# Putting Data from 30,000 Home Assessments to Work: Real-World Examples of Data-Informed Policy Design

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## ABSTRACT

A major impediment to designing residential decarbonization policies is the lack of aggregable, accurate information on existing housing. This creates a cycle wherein governments are hesitant to adopt policies with potentially unknown impacts, while the lack of policies and programs prevents large-scale data collection. Most data about housing conditions come from surveys, assessor parcel data, and building permits. These sources are typically incomplete, outdated, and possess unknown accuracy. Meanwhile, single-family homes built before energy codes were adopted make up the majority of buildings in the US.

To tackle this problem, the Bay Area Regional Energy Network (BayREN) launched a Home Energy Score (HES) program in 2018. Since then, more than 30,000 reports have been generated across the nine-county region, representing about 1.7% of the Bay Area's single-family housing and about 10% of the approximately 300,000 HES reports nationwide. While the primary purpose of this program is to support energy literacy among homeowners, the aggregated dataset offers novel insights into housing conditions and energy feature distribution by home location and age. In 2026, BayREN launched this program statewide as Home Energy Score California (HESCA).

Through data analysis and interviews with staff at the City of Berkeley, Community Choice Aggregators (CCAs), and the California Energy Commission (CEC), this paper demonstrates how HES has been and could be used in energy efficiency and decarbonization program and policy design. Many homes scored through BayREN are well-positioned to electrify based on sufficient electrical panel capacity and optimal water heater location and could significantly benefit from cost-effective upgrades like attic insulation. However, high electricity rates may present a barrier. Finally, we discuss how others could benefit from this data, overcome existing limitations, and support additional research.

## Introduction

In 2018, BayREN began offering rebates for HES in the nine California Bay Area counties through the Green Labeling program. Since then, BayREN has overseen delivery of more than 30,000 scores via roughly 50 HES Assessors, utilizing rebates to make these assessments more affordable for eligible participants.[1] These HES reports provide standardized

[1] The current rebate amount for an HES is $250. Rebates are not available in the City of Berkeley where HES assessments average $350.

home energy information to help single-family residents better understand their home's current energy features, associated energy costs, and opportunities to reduce energy use and emissions. Each BayREN HES report provides:

- An official DOE Home Energy Score for the home based on its current conditions or "Score Today".[2]
- Estimated scores the home would expect to receive if weatherization upgrades or weatherization plus electrification upgrades were completed.
- Estimated energy costs by fuel and carbon emissions associated with the current conditions, the home with weatherization upgrades, and the home with weatherization plus electrification upgrades.
- A complete list of weatherization and electrification home upgrade recommendations that informed the above building energy model (BEM) results.
- Educational information about the benefits of energy upgrades and links to various resources that can help recipients make the recommended upgrades.

An example HES report is shown in Figure 1.

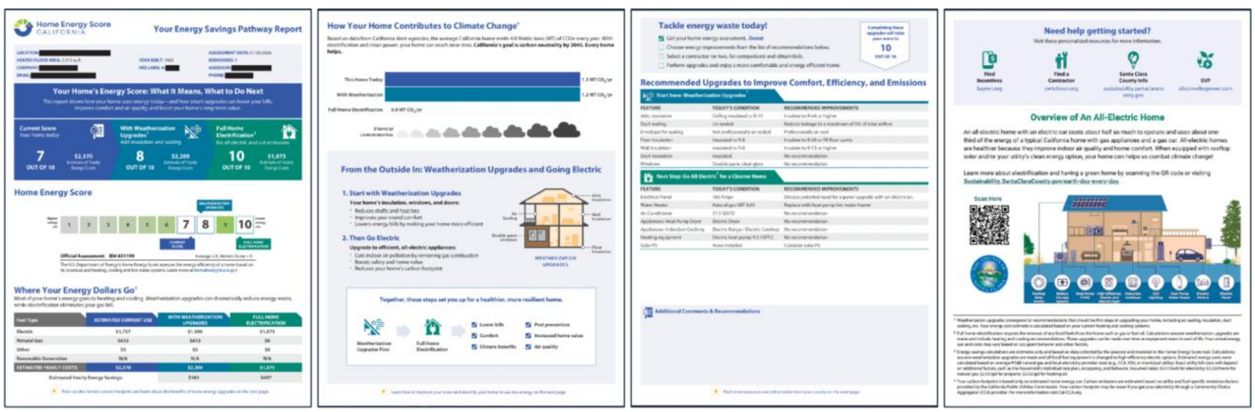



Figure 1. Redacted Example HES California Report. *Source*: Green Building Registry 2026.

Under the California Public Utility Commission's (CPUC) segment criteria, BayREN's Home Energy Scoring efforts are categorized as "market support" (BayREN and Earth Advantage 2025). With the objective of supporting the long-term success of the energy efficiency market, BayREN's program works to:

1. Increase energy literacy among HES report recipients through better understanding of their home's energy features.
2. Increase awareness of home energy upgrade opportunities, including incentive programs, among HES report recipients.
3. Create robust documentation of California housing to inform policies and programs.

