INFLATION REDUCTION ACT
HOME ENERGY REBATES

Home Efficiency Rebates Program (Sec. 50121)
Home Electrification and Appliance Rebates Program (Sec. 50122)

EVALUATION RECOMMENDATIONS

U.S. Department of Energy
Office of State and Community Energy Programs
1000 Independence Avenue, SW Washington, DC 20585

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The intended audience for this document is state or territory energy office staff who are considering or designing evaluations for their Inflation Reduction Act (IRA) Home Energy Rebate programs, which include Home Efficiency Rebates (Section 50121, herein HOMES-Modeled and HOMES-Measured) and Home Electrification and Appliance Rebates (Section 50122, herein HEAR). States should use these recommendations to facilitate decision-making, scoping, planning, budgeting, and development of RFPs for competitive evaluation solicitations.

1.0 Why Evaluation?

Evaluations are valuable to measure program impacts, reduce risk, increase transparency, and enable continuous improvement. Evaluations provide insights about program operations and participant experiences; verify energy, bill, and greenhouse gas (GHG) savings; and provide recommendations for program improvement. Evaluations fit into a cycle of continuous improvement, whereby evaluations provide insight into program efforts and provide recommendations to support adjustments in program design.

This document provides recommendations for states to conduct evaluations for IRA Home Energy Rebate programs, which include HOMES-Modeled, HOMES-Measured, and HEAR. As described in the Program Requirements and Application Instructions Section 3.1.6.3, DOE plans to conduct independent evaluations of the programs. States must participate in DOE-led impact and process evaluations and/or conduct their own evaluations.

DOE-led evaluations are expected to provide findings and recommendations at a national level. DOE recommends that states conduct evaluations so that states can design and customize evaluations for the unique program design, goals, and interest areas. Evaluations sponsored and managed by states serve multiple benefits:

- States gain insights into how their programs are functioning and are provided information that enables continuous improvement in programs over time.

- States can confirm homeowners are saving energy and money as expected and communicated by the program.
- States can share their findings with DOE and other states to provide a network of evaluation learnings that can help improve programs and processes.

The recommendations in this document are intended to provide high-level guidance to states that are planning and implementing their own evaluations. These recommendations provide an overview and best practices of evaluations and recommended studies, including timing, objectives and recommended evaluation tasks.

2.0 Overview and Best Practices Summary

2.1. Best Practices in Evaluation Planning and Management

States should consider the following when planning and conducting evaluations:

- **Ensure evaluations are independent.** States should ensure that evaluation staff are functionally independent of program implementation staff. Typically, evaluations are conducted by third-party evaluation contractors; DOE recommends that firms conducting implementation in one state should not also conduct evaluations in that same state.
- **Engage stakeholders**. DOE recommends that states conduct their evaluations transparently and gain stakeholder and community input into the evaluation objectives, plans, and deliverables. Stakeholders may include program participants, community representatives, industry partners, and policymakers. Feedback from stakeholders can yield valuable insights and ensure that the conclusions drawn from the evaluation are accepted and utilized.
- **Focus on timely, actionable research.** Evaluation is most useful when it is timed to provide insights that enable continuous improvement by informing program design changes. To gain the most value from evaluation activities, a series of evaluations should be planned to deliver insights over time to a growing and evolving program. This could include more frequent, targeted evaluations, especially in the early stages of program deployment.
- **Develop a research strategy**. DOE recommends that states develop a research strategy outlining the timing and objectives of studies, necessary budget, and roles; Section 3.0 provides study recommendations. States should customize an evaluation strategy based on their unique needs, resources, and program design. During the research strategy process, states should develop expected annual budgets for evaluation, based on the state's evaluation goals or available funding[1].
- **Conduct a competitive solicitation for evaluation**. Once an evaluation strategy has been developed, states should conduct a competitive solicitation for an evaluation contractor or contractors. Depending on the state's strategy, there may be value in a contracting arrangement that covers multiple evaluations (i.e., across programs or time), allowing the evaluator to gain deeper knowledge over time, which makes the evaluation more effective and insightful while minimizing the state's contracting effort.

[1] Although a rule of thumb is for evaluations to be 3%–5% of program cost, states may consider lower levels given the administrative cost requirements of the HOMES and HEAR programs.

- **Leverage resources.** See Section 4.0 for recommended references.

2.2. Overview of Evaluation Types

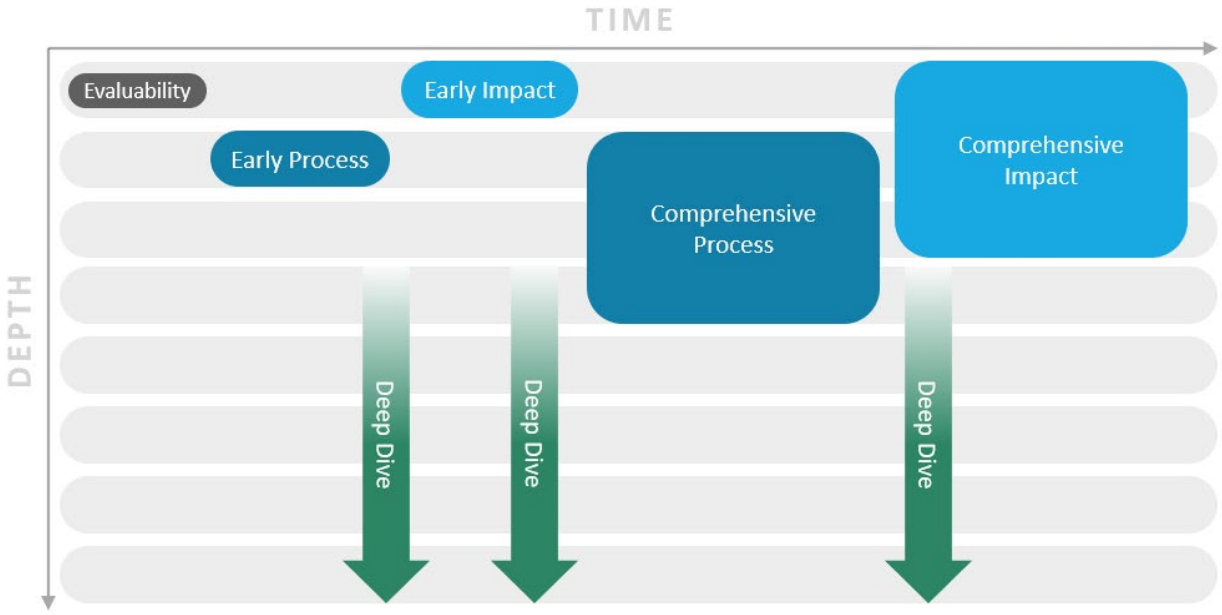
This section provides an overview of key types of evaluations. Section 3.0 provides specific recommendations on studies for HOMES and HEAR programs.

