CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

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Final Report:

Statewide Home Energy Score (HES) Demonstration Project

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This report was prepared by StopWaste and funded by the California utility customers under the auspices of the California Public Utilities Commission.

Acronym List

BayREN – Bay Area Regional Energy Network

BESO – City of Berkeley's Building Emissions Savings Ordinance

C&S – Codes and Standards

CBECC - California Building Energy Code Compliance

CBSC - California Building Standards Commission

CEC - California Energy Commission

CZ – Climate Zone

DOE – Department of Energy

GHG - Greenhouse Gas

HERS II – California Whole House Home Energy Rating System

HES – Home Energy Score

HERS – Home Energy Rating System

HPWH – Heat Pump Water Heater

HVAC – Heating, Cooling, and Air Conditioning

IOU – Investor-Owned Utility

kWh – Kilowatt Hour

PG&E – Pacific Gas & Electric (utility)

QA – Quality Assurance

Title 24 – California Code of Regulations Title 24, Part 6

TOU – Time of Use

Summary of Revisions		
Date	**Description**	**Reference (page or section)**
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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Executive Summary

The California Codes and Standards (C&S) Reach Codes program provides technical support to local governments considering adopting a local ordinance (reach code) intended to support meeting local and/or statewide energy efficiency and greenhouse gas (GHG) reduction goals. The program facilitates adoption and implementation of the code when requested by local jurisdictions by providing resources such as cost-effectiveness studies, model language, sample findings, and other supporting documentation.

The US Department of Energy (DOE) Home Energy Score (HES) has been used in voluntary and mandatory applications in California and nationwide, largely to provide easy-to-understand information about existing energy assets of a home and options for residents to make improvements. This use-case of HES is mostly for disclosure, with the logic that given this information a certain percentage of homes will make energy upgrades voluntarily. In recent years, four California jurisdictions have passed existing building reach codes that include HES, primarily as a method to acknowledge homes that have already made energy improvements resulting in equivalent savings.

As this reach code HES reference is new and has not been evaluated, this Demonstration Project ("Project") was initiated to review these policies, as well as other reach code use-cases of HES and determine whether HES can provide a robust option for documenting compliance with a reach code. This report documents the findings of the Project, including the appropriateness of HES in a reach code by considering the history and current applications of the tool, a comparison of HES modeling to CBECC-Res, and the results of providing technical assistance to the City of Carlsbad to support HES in their region. CBECC-Res was selected as the state-approved software for demonstrating compliance with Title 24, Part 6, California's Building Energy Code (Title 24). A summary and analysis of the scores conducted in San Diego County are presented in Section 6, as well as findings related to the application of HES in a reach code, including recommended steps before referencing HES in a reach code and opportunities to improve the score's application in California.

The Project team found that, with modifications, HES maintains its usefulness as a disclosure tool despite differences from modeling performed in CBECC-Res. However, between the use of some national datasets in the HES tool and the difficulty in modeling energy savings in the 1 to 10 HES scale, it is not recommended to use HES as a tool for calculating savings in a reach code. HES could be used as part of a reach code to evaluate the home's baseline conditions and provide options for and encourage energy efficiency upgrades. With careful consideration of the score chosen and customizing the report and recommendations, HES may be appropriate in a reach code as an exception as it is a simple way to evaluate and give credit to a home that has already made upgrades or to provide a list of upgrades a home could make in order to comply with a reach code.

Model ordinance language and other resources are posted on the C&S Reach Codes Program website at LocalEnergyCodes.com. Local jurisdictions that are considering adopting an ordinance may contact the program for further technical support at info@localenergycodes.com .

1 Introduction

This report was developed in coordination with the California Statewide Investor-Owned Utilities (IOUs) Codes and Standards (C&S) Program, key consultants, and engaged cities—collectively known as the Project team. The California Building Energy Efficiency Standards Title 24, Part 6 (Title 24) is maintained and updated every three years by two state agencies: the California Energy Commission (CEC) and the Building Standards Commission (BSC). In addition to enforcing the code, local jurisdictions have the authority to adopt local energy efficiency ordinances — or reach codes — that exceed the minimum standards defined by Title 24 (as established by Public Resources Code Section 25402.1(h)2 and Section 10-106 of the Building Energy Efficiency Standards). Local jurisdictions must demonstrate that the requirements of the proposed ordinance are cost-effective and do not result in buildings consuming more energy than is permitted by Title 24. In addition, jurisdictions must obtain approval from the CEC and file ordinances with the BSC to be legally enforceable.