This paper focuses primarily on the third use-case by analyzing the existing HES dataset and documenting examples of how this data has or could inform policy and program design. This

[2] "Score Today" refers to the score a home received when it was assessed. Some of these homes may have been upgraded since their original assessment and would not be reflected in the data set.

paper expands upon literature documenting how HES program data has been and can be used to support home energy, climate, health, affordability, and equity goals.

**The U.S. Department of Energy's Home Energy Score Program**

HES programs are administered by dozens of organizations around the country with varied program purposes and designs. These programs are overseen and recognized by the US Department of Energy (DOE) through federally approved partnerships. HES reports are designed to function like a miles-per-gallon (MPG) style rating to help homeowners, buyers, and renters better understand home energy use, costs, and emissions (DOE 2026). The DOE's Home Energy Scoring Tool can be used as a building block of standardized home energy assessments, allowing for comparable datasets across homes and programs. More than 300,000 HES reports have been delivered to homeowners and residents nationwide.

Since the tool's initial release in 2013, DOE and its national laboratories have launched multiple software updates and enhancements to improve function, efficiency, and accuracy. The Home Energy Scoring Tool produces output reports based on approximately fifty data points characterizing the home's features using a standard EnergyPlus BEM. Underlying assumptions informing the BEM include ANSI/RESNET/ICC 301, the standard for calculating and labeling energy performance. DOE has published the system methodology online (DOE 2021).

Like how an MPG rating characterizes the vehicle but not the driver, HES BEM results are based on the home's features, not user behavior. This design enables scoring homes that are new, vacant, or with inconsistent residency, and helps any potential resident understand how an "average" user may experience energy use in the home. Because current/prior resident behavior does not influence report metrics, HES output results are comparable across homes.

**BayREN's Home Energy Score Background**

BayREN formed in 2013 as a collaboration of the nine Bay Area counties who utilize ratepayer funds to run regional energy efficiency and electrification programs approved by the CPUC. StopWaste is the Alameda County representative for BayREN and has served as the Program Lead for the Green Labeling Program since 2018. In 2023, via Decision 23-06-055, the CPUC authorized BayREN to become the first non-Investor-Owned Utility to lead a ratepayer-funded statewide program through HESCA, which was launched in 2026 (CPUC 2023). StopWaste contracts with Earth Advantage to implement the program through HES report customizations, assessor training, quality assurance (QA), and rebate processing.

StopWaste first became a DOE HES partner to support the City of Berkeley's Building Emissions Savings Ordinance (BESO), which is the first policy in the US to require HES reports in real estate transactions. Since 2015, the City of Berkeley has updated BESO twice: first in 2020 to change the trigger point to time of listing, and then again in 2025 to include home energy upgrade requirements (City of Berkeley 2025). In 2021, the City of Piedmont began requiring an energy audit at the time a home is listed for sale, wherein HES is one compliance pathway.

To better align with BayREN and State of California priorities, in addition to the required HES data, HES Assessors began collecting information about electrical features and fossil fuel powered appliances in August 2020, known as the Electrification Checklist. Since then, about 20,000 reports have included data points characterizing electric panels, appliances, and electric vehicle (EV) chargers.

### The Value of Home Energy Score Data

HES data collected over the last decade+ can serve as a useful resource to better understand the current condition of California housing and to design programs that meet homeowner needs. Broadly, the goal of providing these HES reports is to supply relevant and useful home energy information to homeowners, buyers, renters, lenders, and policymakers to spur investments in weatherization and electrification. Through customer surveys and a program evaluation analyzing data from 2019-2023, BayREN determined that homeowners find the score valuable, and about 11% of participants go on to make upgrades after receiving the report (Mitchell-Jackson and Sutter 2024).

HES reports are also designed to drive wider, longer-term impacts. In cases where HES reports are included in real estate transactions – either through disclosure policy requirements or as a way to market home energy upgrades – they can help a prospective buyer or renter better understand the home's energy features, costs, and opportunities. When homeowners and buyers have access to information about home energy features, they can make more informed home investment decisions. Studies have shown that when this information is consistently available in transactions, higher scores are appealing to buyers and renters (Nadel 2025, Breshears 2022, Sussman et al. 2020). One study found a 1-point increase in score is tied to a 0.5% increase in home sale price and a reduced risk of 90-day mortgage delinquency (Pigman et al. 2022).

This paper focuses on elucidating how HES data can increase understanding of home energy features among policymakers and program designers to craft better policies and programs. Outside of this paper, research has generally not focused on this impact. When policy and program designers lack information on local housing conditions and patterns, they run the risk of designing solutions with unknown costs or carbon impacts. Aggregable, standardized home energy information can help bridge these gaps to help homeowners, buyers, renters, appraisers, lenders, program designers, and policymakers invest more efficiently and effectively.