- **Impact evaluations** are assessments that determine and document the direct and indirect benefits of an energy efficiency program. DOE recommends that states conduct impact evaluations to understand and quantify the savings and non-energy benefits associated with the Home Rebate Programs. Savings that may be a focus of impact evaluations include energy (electricity, natural gas, delivered fuels), customer bill savings, and GHG savings. Additionally, impact evaluations may provide insights on capacity and other non-energy and lifetime impacts of programs. See the Energy Efficiency Program Impact Evaluation Guide for more insights.
- **Process evaluations.** Process evaluations focus on understanding program approaches and experiences of homeowners and program partners (e.g., retailers, contractors, and aggregators). DOE recommends that states undertake process evaluations to understand how the program is functioning, what is working well, and what barriers and challenges homeowners and program partners experience, and then to provide recommendations for how to improve the effectiveness of the program.
- **Market effects evaluations.** Market effects studies aim to measure the lasting changes in the market that result from market intervention. Because of the connected nature of states and markets, DOE plans to conduct market effects evaluations at the national level. States may want to conduct market effects evaluations as part of their Market Transformation Plan, especially if the state has unique market effects goals and objectives.

3.0 Recommended Evaluation Studies

This section outlines recommended evaluation studies for states to conduct and includes considerations for all program types (HEAR, HOMES-Modeled, and HOMES-Measured). These designs can be leveraged by states to develop RFPs or Scopes of Work. States can customize their objectives and activities to match their program design, unique interest areas, and resources.

As shown in the following figure, DOE recommends that in the early stages (first 2–3 years) of the program, states conduct an evaluability assessment and early process and impact evaluations to provide fast feedback to the programs in order to adjust program approaches. Once the program is more mature, states should conduct comprehensive process and impact evaluations to gain insights. Additionally, this document provides recommendations for "deep dive" research into specific topics that states could gain additional in-depth knowledge.



States may consider scoping evaluations to conduct studies for each state program individually or may include multiple programs in a single study, as long as reporting is conducted separately for each program (i.e., HOMES and HEAR) delivered by the state. Specific areas where evaluation should be different by program type are noted below.

3.1. Evaluability Assessment

Overview. Before planning and conducting an evaluation, especially for a new program, it's useful to conduct an evaluability assessment to ensure the evaluation can be conducted as planned (i.e., information, data, and processes are sufficient to conduct an evaluation). At this time, it may also be useful to work closely with the evaluation team to outline the detailed evaluation plan, including creation of a detailed timeline and stakeholder management plan.

Recommended timing. The evaluability assessment should begin soon after program launch, with a small number of completed projects (e.g., 10–20 projects, approximately 3 months into program implementation). Starting this study early in the program lifecycle ensures that the program can create needed documentation or adjust data collection processes to enable full evaluations.

Objectives. Key objectives to study during the evaluability assessment include:

- Does the program have clear, well-documented program goals and requirements, including equity, accessibility, and quality control?

- Is the program collecting and tracking all required data to a) track and report against state goals, b) report to DOE, and c) conduct the evaluation?
- Does the program tracking data provide a replicable estimate of savings?
- What are recommended changes to processes or data collection to enable future evaluations?

Tasks. The following are the key tasks that DOE recommends states include in the evaluability assessment scope of work for evaluators.

1. **Review background materials**. An evaluability assessment, or any new evaluation, will likely begin with evaluators working with program teams to understand and document program goals, objectives, and context. For the HOMES program, evaluators can begin by reviewing the program's final grant application and implementation plan (if complete). Additionally, evaluators should review other existing program materials and may want to interview relevant program staff to understand the program.
2. **Assess data collection.** Next, the evaluation should assess the data collected for each program to ensure data being collected is complete and accurate. Tasks may include:
    - Review program application forms.
    - Review individual project data, ensuring that contact information and complete project data consistent with DOE requirements are available.
    - Ensure that linkages in project data fields support merging of contact information, project information, home assessment, and utility billing data, if needed.
    - For HOMES-Modeled projects, check to see if individual project model input files are being collected in an executable format. Confirm 12 months of pre-installation billing data is being collected for calibration (including delivered fuels).
    - For HOMES-Measured projects, confirm sufficient pre- and post-installation data is being collected, including delivered fuels data where relevant.
    - Conduct QC review of available data to determine if anything is obviously incorrect. Identify QC processes that will prevent bad data collection (e.g., range checking at program application ingestion, technical review of project files, etc.).
    - Attempt to replicate tracked savings (energy, bill, and GHG), based on other tracked data, for any savings calculated using engineering algorithms rather than models or measurements.