This report documents the results of a Demonstration Project (Project) exploring the feasibility and application of utilizing the US Department of Energy (DOE) Home Energy Score (HES) in an existing building reach code. As of the writing of this report, four jurisdictions — the cities of Piedmont, Carlsbad, Chula Vista, and Encinitas — adopted existing building reach codes that reference HES. In all four HES may be used as an exception to the code and in Piedmont HES is also a compliance pathway for selecting improvements. Previously, HES had mainly been used for the disclosure of energy information around home sales (see City of Berkeley's Building Emissions Savings Ordinance or BESO) or through the voluntary HES program run by the Bay Area Regional Energy Network (BayREN).

While reach codes for new construction have been growing in popularity throughout the state, many jurisdictions are still grappling with how to address existing buildings, which often make up the greatest percentage of building energy consumption and greenhouse gas (GHG) emissions. As HES is a tool developed to primarily compare the energy consumption of existing single-family homes, it is an attractive option for an existing building reach code.

The Project also aimed to understand how the modeling and information presented in HES compares to CBECC-Res, which is the State's approved software used to demonstrate compliance with Title 24 and which is often used in cost-effectiveness analysis to support the development and adoption of reach codes. Variables investigated included how a home's score and recommended measures are affected by inputs such as California-specific energy rates, energy sources, and housing stock, and whether recommendations produced by the HES or the score itself can produce measured energy savings. The Project purpose was ultimately to evaluate if the HES is an appropriate rating system to use in a local energy policy context, either as part of the requirements of the reach code itself or as an exemption.

2 Project Background

As of the writing of this report, four jurisdictions had referenced HES in an existing building reach code. This section provides background information on HES, its history in California, and the four existing building reach codes in which it is included.

2.1 What is Home Energy Score?

HES is a home energy asset rating developed by US DOE and its national labs. The Home Energy Scoring Tool is free, quick, and easy to use and does not require any testing or special equipment. Homes are scored from 1 to 10, with 5 being an average home, 10 the most energy efficient, and 1 being the least energy efficient. The HES is normalized to national housing data and is influenced by home size, climate zone (CZ), and the home's energy assets.

Like a miles-per-gallon rating for a car, the HES is based on a standard assessment of energy-related assets to easily compare properties. Information is collected on heating and cooling systems, windows, insulation, home size, and more.[1] As an asset rating, it does not take into account utility bills, since bill data can often be a reflection of occupant behavior more than the home's potential energy performance. Removing user habits allows for a more accurate rating of the energy efficiency of the home itself and where improvements, versus behavioral changes, should be made.

Local and national HES Partner organizations help HES Certified Assessors meet training, mentorship, and quality assurance (QA) requirements, and work with DOE to implement the program. Assessors must hold a license or credential required by DOE, including Building Performance Institute (BPI) certification, Home Energy Rating System (HERS) Rater, or Certified Home Inspector.[2] Conducting an HES generally takes approximately one hour and costs between $200 and $800, depending primarily on the size of the home. It is easily added to other services, such as a home inspection or Title 24 testing. It is largely a visual inspection of energy assets and does not require in-depth testing, such as blower door or duct blasting (though these can be added to the score to improve accuracy). The HES report is designed to be simple for homeowners to review and includes their score, estimated energy consumption, utility bill costs, and GHG emissions, as well as recommendations for energy efficiency upgrades to improve their score.

2.1.1 History of HES in California

StopWaste advised and assisted the City of Berkeley on the development of its 2015 Building Emissions Savings Ordinance (BESO),[3] which was the first existing building policy nationally to utilize an HES mandate. For the City of Berkeley, the most critical barrier to policy adoption was the identification of an accurate, low-cost assessment tool that could be used in a mandatory context where all homes would be expected to apply.

During the American Recovery and Reinvestment Act of 2009 (ARRA) economic stimulus period, Berkeley used city funding to pilot the use of the California Whole House Home Energy Rating System (HERS II) as an assessment tool. HERS II is a California-specific adaptation of the Residential Energy Services Network (RESNET) home rating system. HERS II testing can take several hours and be more invasive as it requires diagnostic testing and is more expensive. As a more technical rating system, the training and enrollment process is more involved than the HES. When looking for a homeowner-facing energy efficiency rating, HERS II is challenging since the 0 to 150 scale may not be intuitive to a layperson. In HERS II, a 100 is a typical home built to 2006 energy efficiency standards, whereas a 100 in many other scales is often meant to represent the "best" or most complete. In HERS II, a 0 represents a zero net energy

[1] More information on the DOE's HES scoring methodology can be found at: https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/Home_Energy_Score_Methodology_Paper.pdf
[2] The DOE's list of applicable credentials can be found at: https://betterbuildingssolutioncenter.energy.gov/home-energy-score/become-assessor
[3] Requirements of Berkeley's BESO can be found at: https://berkeleyca.gov/construction-development/green-building/building-emissions-saving-ordinance-beso

home and a number over 100 is a less efficient home. HERS II reports typically include several pages of more detailed energy information about the home, which may be confusing or too complex for many homeowners. For these reasons, Berkeley concluded that HERS II did not meet the criteria of being simple, easy to use, and inexpensive.