## Methodology

The first step to conducting any data analysis is to collect standardized data. For each of the 30,000+ HES reports analyzed in this paper, data was collected by a home energy and/or inspection professional with HES Assessor training and testing overseen by the US DOE (2026). These standardized processes help ensure the data collected is aggregable and comparable across assessments and not biased by the individual conducting the score. Per these standards, each individual conducting these assessments must have:

- A pre-qualifying certificate or credential accepted by the US DOE.
- Completed 8+ hours of online home energy assessment training.
- Received mentoring while conducting their first assessment.
- Signed a participation agreement for the BayREN HES program.

Completed HES assessments are also subject to QA review to ensure data accuracy. BayREN institutes HES review rates above the minimum thresholds established by the US DOE, including requiring that at least 10% of assessments be reviewed by an HES QA Provider prior to customer delivery. The QA Provider identifies discrepancies between submitted photos from the assessment, data inputs, public records data, and HES data entry guidelines. QA Providers re-enter 5% of these HES to ensure overall accuracy of the reported metrics.

**Data Analysis**

BayREN's HES reports and their full data inputs and outputs are stored in Earth Advantage's Green Building Registry, which aggregates data across 20+ green home verification programs nationwide to ease public and real estate access to this information. When Californians receive an HES report through the BayREN program, they can choose to make their report publicly available on the Green Building Registry or to keep the report private.[3] Program administrators can access all reports through a file download in the administrator portal. Every time an HES is downloaded, the system regenerates the report with the latest-available utility energy cost and carbon emissions rates to keep data elements relevant (Earth Advantage 2026). These files include a minimum of 54 data fields per HES report, resulting in a data file with more than 1.5 million values identifying a variety of home condition data inputs and BEM outputs.

Verdant Associates supported data cleaning and data field analysis activities for the HES assessments conducted between January 2018 and December 2025. Data processing included removal of invalid and outdated scores and recombination of data fields to summarize results by county and home vintage (year built). To gauge bias and representativeness, results were compared to US Census and California Department of Finance (DOF) data, where available.

**Interviews**

To provide firsthand insight as to how policymakers and program implementers have or could use this data to inform their work, we conducted key informant interviews with staff from the City of Berkeley, Silicon Valley Clean Energy (SVCE), and the California Energy Commission (CEC). Interviewees were selected to highlight specific cases where HES data can be useful in supporting home energy program design in California. These organizations represent a mix of use-cases for housing data and experience with the HES program. Berkeley staff has direct access to the BESO reports, as they are considered public information and participant information is needed to enforce the ordinance. BayREN has previously shared anonymized and

[3] All reports delivered in the cities of Berkeley and Piedmont are publicly available due to local ordinances.

aggregated HES data with SVCE for their service area in Santa Clara County.[4] The CEC has not formally used HES data but has explored it as a possible option in an upcoming rulemaking. During 30-minute interviews held virtually over Zoom and email follow-up, interviewees were asked how they currently use building energy data in their work, what data is of greatest interest, and to identify gaps in existing datasets.

### Limitations

Generally, any Bay Area owner of a single-family detached or attached housing unit that is a customer of an IOU is eligible for a HES report. This means that multifamily housing (3+ units) is not included in the data set and all analyses and findings are based on single-family homes only. Additionally, when generalizing conclusions from this analysis to the broader region, it must be acknowledged that program participation is not random. Individual homes are only included in the dataset if the homeowner seeks out and consents to participate.

A 2024 program evaluation identified that about 77% of HES program participants receive their report either as an obligation (e.g., because they are selling their home in Berkeley) or as an add-on service to a required permit inspection for an already completed home energy installation (Mitchell-Jackson and Sutter 2024). This proportion of assessments may represent a relatively random sample of data but has bias toward homes in Berkeley and those with recent HVAC upgrades. The same evaluation found 23% of program participants actively sought an energy audit or otherwise reached out to BayREN about home energy rebates. These assessments may bias the sample toward homes in need of energy upgrades and/or toward homes owned by individuals already interested in energy use.

In addition, this research does not include regression analysis or statistical tests that may identify potentially causational relationships between data values. Any correlations found between two or more data values cannot be deemed to have a causational relationship from this analysis alone. In some cases, causational relationships *can* be stated between data input and data output values, given that the data inputs collected from the assessment influence the BEM that produces energy use, cost, and emissions estimates. Because the data does not include utility bill usage data, conclusions about actual usage patterns are limited.

## Results

Results from this analysis are drawn from the more than 30,000 HES assessments in the California Bay Area, as well as from the key informant interviews. First, data analysis results focus on the overall distribution of the BayREN dataset compared to US Census data and normalized results that would be expected based on the Home Energy Scoring Tool methodology. Second, we provide summary statistics of the BEM results from homes in the sample, first with weatherization upgrades, and then with weatherization plus electrification

[4] Aggregated and anonymized home asset data collected through HES is shareable as long as publicly identifying information (PII), including names, addresses, and contact information is removed due to privacy restrictions.

upgrades. Third, our data analysis summarizes findings about the prevalence of key home energy features that can assist or hinder deployment of energy upgrades across Bay Area housing.

