed ecobee staff members, and reviewed data collection processes and operational systems used to collect and report data. TÜV SÜD found the systems employed result in adequate data collection and presentation with reliable controls. Quality assurance activities are present through data review techniques conducted by ecobee personnel. TÜV SÜD confirmed the Project's management and staff to be highly qualified and competent and determined that the GHG management system is sufficient to generate accurate and reliable data.

TÜV SÜD concludes the Project data used to determine the GHG reductions to be of sufficient quantity and appropriateness of quality in all instances, and data flow from thermostats, aggregation system, storage, calculation and final transposition into the monitoring report is reliable. There is no calibration frequency specified on the monitoring plan, however the telemetry system installed in each thermostat is appropriate and reliable due to the nature of

the activities. Evidence used to determine the emissions reductions is appropriate and complete.

5 VALIDATION AND VERIFICATION OPINION

5.1 Validation and Verification Summary

TÜV SÜD was contracted by ecobee to complete the validation and verification of the improving energy efficiency in homes through smart thermostat optimization Project. The validation and verification of the GHG statement was conducted in accordance with ISO 14064-3:2019. Activities were conducted from 17 January 2024 to 18 July 2024.

The GHG statement is the responsibility of the project proponent, the project conforms with the validation and verification criteria for projects and their GHG emission reductions or carbon dioxide removals set out in VCS Version 4.5. There were no qualifications or modifications.

5.2 Validation Conclusion

The goal of the project validation is to ensure that the project plan and GHG calculation methods are materially correct and meet the methodology requirements. The project meets the eligibility requirements of the VCS program and VM0008, and the planned project could reasonably be expected to achieve the claimed emission reductions.

TÜV SÜD confirms that the validation was performed in accordance with the VCS Program Guide, Version 4.4, and VCS Standard, Version 4.5 in addition to VM0008 Weatherization of Single Family and Multi-Family Buildings – Sectoral Scope 3. V. 1.1 (10 October 2012). The Project Activity will result in a reduction of GHG emissions through reduction of runtime in HVAC systems in households with smart thermostats with eco+ enhancement. ecobee provided the verification team with data that is relevant, complete, consistent, accurate, transparent and conservative.

Upon completion of the crediting period validation process TÜV SÜD concludes that all relevant VCS validation criteria have been satisfied and the Project Activity properly applies the criteria of VM0008. TÜV SÜD concludes that the baseline is valid and that the emission reductions attributable to the Project Activity are additional to any emission reductions that would occur in the absence of the Project.

All CARs, ADRs, and CRs raised by TÜV SÜD have been satisfactorily resolved by the Project Proponent. The ex-ante emission reductions from the Project Activity are estimated to be 2,815,855 tonnes of CO₂e over a 7-year crediting period from 3 – March – 2021 to 2 March -

2028, resulting in an average of 402,265 tonnes of CO₂e annually throughout the crediting period. TÜV SÜD considers it likely that the estimated quantity of emission reductions may be achieved by the Project Activity should the assumptions and operational conditions remain the same including expansion of the project activity subsequent to project validation.

Data used for the emission reduction calculation is historical in nature. All assumptions, limitations and methods that support the outcome of future activities are reasonable, however, actual results may vary since the estimates are based on assumptions that are subject to change. TÜV SÜD concluded that the project is likely to achieve the estimated GHG emission reduction or carbon dioxide removals described below. The project does not report removals separately.

Crediting Period: From 03-March-2021 to 2-March-2028

Validated estimated GHG emission reductions and carbon dioxide removals for the project crediting period:

Vintage period	Estimated baseline emissions (tCO ₂ e)	Estimated project emissions (tCO ₂ e)	Estimated leakage emissions (tCO ₂ e)	Estimated reduction VCUs (tCO ₂ e)	Estimated removal VCUs (tCO ₂ e)	Estimated total VCUs (tCO ₂ e)
01-Mar-2021 to 31-Dec-2021 (achieved)	2,999,118	2,839,476	0	0	0	159,642
01-Jan-2022 to 31-Dec-2022 (achieved)	6,447,557	6,222,659	0	0	0	224,898
01-Jan-2023 to 31-Dec-2023	8,056,871	7,722,866	0	0	0	334,005
01-Jan-2024 to 31-Dec-2024	10,006,261	9,607,192	0	0	0	399,069
01-Jan-2025 to 31-Dec-2025	11,823,478	11,369,838	0	0	0	453,639
01-Jan-2026 to 31-Dec-2026	14,188,173	13,664,475	0	0	0	523,699
01-Jan-2027 to 31-Dec-2027	17,025,808	16,421,230	0	0	0	604,578
01-Jan-2028 to 2-March-2028	3,405,162	3,288,837	0	0	0	116,325
Total	73,952,428	71,136,573	0	0	0	2,815,855

5.3 Verification conclusion

The goal of the verification is to ensure that the GHG assertion is materially correct, that the data provided to TÜV SÜD can be documented and if errors or omissions are detected, they be corrected by the Project Proponent. The data and information supporting the GHG assertion were historical in nature.