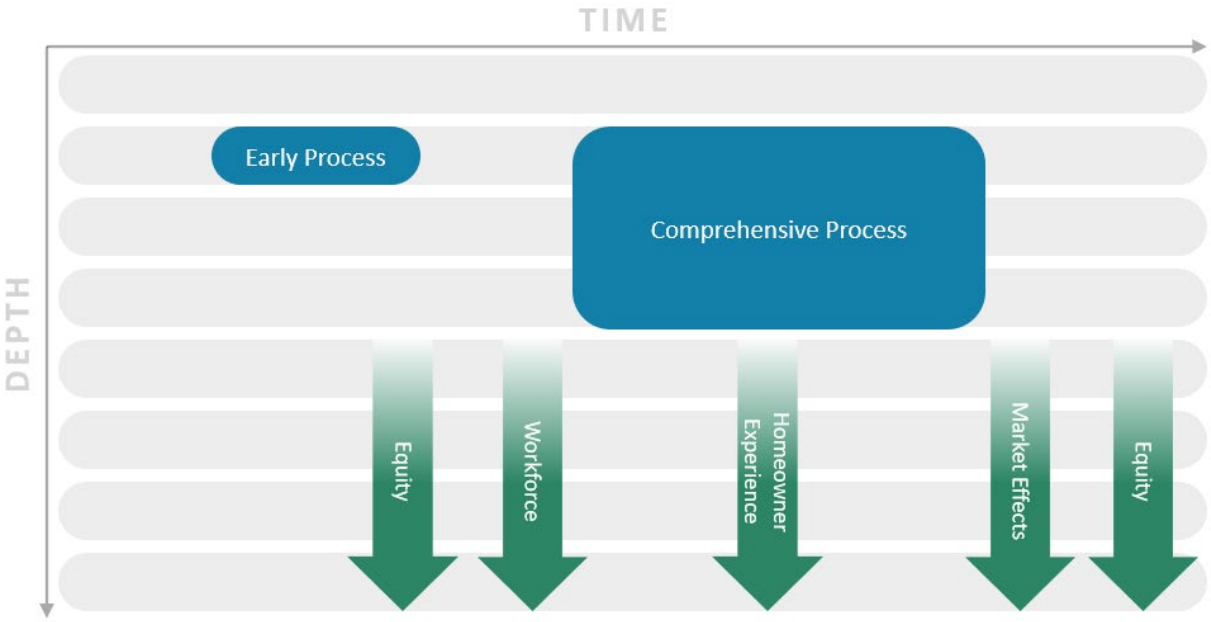
Reporting. Basic reporting on the findings of the above tasks should be conducted to ensure fast feedback of the evaluability assessment to the program, so that adjustments can be made to program design and processes.

3.2. Process Evaluation

DOE recommends that states conduct process evaluation activities at appropriate intervals to understand the effectiveness of program processes, the experience of participating

homeowners and affiliated program partners,[2] and opportunities to improve the programs. Process evaluations can assess participants' and program partners' awareness, motivations, barriers, and program experience to improve the effectiveness of program communication, outreach, application requirements, quality assurance, and contractor management. The insights gained from process evaluations help programs identify opportunities for improvement and document successful practices that should be continued. Process evaluations also help program sponsors ensure that potential participants, program partners, and participating residents can navigate program requirements successfully.

DOE recommends that states conduct at least two rounds of process evaluation over the course of each HOMES and HEAR program period (i.e., early and comprehensive evaluations). DOE also recommends that states include additional "deep dive" topics that may be separate studies or embedded within other process evaluations, as shown in the following figure.



3.2.1. Early Process Evaluation

Process evaluation is most important for new programs or those that have undergone major changes. DOE recommends that states contract for an early process evaluation to confirm that program processes are working as expected and to get feedback from early participants, program partners, and program staff. Maximizing the value of early process evaluations requires program activities to be fully active for approximately six months so everyone has had a chance to work through the steps involved in participating. For HOMES programs, this means identifying and contacting potentially eligible homeowners, scheduling and completing audits, communicating results, scheduling and completing upgrades, and providing quality assurance. For the HEAR program, this means that retailers are engaged, a tracking and processing system

[2] Program partners include auditors, aggregators, tradespeople/contractors involved in home upgrades, retailers, and others involved in delivering services directly to residents.

is in place, and customers are able to access product discounts and complete electrification upgrades.

Recommended timing. The early process evaluation should begin when the program has approximately 10–30 completed projects, (likely within 6–12 months after program launch and after the evaluability assessment).

Objectives. The goal of early process evaluation is rapid improvement and adjustment that will support successful outcomes overall. Therefore, it is important to scope this evaluation for fast feedback, which can be done through rapid deployment of data collection and streamlined reporting. The research should include activities that will help program administrators confirm:

- Program management and processes are effective.
- Program activities are designed to advance equity, reach underserved populations, and/or meet other policy objectives established by the program administrator.
- Program staff can use reporting systems to track measures installed, participation, and preliminary energy or GHG savings.
- Program partners are effectively delivering services to participants and potential participants.
- Marketing, outreach, and education activities are identifying eligible homes, encouraging participation, and effectively communicating the opportunity and value of home energy upgrades.
- Participating homeowner or resident experiences with the program and affiliated contractors are positive.
- The tools and data tracking systems are working well and providing the expected detail.

States may also choose to include deep dive topics of interest at this stage. Yet, states should be careful to not delay the findings of this early evaluation and therefore may want to conduct deep dive studies separately; see Section 3.2.3 below.

Tasks. The following are the key tasks that DOE recommends states include in the early process evaluation scope of work.

1. **Review program documentation, policies, and data collection processes**. A foundational task in process evaluation is to understand how a program works. Evaluators should start by reviewing marketing materials, program guidelines, data collection processes, process flow charts, and other material that informs questions and helps the evaluator identify potential areas of confusion or delay. This task should also include understanding how the program braids funding, coordinates activities with overlapping programs, and engages with community partners.

1. **Interviews with program staff and/or implementation contractors.** These contacts have a deep understanding of how program processes are supposed to work and the status of the program overall. They may also have specific insights or questions that should be included in subsequent research or analysis.
2. **Interviews with market partners involved in delivering program services.** For HOMES, this population includes skilled contractors involved in auditing and analyzing homes, identifying measures, installing measures, and providing quality assurance. This population could include home energy raters; HVAC, insulation, or plumbing contractors; electricians; and other affiliated trades people. For HEAR, this population

includes retailers, community organizations, and contractors involved in verifying eligibility and recommending or selling new equipment.

3. **Interviews or surveys with participating homeowners**. The approach to this data collection will depend on the stage of the program: a small number of completed projects would typically be reached through qualitative methods (interviews, focus groups), while programs with more than 30 completed projects might consider using surveys to cost-effectively reach more contacts.[3]
4. **(Deep Dive Opportunity) Survey "partial" participants.** This population encompasses everyone targeted by program materials—households known to have been marketed to or having received customized messaging about the program opportunity. It also includes those who responded to messaging, made inquiries, received an audit, or otherwise engaged with the program without completing a project.

Reporting. Early process evaluations should be designed for rapid deployment of data collection activities and reporting that provides feedback as quickly as possible to program teams. One way to encourage rapid dissemination of early process evaluation findings is to encourage simplified reporting, either through PowerPoint®-type deliverables or through a short memo-type reports that prioritize concise delivery of critical information.