## Data Conformance to Representative Distributions

This analysis includes review of 30,990 HES reports conducted within the California Bay Area counties between 2018 and 2025. This total sample makes up about 1.7% of Bay Area single-family detached and attached housing (State of California DOF 2025). While individual home data is available, results are presented at an aggregated level to identify trends across the single-family housing stock rather than determine characteristics of any particular home.

***Home Energy Score Today.*** Within this sample, the average current score is 5.4 out of 10, with approximately 13% of homes receiving a score of 1 and 15% of homes receiving a score of 10. Based on the DOE Home Energy Scoring Tool design and binning methodology, this suggests the overall sample may be broadly consistent with an expected distribution of homes in terms of total energy use, with homes in this sample scoring slightly higher on average than an expected perfectly random sample. Given that many homes in this sample are receiving their assessment after a permitted energy upgrade has taken place, it is not surprising that this sample skews slightly higher on the 1-to-10 scale.

***Geographic Distribution.*** In part driven by Berkeley's BESO, 35% of homes in the dataset are located in Alameda County, which only represents 20% of Bay Area single-family housing. Overall, the counties of Alameda, Contra Costa, Marin, and Solano counties are relatively overrepresented within the dataset with more than 2% of their single-family housing stock included, while the counties of San Francisco, San Mateo, and Santa Clara are relatively underrepresented within the dataset with about 0.7% of their single-family housing stock.

***Year Built.*** More than half of the homes in the sample were built before 1969, with only 7% built since 2000. Likely driven by older housing stock in Alameda County, homes in this sample skew slightly older than Bay Area housing overall, which has 13% of housing built since 2000 according to the US Census (2024). Overall, 70% of the sample was built prior to 1980, meaning most homes in the sample were built before the first Title 24 energy codes went into effect in 1978 (Energy Code Ace 2016).

## Building Energy Model Results

***BEM Output Results for Homes Today.*** The Home Energy Scoring Tool generates hourly load calculations based on data inputs, typical user behavior, and Typical Meteorological Year (TMY3) weather (DOE 2021). These results dictate what score each home gets on the 1-to-10 scale and are used to calculate annual energy costs and associated carbon dioxide equivalent ($CO_{2e}$) emissions. Earth Advantage's system that generates HESCA reports applies local energy utility cost and carbon rates to each home's BEM results. The average home in this dataset has an average annual energy cost estimate of $3,969 and emits 2.9 metric tons (MT) of $CO_{2e}$ each year. These results are in alignment with expectations and prior research that California households have higher energy costs and lower carbon emissions compared to average US households, in part driven by California's relatively more expensive utility rates and lower energy emissions factors (EIA 2025). The average home with a score of 1 is estimated to cost an additional $2,312 in annual energy costs and generate 1.8 times as much $CO_{2e}$ each year compared to the average home in the dataset. On average, a 1-point increase in score is associated with more than $500 savings in estimated annual energy costs and a reduction of 0.4 MT $CO_{2e}$ in emissions each year. Table 1 below shows how BEM results vary by score.

Table 1. Full Dataset Results Averaged by HES Today Value

| Score Today | Percent of Sample | Percent with Solar | Energy Cost | MT $CO_{2e}$ | Floor Area ($ft^2$) | Cost / $ft^2$/yr |
|---|---|---|---|---|---|---|
| 1 | 13% | 5% | $6,281 | 5.2 | 2,392 | $2.63 |
| 2 | 7% | 4% | $5,194 | 4.0 | 2,021 | $2.57 |
| 3 | 10% | 5% | $4,840 | 3.5 | 1,889 | $2.56 |
| 4 | 12% | 6% | $4,570 | 3.2 | 1,863 | $2.45 |
| 5 | 12% | 8% | $4,249 | 2.8 | 1,773 | $2.40 |
| 6 | 10% | 10% | $3,966 | 2.5 | 1,723 | $2.30 |
| 7 | 9% | 12% | $3,666 | 2.3 | 1,645 | $2.23 |
| 8 | 7% | 17% | $3,337 | 2.0 | 1,607 | $2.08 |
| 9 | 5% | 28% | $2,909 | 1.9 | 1,574 | $1.85 |
| 10 | 15% | 86% | $1,024 | 1.6 | 1,949 | $0.53 |
| **All** | **100%** | **21%** | **$3,969** | **2.9** | **1,880** | **$2.11** |

In general, a 1-point increase in score toward the bottom of the scale (between 1 and 5) generates higher savings than a 1-point increase in score toward the top of the scale (between 6 and 10). Notably, the average home scoring a 10 has estimated energy costs less than half of an average home scoring a 9, and less than ⅓ the energy cost per square foot. These savings are likely primarily driven by the high prevalence of solar photovoltaic (PV) systems. Eighty-six percent of homes that score 10 in this sample have solar PV systems, and more than 20% of homes in the sample have solar – roughly on par with rates of solar PV statewide.

