U.S. Department of ENERGY | Office of State and Community Energy Programs

Home Efficiency Rebates (IRA Section 50121): Measured Pathway Software Verification Procedures

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Background

Section 50121 of the Inflation Reduction Act provides that for the Home Efficiency Rebates program, commonly referred to as HOMES, rebate measured pathway, state energy offices will submit a plan to the U.S. Department of Energy (DOE):

> *[T]o use open-source advanced measurement and verification software, as approved by the Secretary, for determining and documenting the monthly and hourly (if available) weather-normalized energy use of a home before and after the implementation of a home energy efficiency retrofit, for purposes of measured performance home rebates*[.][1]

This software is used to determine and document a home's monthly or hourly weather-normalized energy consumption before and after the installation of energy efficiency upgrades, which is essential for determining eligibility for performance-based home rebates.

The National Renewable Energy Laboratory (NREL) has established a distinct verification process to ensure alignment with the programmatic requirements of the HOMES rebate program for developers of open-source libraries:

- Open-Source Accessibility: The library must be open-source with publicly accessible code.
- Coincident Weather Data Retrieval: The library must be able to access and retrieve appropriate weather data for the location.
- Energy Use Normalization Methods: The library must have capabilities for both monthly and hourly energy use normalization.
- Comprehensive User Documentation: The library must provide clear instructions and detailed methodologies covering all aspects of software functionality to ensure effective usage.
- Regular Compliance Checks: Developers must ensure that their software remains compliant, submitting it for re-evaluation when significant changes are made, such as alterations that impact core functionality, system architecture, or data handling processes.

NREL will oversee the responses, assess software against the criteria, provide feedback to developers, and facilitate the approval process for software used in the rebate program. The goal is to review and approve submissions within 2 to 3 weeks; however, any necessary clarifications or additional inquiries may extend this timeline.

The verification process ensures transparency, consistency, and accuracy in measuring energy savings, thus supporting the effectiveness of the HOMES rebate program in promoting energy-efficient home retrofits.

Software providers interested in having software approved for measuring energy savings under HOMES should follow the process and requirements described below. All required documentation (as well as questions) should be submitted to homes.rebates.software@nrel.gov.

Verification Requirements for Open-Source Library Developers

Open-Source License Verification

The software has an open-source license, ensuring transparency and accessibility. The complete source code is publicly available for inspection. This open accessibility promotes collaboration and continuous improvement as

[1] *See* 42 U.S.C. 18795(b)(1).

well as enables verification that the software adheres to the necessary standards associated with open-source licenses. Developers should select a license or a compatible license to ensure compliance with recognized open-source criteria ("Licenses – Open Source Initiative," n.d.).

User Documentation

The software includes comprehensive user documentation that guides users through the process of utilizing the software effectively for its intended purposes. The documentation covers all aspects of the software functionality, including:

- Installation and Setup
- User Interface Overview (if applicable)
- Methodology: A comprehensive description of various components of the software including but not limited to key variables used
- Data Inputs: Descriptions of input data requirements (e.g., data granularity, data coverage period) as well as acceptable formats
- Data Constraints: Assumptions made about input data including allowable ranges or thresholds for key variables
- Guidelines for Data Quality Issues: Instructions for identifying and handling poor-quality data such as missing values or outliers
- Functional Use Cases: A set of examples that demonstrate common workflows, ensuring users can replicate the steps needed to achieve desired outcomes
- Troubleshooting and FAQs

This documentation seeks to ensure that users at all levels of technical proficiency can effectively operate the software.

Energy Use Normalization Verification

Energy use normalization is a critical step in ensuring that the software accurately reflects variations in energy consumption due to factors like changes in weather. The software has a method for normalizing energy use with both monthly and hourly energy use data and compare that methodology to known methodologies such as ASHRAE Guideline 14 (ASHRAE 2023).[2]

Weather Data Retrieval

The verification process will also involve testing the software's ability to retrieve and integrate accurate weather data. The software provides reliable sources of historical and current weather information, which will be cross-refenced with the data to ensure consistency and accuracy.

In cases where actual weather data for a specific location is unavailable, the software is designed to automatically identify and use data from the closest available weather station. This capability allows the software to perform the normalization process, even in the absence of direct meteorological data for a given location. It will be verified to ensure that the software correctly selects the nearest weather station based on geographic proximity and comparable climate conditions.

Testing Scenarios:

- Weather Data Availability: Testing the software's ability to retrieve available weather data for a specified location and to identify and use data from the nearest weather station when the specified data is missing.

[2] ASHRAE Guideline 14-2023 is available for purchase from the American National Standards Institute.

- Data Consistency Checks: Cross-referencing the retrieved data against a primary reliable source of historical and current weather information, such as the National Oceanic and Atmospheric Administration (NOAA) or similar, to detect any discrepancies.

Regression Models and Savings Calculations

Regression models are essential for accurately estimating energy savings resulting from home energy efficiency retrofits. These models analyze the relationship between energy consumption and various influencing factors such as temperature, occupancy patterns, and other relevant variables. The purpose is to isolate the impact of the retrofit from other variables, providing a clear, data-driven assessment of actual energy savings.

As part of the software verification process, the following aspects of regression models and savings calculations will be tested:

- Model Selection: The software must demonstrate that it uses appropriate regression models for energy use normalization, such as standard models outlined in ASHRAE Guideline 14.
- Validation against Real-World Data: To verify the accuracy and reliability of the software's regression models and savings calculations, the process will include using pre- and post-retrofit utility data from sample buildings as test cases. This validation will involve utilizing the library to calculate weather normalized observed savings and comparing to other regression methodologies such as ASHRAE Guideline 14 (ASHRAE 2023) to determine the model's accuracy in reflecting real-world conditions.
- Data Cleaning and Outlier Handling: Simulate scenarios with poor data quality and document how the software handles these situations. Identify and document the frequency and patterns of missing data. Identify statistical methods (e.g., Z-scores, IQR-based filtering) for detecting outliers.
- Regular Compliance Checks: Developers must maintain ongoing compliance by ensuring that any updates or modifications to their software. Any significant changes to methods must be submitted for re-evaluation.

Summary of Findings and Determination

DOE/NREL intends to provide a report of the results of its review to the software provider. This will include a determination of whether the software is compliant. In instances where software capabilities are not approved, the report will document where insufficiencies were found.

To appeal a decision, a software provider may resubmit required test results and information for reevaluation, and/or documentation of justification or remedies for insufficiencies identified in the report.

If substantive changes to this verification procedure are required, DOE/NREL will contact approved software providers to submit information for rereview. DOE/NREL does not anticipate such changes and will provide a grace period of at least 4 months for software to meet new testing criteria.

References

ASHRAE. 2023. *Guideline 14-2023, Measurement of Energy, Demand, and Water Savings*. Atlanta, Georgia: ASHRAE.

“Licenses – Open Source Initiative.” n.d. Accessed September 17, 2024. https://opensource.org/licenses.

Office of the Federal Register, National Archives and Records Administration. 2022. *Public Law 117 - 169 - An Act to Provide for Reconciliation Pursuant to Title II of S. Con. Res. 14*. https://www.govinfo.gov/app/details/PLAW-117publ169/summary.