3.2.2. Comprehensive Process Evaluation

Whereas early process evaluation is focused on confirming early program activities are occurring as expected and informing rapid adjustments to program processes to increase the likelihood of overall success, standard process evaluation provides an opportunity for more expansive research activities. These comprehensive process evaluation projects include more data collection activities and allow for customization that can include market research or qualitative approaches to document how the program is working overall and if/how the program is reflecting multiple overarching objectives.

Recommended timing. DOE recommends that states plan for a comprehensive process evaluation to begin 2–3 years after the program launched, or 18 months after early process evaluation data collection activities concluded.

Objectives. Comprehensive process evaluations provide detailed feedback to program administrators on elements of the program that are working well and those that should be modified. Like early process evaluation, the ultimate objective is to support program improvement, but these projects can also facilitate shared learning. The research should include activities that will help program administrators confirm:

- Program management and processes have remained effective as program activities have increased.
- Program partners are effectively delivering services to participants and potential participants.
- Marketing, outreach, and education activities are identifying eligible homes, encouraging participation, and communicating the opportunity and value of home energy upgrades effectively.

[3] States are required to conduct a brief satisfaction survey as part of their standard program operations (Requirements 3.2.5). Although beneficial, these surveys are limited in depth. Evaluations should therefore use other methods to gather deeper insights into homeowner experiences with the programs.

- Participant experiences with the program and affiliated contractors are positive. This exploration can include paperwork, the audit experience, the upgrades completed, and benefits or challenges experienced with upgraded homes.
- Programs are being implemented consistent with the state's Community Benefits Plan, Outreach Plan, and Market Transformation Plan. Research should be designed to confirm that participants reflect the program's stated distribution objectives by income, geography, or other demographic variables.
- Community partners (including community-based organizations and labor groups) are engaged.
- The supply of qualified workforce is sufficient or increasing.
- Program was adjusted based on early process evaluation recommendations.
- The program is likely to achieve its objectives.

States may also choose to add focus-area topics that add to the objectives and data collection; DOE highly recommends deeper research on equity aspects of the program (see Section 3.2.3 below).

Tasks. All of the tasks listed under "Early Process Evaluation" are appropriate for comprehensive process evaluation, but they should be expanded as appropriate to encompass research questions or data needs that have emerged during program implementation. Some examples of expanded tasks include:

1. Additional interviews/surveys segmented to support analysis of participant experience by:
    - Customer type (e.g., single family, multifamily, renter, owner)
    - Income category
    - Justice40 (J40) or other disadvantaged status
    - Participation pathway (e.g., recruited via community organization vs. contractor, braided with other programs).
2. Interviews with an expanded set of program contacts, stakeholders, and policy makers, including state or local officials who might be working towards sustained program funding or other clean energy policies.
3. Ride-along qualitative research with auditors and participating contractors to understand and document their experiences and interactions with potential participants.
4. Mixed methods approaches that combine survey research with qualitative, research-like focus groups or in-depth interviews to obtain a more nuanced understanding of program experiences. Detailed qualitative research can occur prior to surveys, to identify themes that survey research can test for applicability to a wider population, and/or after surveys, to gain a more detailed understanding of any unexpected survey findings.
5. General population research to investigate awareness, value propositions, or preferences through advanced survey designs.
6. Ethnographic research with shoppers or others considering home upgrades to document their path-to-purchase and information sources. Integrating the experience of low-income customers or members of disadvantaged communities could ensure

program designs are working for these populations; see Section 3.2.3 for more specifics on this.

Informed by the results of this process evaluation, states should decide whether additional process evaluation would be helpful. Even if states determine that they do not need additional process evaluation, DOE recommends that states consider deeper dive research topics to answer specific questions or provide needed insight; see Section 3.2.3.

Reporting. Process evaluation findings should be summarized in a final report that includes a description of all methods used, disposition tables by population, and concise descriptions of findings by data collection activity. The executive summary should document areas where the program is succeeding and provide synthesized, cross-cutting findings and recommendations for program improvement.

3.2.3. Deep Dive Process Evaluation Topics

DOE recommends that states consider focused research to augment evaluation activities as needed. A primary benefit of this kind of research is that it can be designed to reflect the specific needs of a given program and jurisdiction. The topics described here could be included in standard process evaluations or as separate studies to answer specific questions through deployment of rapid, focused research that can be completed within six months. The goal is to provide additional research insights as states develop scopes of work for evaluation practitioners. States may choose some or all of the following topics.

Deep Dive Topics and Insights	Recommended Evaluation Objectives
Equity Focus Area DOE recommends that states conduct focused equity assessments early in the lifecycle of the program, as well as mid-cycle of the program. Equity research often requires special attention to data collection activities, including recruitment methods, representativeness, and ethnographic research tools. Additional homeowner survey efforts or focus groups are often required to understand the experience of underserved communities and to identify expected and unexpected benefits and challenges for these communities.	• To what extent is the program advancing equity and improving the lives of disadvantaged homeowners? • In what ways is program implementation consistent with the Community Benefits Plan? Are there areas where the program is falling short of the Community Benefits Plan? • How is the Community Benefits Plan integrated into program delivery? Are there opportunities to improve the effectiveness of this integration? • To what extent has the program engaged and supported a qualified, diverse workforce? What opportunities exist to do this more effectively? • How effective are the program's efforts to integrate workforce development benefiting J40 communities and other populations described in the Community Benefits Plan? • How is the program integrating J40 principles and objectives? • What specific methods is the program using to reach and serve underserved communities (identified in the Community Benefits Plan)? How have these methods worked?
HOMES: Program Partners and Qualified Workforce Programs will need to partner with program implementers, contractors, retailers, and other market actors to deliver the measures and services the program supports. Ensuring the program is maximizing the benefit of market experts and other partners could require focused research on how these partners are identified, supported, and engaged.	• What gaps exist in the supply of skilled contractors? Is there a sufficient supply? Which specialties are harder to find and keep? • How effective are the program's efforts to recruit and train contractors? • What training is required to ensure contractors can deliver high-quality program services? How does the program's engagement with workforce development efforts provide that training? • To what extent do contractors understand and effectively communicate program opportunities? Do participants understand the information they receive from contractors? Do they trust these market actors?