***Modeled Upgrade Potential.*** For a subset of the whole sample (n=7,963 scores), homes were modeled with their current conditions ("Score Today") as well as with weatherization and electrification upgrades. Figure 2 shows the spread of score results between these models. This sample is generally composed of homes that were assessed in 2024 and 2025, after the HES report was updated to provide recipients with weatherization and electrification modeling. While 40% of these homes received an HES of 5 or below, this drops to 13% when these homes are modeled with weatherization improvements, and down to less than 3% with weatherization plus electrification upgrades.

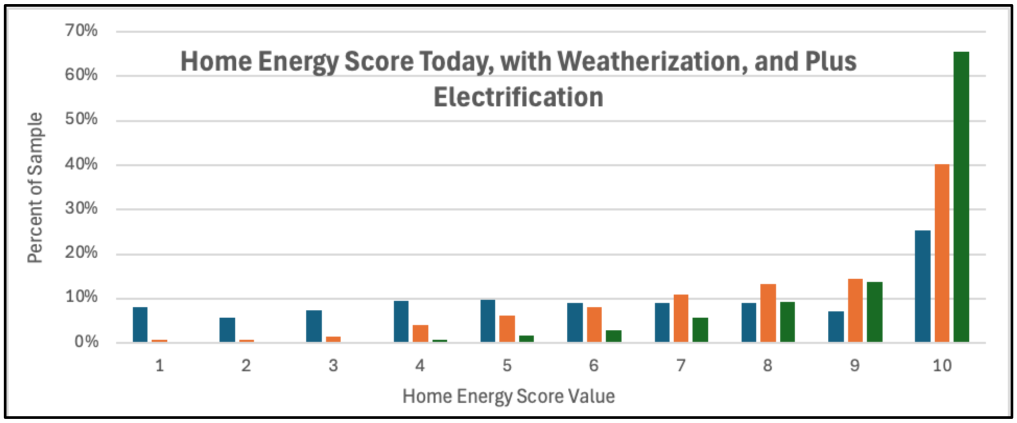



Figure 2. HES result for homes today (blue), with weatherization (orange), and plus electrification (green). *Source*: BayREN 2025.

This analysis, summarized in Table 2 below, finds that for this subset of homes, the vast majority can improve their score and reduce estimated energy costs and carbon emissions through a combination of weatherization and electrification upgrades. Nearly all homes (98%+) are modeled to reduce energy costs with weatherization upgrades alone. When modeling the combined effects of weatherization and electrification, approximately 80% of homes save on energy costs. Whether or not any home actually experiences energy cost savings from electrification depends on a variety of complex factors that require more analysis and more utility information than is collected in the HES, such as the exact rate schedule for each home. For some homes, California's current electricity rates, which are high relative to gas rates, represent a barrier to motivating electrification improvements due to risks of rising energy costs.

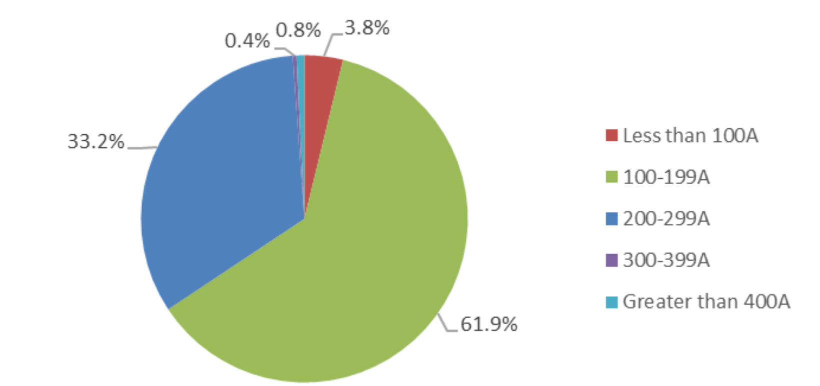
Table 2. BEM Results from Weatherization and Electrification Upgrades

| **Average Data Value** | **Score Today** | **With Weatherization** | **Plus Electrification** |
|---|---:|---:|---:|
| Home Energy Score | 6.4 | 8.2 (+1.8) | 9.2 (+2.9) |
| Energy Cost | \$3,510 | \$3,115 (-\$395) | \$3,201 (-\$309) |
| Carbon Emissions | 2.5 MT $CO_{2e}$ | 1.9 MT $CO_{2e}$ (-0.6) | 0.5 MT $CO_{2e}$ (-2.0) |

**Key Home Energy Feature Results**

Some of the standard HES data, such as insulation levels, heating equipment type, and HVAC equipment age may be estimated based on home age or permit data. However, permit data is notoriously incomplete, with only 8-29% of HVAC systems estimated to receive a permit in California (DNV-GL 2017). Other features, like electrical panel size, may be known by the electric utility, but are privately held. Some data collected in the Electrification Checklist, like water heater location, are not found in other private or public data sources and thus are newly available through this dataset. To showcase some of the data insights made available through this program, we provide summary analysis on electrical panels, water heaters, and insulation.