TÜV SÜD conducted a risk-based analysis of the Improving energy efficiency in homes through smart thermostat optimization Project including a strategic review of the Project data, documentation, and emission reduction calculations. TÜV SÜD concludes to a reasonable level of assurance that the GHG assertion is free of material misstatement. The emission reductions resulting from reducing runtimes in HVAC systems using smart thermostats with eco+ optimization for the reporting period 3-March-2021 to 2-March-2023 can be considered in conformance with the following criteria:

- VCS Standard, Version 4.5 (29 August 2023)
- VCS Program Guide Version 4.4 (29 August 2023)
- VM0008 - Weatherization of Single Family and Multi-Family Buildings – Sectoral Scope 3. V. 1.1 (10 October 2012)
- ISO 14064-3:2019 “Greenhouse gases – Part 3: Specification with guidance for the validation and verification of greenhouse gas statements”
- Improving Energy Efficiency in Homes Through Smart Thermostat Optimization Project Description Document. Version 1.6 dated 19 July 2024.

Verification period: From 3 March 2021 to 2 March 2023

Verified GHG emission reductions and carbon dioxide removals in the above verification period:

Vintage period	Baseline emissions (tCO ₂ e)	Project emissions (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Reduction VCUs (tCO ₂ e)	Removal VCUs (tCO ₂ e)	Total VCUs (tCO ₂ e) before occupied dwelling discount	VCUs Issued by vintage after occupied dwelling discount
03-Mar-2021 to 31-Dec-2021	2,999,118	2,839,476	0	0	0	159,642	132,503
01-Jan-2022 to 31-Dec-2022	6,447,557	6,222,659	0	0	0	224,898	186,665
01-Jan-2023	1,814,137	1,728,012	0	0	0	86,125	71,484

to 2-March-2023							
Total	11,260,812	10,790,147	0	0	0	470,665	390,652-

5.4 Ex-ante vs Ex-post ERR Comparison

Vintage period	Ex-ante estimated reductions/removals	Achieved reductions/removals	Percent difference	Explanation for the difference	VCUs Issued by vintage
03-Mar-2021 to 31-Dec-2021	159,642	159,642	0%	The ex-ante estimated reductions were calculated with real data of the first monitoring report. VCU issued by vintage considers a discount of 17% to account only for occupied dwelling as per section 4.1 of the Methodology ¹ .	132,503
01-Jan-2022 to 31-Dec-2022	224,898	224,898	0%		186,665
01-Jan-2023 to 2-March-2023	86,125	86,125	0%		71,484
Total	470,665	470,665	0%		390,652-

1VM0008, Section 4.1 Applicability conditions. "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." Total VCUs Issued by vintage account only for dwelling that met this criteria.

APPENDIX A: DOCUMENTS REVIEWED

FINAL_11JUL2024_ecobee_PD-VM0008.docx

FINAL_11JULY2024_ecobee_MR-VM0008.docx

VCS_R_REQUEST_DENIED_3352_24JUL2023.pdf

ecobee eco+ project stakeholder consultation-20230116_150152-Meeting Recording.mp4

Carbon Stakeholder Consultation_Deck_Jan2023.pdf

DOE protocol.pdf

ContiguousUSA.kml

Konomi, Shin'ichi & Sasao, Tomoyo & Hosio, Simo & Sezaki, Kaoru. (2017). Exploring the Use of Ambient WiFi Signals to Find Vacant Houses. 130-135. 10.1007/978-3-319-56997-0_10.

Carbon Crediting Period - Daily Footprint (By Climate zone, Equipment)[4].csv

eco plus cost breakdown.xlsx

dr_events_dsa_dr_events.csv

CO2_Dashboard_V2_LowerBound.xlsx

ecobee_CO2 Dashboard_emission reduction workbook.xlsx

ecoplus_feature_data_no_heat_pump_acceptors_no_heat_pump_ecoplus_data_000000000000.csv

ecoplus_feature_data_no_heat_pump_acceptors_no_heat_pump_ecoplus_data_000000000001.csv

...ecoplus_feature_data_no_heat_pump_acceptors_no_heat_pump_ecoplus_data_000000000050.csv

ecoplus_feature_data_heat_pump_acceptors_heat_pump_ecoplus_data_000000000001.csv

ecoplus_feature_data_heat_pump_acceptors_heat_pump_ecoplus_data_000000000002.csv

...ecoplus_feature_data_heat_pump_acceptors_heat_pump_ecoplus_data_000000000029.csv

runtime_data_daily_000000000000.csv

runtime_data_daily_000000000001.csv

...runtime_data_daily_000000000017.csv

device_characteristics_acceptors_heat_pump.csv

device_characteristics_acceptors_no_heat_pump.csv

device_characteristics_deniers_heat_pump.csv

device_characteristics_deniers_no_heat_pump.csv

05_01_Panel_Regressions_Cleaned.do

05_02_Conversions.do

05_02_Egrid Prep.do

Additional documents reviewed (not provided by the project developer):

Marginal emissions use cases report.pdf

Scope 2 Guidance.pdf

Title24.pdf

Programmable Thermostats _ Department of Energy.pdf

egrid2022_summary_tables.pdf

2022 Joint Appendix JA5 _Requirements of OCST.pdf

APPENDIX B: LIST OF FINDINGS