Deep Dive Topics and Insights	Recommended Evaluation Objectives
	• How do homeowners identify contractors? Do they seek multiple bids or verify cost estimates somehow?
HEAR: Program Partners and Qualified Workforce For HEAR, market partner research will primarily focus on referring contractors and participating retailers (or other platform providers). Focused research for HEAR could reflect the overall path-to-purchase process.	• To what extent are retailer partners stocking and promoting qualified products overall? • How accessible are participating retail channels and Point-of-Sale (POS) discounts? • What is the range (number, style, feature set) of qualified products available? What gaps are there in the availability of specified products (are there lower-cost models, models with certain features, etc.)? • How do retailers provide information about the opportunity? • What is the typical timeframe required for a participant to identify a project, make a purchase, and install an upgrade? • How long does it typically take for retailers to receive payment for POS discounts? • What do retailers expect from their program engagement? Are those expectations being met?
Program Efforts to Target and Educate Homeowners To recruit participants, the program must effectively target and educate homeowners.	• Is the program operating consistent with its Education and Outreach Strategy? • What barriers continue to prevent homeowners from taking action? How do homeowners receive and understand outreach messages? What concerns persist? • What is motivating homeowners who choose to move forward? Are these motivations consistent with the outreach messaging or marketing campaign? • How aware are participants and potential participants of the program opportunity, other state or local programs for which they might qualify, tax credits, and other options for making their home more efficient? What are the primary sources of awareness and information?

Deep Dive Topics and Insights	Recommended Evaluation Objectives
	• To what extent do homeowners understand the risk of increased electricity bills associated with electrification projects?
Monitoring the Homeowner Experience Evaluations should strive to provide deeper insights into homeowner experiences through additional survey research, focus groups, or other methods that reveal the customer journey and identify opportunities for improvement. This research should consider the full range of participant experience and include the following types of questions:	• Are participants (and partial participants) accurately informed of the program opportunity and requirements, including bill impacts? • What elements of confusion remain for homeowners engaging with the program? Are contractors and/or program representatives able to address these? • What challenges emerged in deciding what upgrades to pursue, completing the upgrades, and operating the home after project completion? • Are contractors perceived as competent, trustworthy, and reliable? • How satisfied are participants with the performance of their homes (or equipment) 6–12 months after installation? Have they observed any bill impacts? • What recommendations do participants have for improving the overall program experience?
Market Effects Given the size, scale, and duration of IRA program implementation, it is logical to expect the programs may generate long-term market effects. Market effects are structural or market changes that occur outside of direct program activities but are logically tied to those activities. States should consider including additional market transformation questions consistent with the goals of the state's Market Transformation Plan.	• Is there evidence of market change occurring outside of direct program activities that indicate broader market influence? • Are contractors or other market partners carrying program messaging and upgrades to non-program households? • Are there new local or regional policies that will support similar work outside of direct IRA funding? • Are there new or enhanced financing mechanisms for non-program projects? • Are upgraded homes identifiable on multiple listing services? • Are any of the program-developed tools being adopted by other programs to facilitate income qualification, service delivery, or tracking of GHG and other sustainability objectives?

3.3. Impact Evaluation

DOE recommends that states conduct impact evaluations to understand and quantify the savings and non-energy benefits associated with the Home Rebate Programs. Savings that may be a focus of impact evaluations include energy (electricity, natural gas, delivered fuels), customer bill savings, and GHG savings. Additionally, impact evaluations may provide insights into capacity savings and other non-energy impacts (e.g., health and safety) and parameters for understanding lifetime and cost-effectiveness of programs.

Impact evaluations should aim to establish reliable estimates of savings due to the program, as well as provide insights and improvements into the savings estimation of programs. This is especially true for the HOMES-Measured and HOMES-Modeled paths, where rebates are based on an estimate of energy savings. It is important to understand and verify these savings to ensure that customers are receiving the benefits expected by the program. This ensures that the funds are spent effectively and that customers can have confidence in the results.

Recommended timing. Similar to process evaluation, DOE recommends that states undertake an early impact evaluation and at least one comprehensive impact evaluation, described below. These are differentiated by time as well as depth.

- **Early Impact Evaluation.** Begin the evaluation approximately 12–18 months from program launch. There must be a sufficient number of projects completed (typically 70+) to have a reliable sample for the impact evaluation and, if needed, sufficient post-billing data.
- **Comprehensive Impact Evaluations**. Comprehensive evaluations are likely to include more sample sites with more segmentation, follow up on any issues found during the early evaluation, and conduct a deeper analysis of the issues. Begin comprehensive impact evaluations approximately 2 years after the start of the early evaluation. Best practice is to continue conducting impact evaluations every 2–4 years. This is especially true if there are notable issues found in the previous evaluations or there are major program or participation changes.

Objectives. The primary objective of impact evaluation for Home Energy Rebates (all program types) is to establish an independent evaluation of energy savings of the program participants, by fuel type and as a percent of household consumption. With this, the evaluation can then assess key impacts and associated recommendations, such as:

- How accurate are program-estimated energy savings (i.e., a realization rate)?
- How do energy savings vary by key targeted customer (e.g., multifamily, low-income, moderate income)?
- How much money are homeowners saving on their bills?
- What are the drivers of energy savings and bill savings?
- What types of customers and projects are saving the most energy? The least energy?
- How much GHG is the program saving?
- What are the peak capacity impacts, including winter and summer peak reductions or increases due to the program?
- What are recommendations for improving data collection, measurement techniques, program estimates of impacts, etc.?

Additional impact objectives may include:

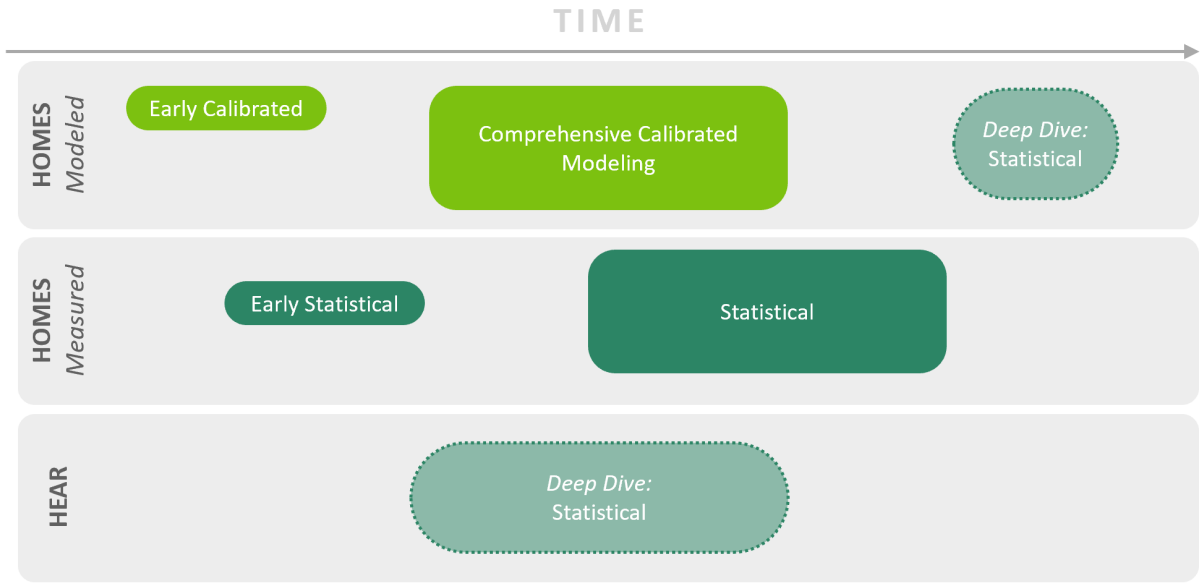
- What are the non-energy program impacts and what is the value of those impacts (e.g., health, safety, building value, building improvements, comfort)?
- What are other time or locational impacts of the program?

Note that DOE views energy savings as gross savings. DOE views utility program efforts and federal efforts as collaborative and synergistic and recommends that all parties engaged in leveraged programs count the savings associated with their efforts. Therefore, DOE recommends that states work with local programs to maximize the ability for local programs to count savings toward braided projects.

Study types. Recommended impact evaluation approaches generally follow two types: calibrated energy modeling and statistical analysis of energy consumption data. Calibrated energy models use home, energy, and project data within simulation models to calculate upgrade savings. Statistical analysis uses energy consumption of homes before and after the home upgrade to calculate savings. The timing and approaches can vary between program types, as shown in the figure below.

For HOMES-Modeled, the general recommendation is for evaluation to conduct calibrated energy models for individual homes (Section 3.3.1). If states want to go deeper in their understanding of the savings, then an option for statistical evaluation is provided (Section 3.3.2).

For HOMES-Measured, a statistical evaluation is recommended (Section 3.3.2) consistent with the program savings estimation approach. If states would like to conduct evaluations of HEAR savings, then a statistical approach is also recommended; this is considered a deep dive opportunity due to the potential difficulties collecting evaluation data.



This section is organized by evaluation method and program type, as these are the key drivers of impact evaluation approaches for Home Energy Rebate programs.

3.3.1. Calibrated Modeling: HOMES-Modeled

3.3.1.1. Evaluation for Calibrated Homes

The HOMES-Modeled program requires that the program calculate modeled savings based on BPI-2400 methods and meet savings thresholds to qualify for a rebate. Therefore, the basic impact evaluation approach is to ensure that the modeling being conducted by program partners is a reliable basis for providing incentives. This method would essentially re-run and confirm the estimates of savings for a sample of projects to ensure that the program estimates were reliable and completed with sufficient accuracy.

This section is for projects that used calibrated engineering modeling as the program estimate of savings. If homes used an exception and the program did not use modeled savings consistent with BPI-2400, see Section 3.3.1.2 below.

Tasks. The following are the key tasks that DOE recommends states include in the evaluation scope of work.

1. **Conduct sampling of projects.** Establish a sample of homes based on target confidence/precision levels (e.g., 90/10 or 90/20 one-tailed) based on targeted customers or programs of interest.[4] In designing the evaluation, the scope should consider those important categories where the evaluation should separately analyze and report results, including single family and multifamily, income category, and J40 status. Early impact evaluation will likely have fewer segments, while comprehensive impact evaluation should increase the sample size and segments in order to gain insights by participation type.
2. **Collect project data and review energy model inputs and outputs.** Collect all information used by the program to calculate energy savings, including executable models and available data used for inputs and calibration including billing data, home assessment data, and project information.
   For each sampled project, review the energy model, the home assessment, and project data. If the evaluator has questions about the modeling approach or inputs, the evaluator should be able to ask questions to the modeling implementer.
3. **Conduct verification of home assessment and project data.** Verify the accuracy of the information in the home assessment and project data. In some instances, the program's documentation may be detailed enough (i.e., including photos and detailed invoices) that no homeowner contact is required. The scope should be designed such that, if the modeling inputs are not substantiated, the evaluation should conduct some type of verification (e.g., phone, web, or onsite).
4. **Conduct modeled savings analysis.** Use calibrated engineering models, utilizing detailed home characteristics, billing, and project data, to establish modeled savings for individual projects based on pre-project consumption data. The evaluator should calculate energy savings for each sampled project by creating a new calibrated model

[4] Refer to UMP chapter on sampling in evaluation for best practices in sample design. Chapter 11: Sample Design Cross-Cutting Protocol. The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures (nrel.gov).

using verified home and project data. The evaluation should conduct modeling consistent with BPI-2400[5]. The analysis should include:

- Exploration of patterns in differences between initial modeled results and new calibrated models, in order to deliver recommendations on modeling software or process improvements.
- A distribution of energy savings for individual homeowners, in addition to calculating average energy savings across customers.
- Comparison of energy savings with other home and project characteristics to identify reasons for major drivers of energy savings and identify opportunities to target homes with a higher likelihood of saving energy.

5. **Estimate Customer Bill Savings ($).** The evaluator should calculate bill savings, using evaluated savings by fuel type and published utility rates for each homeowner[6]. In addition to calculating average bill savings across customers, the evaluation should produce a distribution of bill savings for individual homeowners.
6. **Conduct GHG Analysis.** Based on the evaluated energy savings by fuel type, the evaluator should calculate evaluated GHG savings, using state-specific GHG estimates and savings by fuel type. If possible, the evaluation should conduct this analysis based on the timing of energy savings, by day or by season, to provide more accurate GHG estimates.

Deep Dive Opportunities. The following tasks could be included in evaluations by interested states that have the available data.