***Electrical Panel Capacity.*** Electrification of fossil fuel appliances requires sufficient panel amperage. In most cases, homes with 200 Amp (A) panels or greater have the capacity for electrification. Many homes with 100A panels can also electrify without service upgrades by utilizing power-efficient design, such as alternate methods for calculating peak amperage and/or lower-amperage appliances (e.g., 120-volt heat pump water heaters [HPWH]). However, homes with less than 100A panels may need to increase their capacity before whole-home electrification is feasible. Figure 3 below shows results from the 22,312 homes in the dataset with assessed electrical panel capacity. Most homes (3 in 5) have panels between 100-199A and only 4% have panels below 100A. This suggests that the large majority of Bay Area homes may be able to electrify without upsizing their electrical panels, decreasing costs and timelines.




| Panel Size | No. Homes |
|---|---|
| <100A | 850 |
| 100-199A | 13,804 |
| 200-299A | 7,404 |
| 300-399A | 81 |
| ≥400A | 173 |

Figure 3. Electrical Panel Size for Homes with an HES Electrification Checklist. *Source*: BayREN 2025.

Having free breaker spaces in the panel is also important for electrification-readiness to support new electrical loads. Assessors are asked to note if the panel had free breaker spaces. Of the homes with less than 100A panels, 72% were reported to have no free breakers. While a 100A panel may be sufficient to electrify, 58% did not have free breakers. Most of the larger panels (about 62%) did have free breaker space. It is important to note that it is not always easy to assess breaker space. For example, even a "full" panel may still be able to use tandem breakers, install a sub panel, or utilize circuit splitters to electrify without upsizing the panel and with minimal or no additional electrical work.

***Water Heater Type and Location.*** Powered by electricity and more efficient than gas storage tank water heaters, HPWHs are a key piece of equipment to decarbonize existing homes. However, they cannot always replace existing water heaters in the same location. The tanks for HPWHs are often over-sized compared to fossil fuel water heaters due to slower refill times and taller form factors with compressors on top of the tank. Other installation considerations include noise from the compressor, cold air exhausted from the compressor, and need for a minimum volume of air from which to pull heat. This means that water heaters located in small, interior closets, conditioned living spaces, or outdoors may be more challenging to switch to a HPWH.

HES report data (n=30,990) shows that the top three most common water heater types are gas storage tank (85%), gas tankless (11%), and HPWH (3%). Where water heater location data is available (n=22,255), 60% were in a garage, 23% in a basement, and 8% outdoors. About 9% were located in an interior closet or in conditioned living space. The location did vary by county, with Alameda County having more in basements and Napa having the highest percent outdoors. This may reflect variations in climate zones or housing typologies, such as counties with older housing stock like Alameda having fewer attached garages.

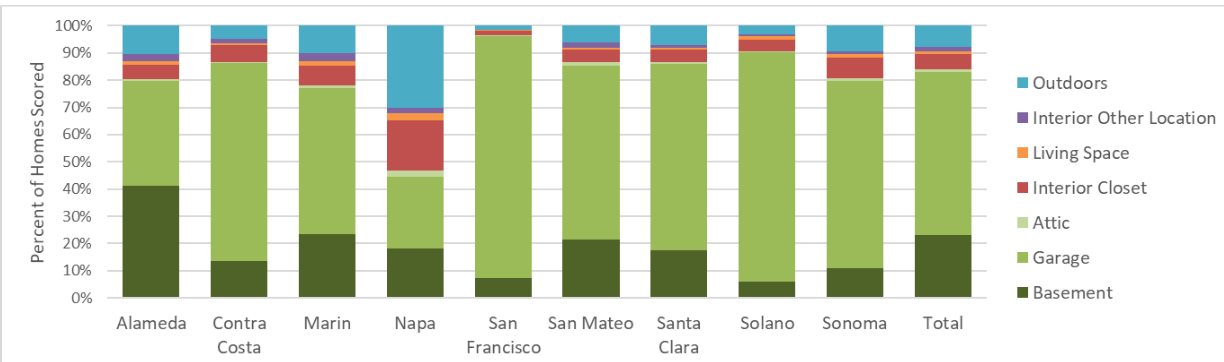



Figure 4. Location of Hot Water Heater by County. *Source*: BayREN 2025.

***Envelope Insulation***. Since the majority of homes in the Bay Area were built before energy codes, many were built with limited or no insulation in the walls or attic. However, Figure 4 below shows that the majority of homes scored have at least some level of either wall or attic insulation, with 53% having both. Attic insulation was more common than wall insulation, with 34% having just attic insulation. This varies by county, with San Francisco being the only county where most homes have insulation values of R-0 in both the walls and attic (80%).