In tandem, StopWaste led a statewide pilot to produce scores in an offline testing environment for a variety of home types and CZs to evaluate the potential for using HES in California. Based on feedback regarding the limitations of the existing tool, DOE changed underlying assumptions such as CZ data to better address the California context. Other modifications included using PG&E utility data and producing a set of custom recommendations that better align with Title 24 (since this exceeds the national energy code) and local programs, such as BayREN's Home+ rebates which are only eligible for above-code improvements.

After these modifications were made, StopWaste became an HES partner to support both the City of Berkeley's ordinance and a voluntary regional program in the Bay Area. Having a regional partner to maintain the tool was critical to Berkeley's adoption of the BESO and use of the HES. During this time, StopWaste also convened a statewide Green Real Estate Working Group comprised of real estate industry stakeholders, program administrators and implementers in California. This working group facilitated statewide coordination of real estate sector education and other HES initiatives in California, including the Center for Sustainable Energy's (CSE) pilot in San Diego and PG&E's Advanced Home Upgrade program.

StopWaste's HES partnership supports two parallel channels: scores in jurisdictions that have mandatory policies and voluntary scores in the rest of the Bay Area region through the BayREN Green Labeling program. Since the launch of the program in 2018, BayREN has scored over 20,000 homes. As an HES partner, StopWaste has also built and maintained relationships with the DOE and other HES partners nationwide to continue to improve the use of HES for the California market, including how the score can better address electrification.

2.2 HES in Existing Building Reach Codes

This section summarizes the four existing building reach codes that reference HES.

2.2.1 City of Piedmont

The City of Piedmont existing building reach code went into effect on June 1, 2021.[4] It requires that:

1. Projects that include an entirely new level or expand the total roof area by 30 percent or more must install solar panels on the roof.
2. An application for a kitchen or laundry area renovation must include electrical outlets for future appliance installations.
3. A renovation project that costs $30,000 or more must include an energy efficient insulation or heating system electrification improvement. A renovation project that costs $115,000 or more must include two energy efficient insulation or heating system electrification improvements.

Energy efficient and electrification improvements referenced in (3) above include several options, such as R-49 attic insulation, replacing a gas furnace or water heater with a heat pump, or implementing "one or more recommendations specified in a Home Energy Score or Home Energy Audit report that has been completed within the past five years and that is submitted with the application for a building permit, with the approval of such recommendation by the Building Official." The code also provides an exception for homes with an HES report with a score of at least 7 conducted within the past five years.

[4] More information on Piedmont's reach code can be found at: https://piedmont.ca.gov/services departments/planning building/about building /reach code information

2.2.2 Cities of Carlsbad, Encinitas, and Chula Vista

The City of Carlsbad existing building reach code was the first in the state and went into effect on January 1, 2020.[5] The code applies to renovations of existing single-family residential buildings with a building permit valuation of $60,000 or more. Required upgrades are based on the home vintage. For example, a home built in or after 1978 can choose between a lighting and water heating package while a home built before 1978 has the option to seal ducts, install attic insulation, or install a cool roof. The code provides an exemption from these requirements for residential buildings that receive an HES of 7 or higher based upon an assessment by an HES Certified Assessor, to the satisfaction of the building official.

The City of Encinitas' existing building reach code is similar to Carlsbad's code with an effective date of January 1, 2023.[6] It also provides a list of measures available by building vintage, but the valuation trigger point is $50,000. It includes the same exception for an HES of 7 or higher.

The City of Chula Vista's existing building reach code had an effective date of February 24, 2021.[7] While the measures required to comply with the code were similar to Carlsbad's and it also defined measure packages based on home vintage, there are a few key differences. First, applicability was not based on project valuation and all projects applying for a permit to add square footage, move interior walls, or add windows and doors must comply. Additionally, it included an exception to the reach code for an HES, but it must be an 8 or higher and be conducted within the past three years.