1. **Conduct or leverage customer surveys.** If surveys are conducted, then the evaluation can analyze energy savings estimates for each home and compare the customer responses on energy and bill savings against the homeowner perception of savings. This could take the form of a web survey on a sample of participants and could be integrated as part of a process evaluation of homeowners. It is ideal to collect insights from participating homeowners in order to identify the "why" of the savings and understand other changes to the home that may impact the results (e.g., change in building occupancy, addition of EV or solar, other equipment replacements outside of the program, significant renovations or additions to the home.)

1. **Calibrate to post-data.** As part of Task 4 above, the evaluation could also leverage post-installation billing data to also calculate the as-experienced energy savings for the project. That is, in addition to creating an updated modeled estimate using information at the time of project, it would also estimate the actual post-installation savings based on post-billing data and home characteristics (e.g., based on changes in usage, occupancy, or other factors).
2. **Estimate Utility Peak Demand Impacts.** The evaluation could use multiple approaches to calculating utility peak demand including:

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[5] Ideally, the evaluation should use the same software or tool as the program implementer, if feasible. The evaluation should, at a minimum, leverage pre-project data to calibrate the energy savings model to enable a comparison of the program savings estimate with an evaluation estimate.

[6] If utility rates change during the measurement period, then the evaluation should report the bill savings based on the final bill amount, i.e., what the customer would have saved in the post-period given the evaluated energy savings.

- Building models provide hourly output and calibrate to demand peaks.
- Utilizing best available hourly savings load shapes from the NREL load shape project[7] and allocating annual electricity reductions or increases to electricity during peak hours[8]

Reporting. The evaluation should report the results, including but not limited to:

- Evaluation energy savings, by portfolio, fuel type, and key customer type.
- Bill and GHG savings.
- Utility peak demand impacts.
- Comparison of average program savings to evaluated savings[9] (i.e., realization rates of modeled savings based on information used at the time of the project).
- Recommended modeling improvements, data collection and tracking, and other program processes.
- Details on the methods used to collect, clean, and model the energy savings, including functional forms of the models and statistics for resulting models.

3.3.1.2. Evaluation for Exceptions Projects

As defined in the HOMES-Modeled Requirements, there are instances in which using BPI-2400 is not feasible on each home, typically due to data constraints at the time of the project. These projects are considered exceptions in Section 3.2.4.1.1 of the Program Guidance and an impact evaluation may be required.

Fundamentally, the goal of conducting an evaluation on the exceptions projects is to ensure that the energy savings are consistent with the program guidance and statutory requirements. Therefore, the evaluation strategy for exceptions must establish a reliable method to calculate project energy savings, compare the evaluated savings with the program-reported savings, and provide a realization rate for adjustments and recommendations for improvement. The overall recommended approach is to use a site-specific modeling approach, calibrated to post-installation bills.

Tasks. The following are the key tasks that DOE recommends states include in the evaluation scope of work.

2. **Collect information on exceptions savings approach.** If not conducted and vetted in the Evaluability Assessment, then the evaluation should first understand the approach by the program to establishing energy savings for individual exceptions projects. For example, this may include a simplified calculator or prescriptive savings approaches, depending on the characteristics of the homes or projects. The evaluator should begin the study by understanding these nuances in order to develop the evaluation method.
3. **Design a sample.** See Section 3.3.1.1 above. Sampling should be based on key differentiators of exceptions such as multifamily or delivered fuels.

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[7] End-Use Load Profiles for the U.S. Building Stock | Buildings | NREL

[8] Evaluators can use local estimates of peak times from local utilities wherever possible and estimate for top hours in a typical year. Refer to UMP chapter on peak demand and time-dependent energy savings and use methods consistent with UMP. Chapter 10: Peak Demand and Time-Differentiated Energy Savings Cross-Cutting Protocol. The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures (nrel.gov).

[9] If a deep dive using post-billing data was also used, create an estimate of the actual post energy savings and its relationship to the evaluation-estimated savings at the time of the project implementation.

4. **Collect project data and post-installation bills.** Starting with project files and then supplementing with customer surveys, the evaluation should obtain information about the home and projects conducted, including baseline and efficient condition of the home for all implemented measures. Obtain post-installation energy consumption from utilities or residents, including any available delivered fuel bill data.
5. **Conduct Energy Savings Analysis.** Conduct post-installation calibrated modeling for all sampled projects. Use BPI-2400-compliant modeling software and approach similar to Section 3.3.1.1 above, except calibrate to post-installation bills and condition of home and model pre-installation using adjusted pre-installation condition of home. The analysis should include:
    - Comparison of calibrated simulation modeling results to engineering estimates of savings.
    - Exploration of patterns in differences between program estimates of savings and new calibrated models, in order to deliver recommendations on differences and savings estimation improvements.
    - A distribution of energy savings for individual homeowners, in addition to calculating average energy savings across customers.
    - Comparison of energy savings with other home and project characteristics to identify reasons for major drivers of energy savings and identify opportunities to target homes with higher likelihood of saving energy.
6. **Estimate Customer Bill Savings.** See Section 3.3.1.1 above.
7. **Estimate Utility Peak Demand Impacts.** See Section 3.3.1.1 above.
8. **Conduct GHG Analysis.** See Section 3.3.1.1 above.

Deep Dive Opportunities. Similar to Section 3.3.1.1 above, States may choose to add customer surveys or calculation of Utility Peak Demand impacts to their evaluation scope.

Reporting. See Section 3.3.1.1 above. The report should include calculations of realization rates of the exceptions projects to evaluated savings, as well as recommendations for improvement in the future.

3.3.2. Statistical Analysis

As described above, statistical analysis is the recommended basic evaluation approach for HOMES-Measured and is a deep dive opportunity for HEAR and HOMES-Modeled.

3.3.2.1. HOMES-Measured Statistical Analysis

The HOMES-Measured path requires that energy savings thresholds are met for an individual project or for a portfolio of homes. This measurement is conducted using open-source advanced M&V software. Therefore, DOE recommends that the evaluation leverage the open-source code developed by the program implementers and leverage a similar approach to conducting the evaluation using a statistical billing analysis approach, as described in detail below.

Tasks. The following are the key tasks that a state should include in the evaluation scope, as well as additional optional tasks that states may want to include.