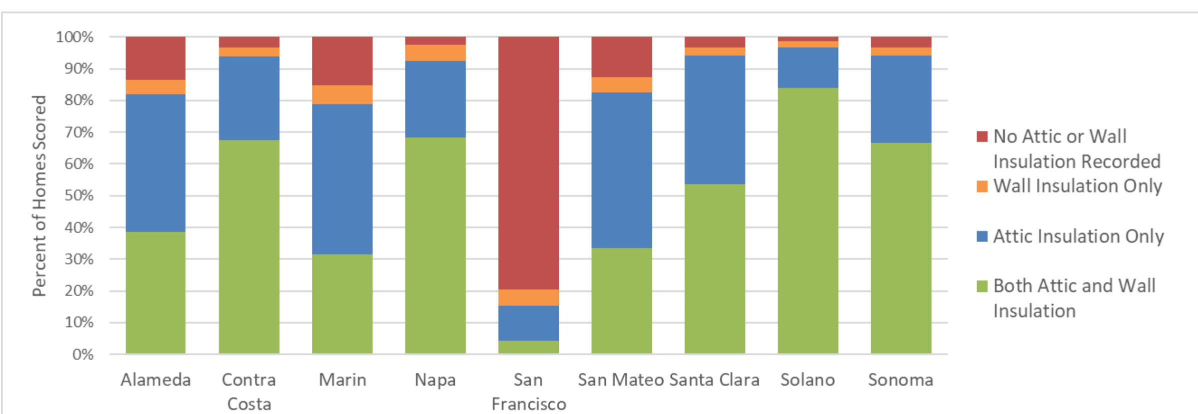



Figure 5. Presence of Envelope Insulation by County. *Source*: BayREN 2025.

Even with many homes in the Bay Area showing at least some envelope insulation, most are not insulated to current building code levels. For homes where attic insulation is possible, meaning there is an attic or crawlspace and not a vaulted ceiling (n=29,353), only 14% have insulation that meets or exceeds the current building code of R-38. Overall, 8% of homes in the sample were found to have no attic insulation and 51% had attic insulation values below R-21. Attic insulation is often one of the most cost-effective energy efficiency measures, and this data shows significant opportunities for policies and programs to facilitate this upgrade.

**Interview Results**

***City of Berkeley.*** Ammon Reagan, Sustainability Program Coordinator with the City of Berkeley, used HES data collected through BESO to inform the inclusion of mandatory upgrades at time of a real estate transaction. The updated policy, which went into effect January 1, 2026, requires homes to either complete upgrades to meet a minimum number of credits using a flexible compliance system that awards credits for various energy and resilience improvements or have a HPWH or heat pump HVAC system. Credits are also provided to homes that previously made sufficient energy upgrades to receive an HES of 9 or 10.

To discern which upgrades should be prioritized in this policy, City staff needed to better understand Berkeley's existing single-family housing stock. Staff noted that the HES data was the best data set available on current home conditions in Berkeley. Since HES reports have been mandated in Berkeley since 2015, the city has a rich set of in-home data to pull from. Between 2015 and 2025,[5] 3,934 homes were assessed in Berkeley, representing about 16% of single-family homes.[6] City staff utilized this data in several ways, including estimating the number of homes with a heat pump, evaluating the percent of homes with electrical panels that can support electrification, and reviewing the geographic distribution of high scoring homes. Using this data, a consultant created building typologies to help the city estimate the cost of compliance and available upgrade options for typical homes.

***Silicon Valley Clean Energy (SVCE).*** In 2025, BayREN provided Santa Clara County HES data to SVCE to evaluate how many homes within their service territory might face challenges electrifying. Jessamyn Allen, Decarbonization Programs Lead, and Peter Mustacich, Technical Manager of Decarbonization Planning and Strategy, explained that in their Electrification Solutions Analysis, they wanted more granular information on "difficult to electrify" water heater scenarios, estimating how many homes would be impacted and costs for electrification. They acknowledged a lack of accurate datasets in building stock details and that sources often lack specifics such as water heater location.

[5] Note that the HES data analyzed contains only 3,129 Berkeley scores approved from 2018-2025 since the HES database was not in place before the BayREN program launched in 2018.
[6] This is an approximation since it does not consider homes scored more than once, which has shown to be low in program data analysis.

SVCE presented several of their findings to Bay Area Air District (BAAD) staff in August 2025[7] to help inform exceptions to BAAD's upcoming Rule 9-6,[8] noting that the HES data implies that only ~4% of homes in Santa Clara County had water heaters located in interior spaces, an encouraging finding since this scenario often leads to space constraints and difficulty installing a HPWH. Electrical constraints (homes with sub-100A service) were also identified as a challenging electrification scenario, due to lacking low-cost, electric equipment options.

To verify the accuracy of the HES data, SVCE compared housing characteristics collected to tax assessor data on square footage, number of bedrooms, and year built and found that it was fairly aligned, increasing confidence in its use. In-home data collected by Assessors may also be more reliable than self-reported homeowner survey data. However, SVCE staff noted a higher-than-expected incidence of heat pump HVAC equipment and recognized existing data gaps as the HES program is more likely to reflect owner-occupied homes and excludes multifamily properties. Still, SVCE believes that the HES data can help them identify innovative programs or encourage new technologies to come to market to produce workable solutions.