[5] Carlsbad reach code language can be found at: https://library.qcode.us/lib/carlsbad_ca/pub/municipal_code/item/title_18-chapter_18_30-18_30_060
[6] City of Encinitas reach code can be found at: https://www.encinitasca.gov/home/showpublisheddocument/5628/638073157948970000
[7] Information on the City of Chula Vista's reach code can be found at https://chulavista.municipal.codes/enactments/Ord3536/media/original.pdf.

3 Policy Analysis

This section provides an overview of several use cases where HES could be utilized to provide information to homeowners or potential buyers to help them lower energy consumption in existing single-family homes.

3.1 Disclosure Policies

Throughout the country, the most common application of HES in a mandatory setting is as a disclosure policy. These policies can be found in Berkeley, California; Portland, Oregon; and Gainesville, Florida; as well as others. Residential energy rating and disclosure is a promising low-cost policy option that can help increase consumer transparency about the costs associated with operating a home, promote more sound purchasing or rental decisions, or guide new homeowners towards energy efficiency or electrification upgrades at a key intervention point. By quantifying building energy use and gathering data on home features, these policies can inform future efforts to reduce building energy consumption and track progress toward achieving community-wide climate and/or energy targets.

3.1.1 Time of Listing

The City of Berkeley passed the first policy requiring HES at the time of a real estate transaction in 2015. Berkeley's BESO requires an HES at the time of listing of a single-family home for sale. To-date approximately 3,000 scores have been conducted in Berkeley. Portland, OR requires an HES at time of listing of a single-family home and has scored over 30,000 homes since its policy passed in 2018.[8] Several jurisdictions throughout the State of Oregon have since passed their own HES mandates modeled off of Portland's, including Bend and Milwaukie.

In these and other labeling policies utilizing HES or another tool, the logic model is that when residents are evaluating their purchase or rental options, energy consumption could be a deciding factor but is largely unknown. In a home-buying scenario, one may receive a home inspection and/or pest report, but the information about potential utility bills, as well as the indoor air quality, health, or comfort impacts of an inefficient home are not readily available. Providing this information can lead to better informed decision-making. Additionally, according to the Joint Center for Housing Studies, a homebuyer spends more than $8,000 per year on home improvements in the first two years of buying a home.[9] A disclosure policy at the time of a real estate transaction can provide information on energy efficiency upgrades at this critical decision-making time, so that they may be easily considered with potential investments in other upgrades or information revealed through real estate disclosure documents, such as termite damage.

3.1.2 Time of Rental

As of the writing of this report, the City of Gainesville, FL is the only city in the country utilizing HES in a time of rental requirement.[10] Since the ordinance went into effect October 1, 2021, over 450 rental units have been scored. In addition to the score, lower-efficiency units must make minimum energy and life-safety upgrades, such as attic insulation and low-flow fixtures. Boulder, Colorado has required disclosure via a different tool and mandatory upgrades through their SmartRegs program since 2010.[11] Through their policy, a rental unit must either meet a minimum HERS score of 120 or achieve a minimum number of points in a checklist of options. Rental owners were given eight years to comply with the policy.

Time of rental policies are designed to provide a tenant with information about the energy efficiency of the property. Ideally, this would allow renters to "shop" for more energy efficient rentals. However, not all renters have the option or

[8] City of Portland, OR HES mandate can be found at: https://www.pdxhes.com/
[9] See Improving America's Housing 2015: Emerging Trends in the Remodeling Market by Joint Center for Housing Studies at Harvard University
[10] Gainesville, FL rental housing policy can be found at: https://www.gainesvillefl.gov/Government-Pages/Government/Departments/Sustainable-Development/Rental-Housing-Ordinance
[11] Boulder SmartRegs requirements can be found at: https://bouldercolorado.gov/smartregs-guide

budget to choose higher scoring properties. Incorporating minimum efficiency standards into these requirements is key to improving rental housing stock. Tying these requirements, as in Gainesville and Boulder, to a rental license increases the likelihood of compliance.

3.2 Reach Codes

Throughout this Project, evaluating the applicability of HES in an existing building reach code has been the main objective. There are two main cases where HES could appear in a reach code:

1. Requiring that a home reach a minimum score or an improvement from their current score (either by percent or increase in a specific number of points). Example: to comply with the reach code, homes that trigger the reach code (e.g., applying for a permit for a renovation over a certain square footage or project valuation, listing a home for sale, or obtaining a rental license) would have to increase their score by 2 points by completing the recommended upgrades. This would require scoring before and after renovations, an initial set of recommended upgrades that meet a certain performance threshold, and quantification of energy savings for improving the score.
2. An exemption to a reach code by providing a way to acknowledge previous upgrades made to a home. Example: a home with a minimum HES of 7 is exempt from a reach code. This application of HES is agnostic to the existing conditions of the home and while it still provides recommended upgrades to improve a home's score, it would not mandate any additional action.