1. **Collect billing data and models from program implementers.** Begin by collecting all relevant program information from implementers and/or aggregators used in estimating energy savings. This should include data on individual projects and the raw (unfiltered, uncleaned) billing data, and the modeling code used to clean and merge datasets and conduct the energy savings analysis.
2. **Conduct energy savings analysis.** Using the collected data, the evaluator should clean and analyze data, leveraging the DOE-approved method for this program and best practices in statistical evaluation of energy savings (Section 4.0).[10] The analysis should include:
    - Analyzed savings overall, by fuel type, by key customer type, by individual home, and if relevant, by aggregator.
    - A distribution of energy savings for individual homeowners to show the range of experiences by participants.
    - Analysis of drivers of energy savings based on project and home characteristics, enabling the program to improve its approach to identifying target homes with higher likelihood of saving energy.
3. **Estimate customer bill savings ($).** See Section 3.3.1.1 above.
4. **Conduct GHG Analysis.** See Section 3.3.1.1 above.

Optional Additional Tasks. States could include the following options in the evaluation tasks.

1. **Conduct or leverage customer surveys.** See Section 3.3.1.1 above.
2. **Include non-reported participants.** The evaluation could also include customers who participated in the program but did not meet the individual or portfolio savings thresholds and were therefore not reported as part of the portfolio of savings to the state. This analysis would support the understanding of what are the characteristics of homes that are not meeting the savings thresholds.
3. **Develop a comparison group.** Although it may not be required as part of the program protocol, it is ideal to include a comparison group of customers in order to control for exogenous factors that influence energy consumption, such as billing rates or major events like the COVID-19 pandemic. Alternatively, overall population monthly consumption data can be compared during two periods (e.g., EIA state monthly electricity and gas consumption data and number of customers).
4. **Utility Peak Demand impacts** - See Section 3.3.1.1 above.

Reporting. The evaluation should report the results, including but not limited to:

- Evaluated energy savings, by portfolio, fuel type, key customer type.
- Customer bill and GHG savings.
- Peak demand impacts.
- Comparison of program savings to evaluated savings (i.e., realization rates).
- Recommended modeling improvements, data collection and tracking, and other program processes.

[10] https://www.energy.gov/node/1413841

- Appendices should provide details on the methods used to collect, clean, and model the energy savings, including functional forms of the models and statistics for resulting models.

3.3.2.2. HEAR Statistical Evaluation

There is value in conducting impact evaluation of HEAR programs, particularly for states that want to understand actual bill savings for customers. To do this requires a calculation of energy savings based on home and/or energy consumption data. Because of the POS approach to these rebates, it is expected that there will be less home assessment and billing data to leverage for the evaluation. Statistical impact evaluation is possible for states that can easily access the billing data for HEAR customers.

Tasks: The following are the key tasks that a state should include in the evaluation scope, as well as additional optional tasks that states may want to include.

1. **Conduct sampling of projects.** Evaluator should first establish a sample of homes based on target confidence/precision levels (see Section 3.3.1.1 above for more specifics). For HEAR, the evaluation must consider which measures are candidates for evaluation given the likelihood of detecting the energy savings in the billing data and any program constraints on data availability. The evaluation should attempt to select a sample that enables savings estimates for major measures, measure packages, and customer types such as single family and multifamily, and key factors such as income category (e.g., low and moderate) and equity status.
2. **Collect billing data.** Pre- and post-billing data for all fuels will need to be collected. Where collecting these data from utilities is infeasible, the program can consider providing incentives directly to homeowners to provide copies of bills to the program.
3. **Conduct Energy Savings Analysis.** See Section 3.3.2.1.
4. **Estimate Customer Bill Savings ($).** See Section 3.3.1.1.
5. **Conduct GHG Analysis.** See Section 3.3.1.1.
6. **Deep Dive Opportunities**
    - **Conduct or leverage customer surveys.** See Section 3.3.2.1 above.
    - **Develop a comparison group.** See Section 3.3.2.1 above.
    - **Estimate Capacity Impacts.** See Section 3.3.1.1.

Reporting. The evaluation should report the results, including but not limited to:

- Evaluated energy savings, by measure, fuel type, key customer type.
- Customer bill and GHG savings.
- Peak demand impacts.
- Comparison of program savings to evaluated savings (i.e., realization rates).
- Recommended improvements to data collection and tracking and other program processes.
- Appendices should provide details on the methods used to collect, clean, and model the energy savings, including functional forms of the models and statistics for resulting models.

3.3.2.3. HOMES-Modeled Statistical Analysis of Pre- and Post-Data

For states that want to understand actual bill savings, statistical analysis is recommended to calculate energy savings for projects based on pre- and post-installation billing data. That is,

Section 3.3.1 provides engineering estimates of energy savings but does not provide statistical results based on a population analysis.

Tasks. The following are the key tasks that a state could include in the evaluation scope, as well as additional optional tasks that states may want to include.

1. **Collect billing data and models from program implementers.** Because the HOMES-Modeled path collects home assessment, project data, and pre-period bills, the evaluation should collect this information. The evaluation also needs to collect the post-period billing data from utilities or homeowners.
2. **Conduct energy savings analysis.** See Section 3.3.2.1 above. Alternatively, other site-specific approaches to estimating impacts using analysis of bills may be appropriate (IPMVP Option C).
3. **Estimate customer bill impacts ($).** See Section 3.3.1.1 above.
4. **Estimate utility peak demand impacts.** See Section 3.3.1.1 above.
5. **Conduct GHG analysis.** See Section 3.3.1.1 above.
6. **(*Deep Dive Opportunity*) Conduct or leverage customer surveys.** See Section 3.3.2.1 above.
7. **Reporting.** See Section 3.2.1 above.

4.0 Relevant Links

EERE Program Evaluation | Department of Energy

Strategic Evaluation Planning | Department of Energy

Why Evaluate: Making Informed Decisions | Department of Energy

What and When to Evaluate | Department of Energy

Impact Evaluation Process | Department of Energy

EERE Guide for Managing Program Evaluations

Model Energy Efficiency Program Impact Evaluation Guide (epa.gov)

Energy Efficiency Program Impact Evaluation Guide

Guidebook for Energy Efficiency Evaluation, Measurement, and Verification

Uniform Methods Project for Determining Energy Efficiency Program Savings

Project Manager's Guide to Managing Impact and Process Evaluation Studies (energy.gov)

Evaluator's Resources - IEPEC

M&V Guidelines: Measurement and Verification for Federal Energy Projects