***California Energy Commission (CEC).*** Cheng Moua, Senior Mechanical Engineer with the CEC, is working on the rulemaking for the Home Energy Rating and Labeling program under Public Resources Code § 25942 that directs the CEC to establish a "consistent, accurate, and uniform home energy rating system based on a single statewide rating scale for new and existing residential dwellings (CEC 2024)." The rating must include reasonable estimates of potential utility bill savings and recommendations on measures to improve energy efficiency. As HES is a national rating that includes these metrics, the CEC has considered how HES may fit into their rulemaking, especially given the customizations made to better reflect the California housing sector and its decarbonization goals.

Cheng noted that most equipment and building characteristic data available statewide is incomplete. While California's HERS registry provides a wealth of information, it mostly covers new construction, not existing homes. The CEC's forecasting division collects residential appliance survey data, but gaps in between surveys can lead to outdated results.

The rulemaking is meant to help homeowners benefit from consistent home energy data, as well as to use representative statewide datasets in policy analysis. The CEC has looked to Denmark as an exemplar labeling program that has been able to use home data from their energy labeling policies for large-scale decision-making. The CEC is most interested in the HES scores themselves, estimated energy consumption, HVAC equipment types, and envelope efficiency information. The CEC may also be interested in comparing assessment data to existing permit or parcel data and the vintage table in the California Energy Code to assess accuracy of those data sets and estimates. Finally, HES could aid in understanding energy code compliance.

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[7] SVCE's presentation is available on their website at: https://svcleanenergy.org/wp-content/uploads/electrification_solutions_analysis_svce_webpage_jan2026_noc.pdf

[8] BAAD Rule 9-6 mandates Zero NOx water heaters beginning in 2027. More information can be found at: https://www.baaqmd.gov/rules-and-compliance/rules/reg-9-rule-6-nitrogen-oxides-emissions-from-natural-gasfired-water-heaters

## Discussion

This paper represents an initial exploration of the data analysis possible with BayREN's HES dataset. More comprehensive analyses could incorporate demographic data to identify trends and relationships between home energy features and household/neighborhood statistics. More rigorous analyses and regressions could control for potentially confounding variables to identify causational relationships between datapoints. Such research could help policymakers and program designers better reach underserved California households.

There are also opportunities to collect a broader and more comprehensive sample of data aligned with the CEC's needs for analysis. Through the launch of HESCA statewide, there are new opportunities to deliver assessments to households across the state's climate zones, communities, and home types/vintages. As of 2026, the DOE's Home Energy Scoring Tool is also able to assess housing units in multifamily properties.[9] The HESCA program can work to recruit Assessors across diverse geographies and collaborate with partners to reserve a subset of rebate funds for a stratified random sample.

While the program's data is all held in the Green Building Registry, the availability of data and tools to analyze it in an aggregated format are not easily accessible to the public. Additional resources could support software development that provides aggregated HES statistics at census tract, zip code, or jurisdictional levels in a manner that preserves individual household privacy. Such functionality would democratize data access and enable more program implementers and policymakers to ask their own research questions and conduct analyses.

These HES reports in California represent about 10% of the 300,000 scores nationwide. There are opportunities to conduct similar analyses on this larger dataset, both to understand its representativeness of US housing and to potentially identify broader housing trends. BayREN has done more work to collect data on home electrical assets and electrification opportunities, but data regarding home energy use, costs, emissions, HVAC, water heating, and insulation values should be broadly aggregable across programs.

## Conclusion

While designed to primarily build consumer knowledge, our analysis shows that HES can also enhance the abilities of program- and policymakers to design effective solutions, estimate impacts of various scenarios, and target housing stock needs more effectively. This analysis has displayed that many scored homes are, in some ways, well-positioned to electrify due to sufficient electrical panel capacity and optimal water heater locations. However, high electricity rates may present a barrier to households seeking to maximize energy cost reductions. The data also identifies where the potentially greatest cost-efficient upgrade opportunities lie (e.g., attic insulation). More analysis is needed to determine which trends persist after controlling for more

[9] While the functionality for multifamily scoring is now available in the Home Energy Scoring tool, it is not currently part of the statewide HESCA program. This could change in the future.

variables, such as high prevalence of under-insulated housing in San Francisco County or electrifying outdoor water heaters in Napa County.

HES can help build demand for energy efficiency upgrades by providing reports to homeowners that present existing conditions, costs, GHG emissions, suggested energy upgrades, and resources for making upgrades. When households lack this information and overall energy literacy, they may prioritize spending on home improvement and repair projects that do not deliver as many benefits. HES data has augmented incomplete or poorer quality datasets currently available, such as surveys, tax assessment data, or permit data. At an aggregated level, the HES data is the largest and most accurate dataset of home energy assets in the Bay Area and has the potential to be statewide with the rollout of HESCA. Continued data collection and analysis can improve policymaking, program planning, cost assessment, and impact evaluation efforts that are needed to meet California's residential decarbonization goals.

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