Each of these is further analyzed below.

3.2.1 Reach Code Modelling

Selecting a tool to model energy use and demonstrate compliance is a critical step in the development of a reach code. This section presents some key features and differences in utilizing HERS II and HES as the modeling tool in a reach code. HERS II is a diagnostic rating system adapted for California and regulated by the California Energy Commission. A HERS II rating requires additional field and modeling work relative to HES and is often not a cost-effective option. HES, a national home rating system, is now being used in reach codes in several California jurisdictions. While other energy modeling or scoring tools are available, they are not included in this report due to concerns with cost, scalability, familiarity, or applicability to the California market.

The HERS II score is based on a reference home score of 100 with every percentage of energy reduced representing a score reduction of one point. A HERS II rating of 0 would represent a Zero Net Energy home and a negative score represents a home that produces more energy than it consumes. Inefficient homes can score over 100. The scale of HERS II can be confusing for homeowners, as 0 being the best and 100 being the reference case (with the potential for both negative scores and scores over 100) may be difficult for a homeowner to understand, as a 100 in many other instances represents the "best" of something. Due to some of the limitations listed in Section 2.1.1 HERS II has struggled to become widely used.

A key difference between HERS II and HES is that HERS II utilizes source energy conversion factors that are specific to California, while HES uses national source energy conversion factors. This means that HES does not provide as accurate information about GHG emissions as California's grid is cleaner than the national average. This can be partially addressed by using local utility emissions factors to calculate the GHG emissions of a house via a custom HES report (see BayREN sample report in Figure 10 in the Appendix). However, this would serve as an educational tool and would not change the impact of the grid's emissions on the HES model itself. More information on the ramifications of this can be found in Section 4 of this report.

The primary audience for HES is a homeowner, realtor, or other non-technical audience. This makes it a logical tool around which to design an existing building reach code. For example, instead of a homeowner having to meet a minimum number of points from a checklist or install a cost-effective package of measures, one could require a

minimum score or an improvement to the existing score of a certain number or percentage of points. A homeowner could make improvement(s) from their recommendation list to comply. The score report also connects them with available rebates or other resources to make improvements. This would be simple for building departments to verify, as the score report completed by a Certified Assessor would be all of the documentation required to verify energy savings and conformance with the reach code.

The DOE's methodology for calculating an HES is based upon the individual home's assets and energy consumption potential in comparison to the national housing stock. This makes it difficult to quantify the savings from a specific home's energy improvement as a two point increase in score may represent different savings for different homes. For example, home size is a factor in the HES since a larger home, even with efficiency upgrades, may still consume more total energy than a smaller home with fewer upgrades. Therefore, a smaller home could potentially be required to do less than a larger home and still comply with the existing building reach code. This would make it difficult to design a reach code that would use HES and demonstrate a minimum energy savings or performance for all homes based on score alone. While it would be possible to address this by designing custom recommendations that included packages of upgrades, this removes much of the simplicity in the process. See Section 4 of this report for more information.

3.2.2 Exception for HES

For the reasons listed in Section 3.2.1 above, the application of HES as the main modeling tool in an existing building reach code may not be appropriate to demonstrate minimum energy savings or consistent savings across all homes no matter their size. However, in the four existing building reach codes in California, most have utilized HES not in the modeled or prescriptive options of their codes, but as an exception.

It is vital for an existing building reach code to have exceptions for homes that have already made energy efficiency or electrification upgrades to prevent early adopters of energy efficient technologies from being penalized for upgrading before the code went into effect. As the efficiency of appliances, insulation, windows, or other energy assets changes with technology or code updates, or as greater emphasis is placed on electrification, proving equivalency for an existing building reach code can be nuanced. Without guidelines, this has the potential to place a burden on building departments to understand when a home is sufficiently upgraded to be exempt. In this case, mandating a minimum HES could be very useful.

Which score to choose for an exception must be carefully considered. If a 5 is the average home, choosing a score higher than 5 would assume a home is at least on the better performing side of the scale. Selecting a 10 as the exception threshold would mean only homes that consume the least amount of energy would be exempt. As discussed in Section 6 of this report, CZ can have a significant impact on the score. In a CZ with very little heating and cooling load, a high-scoring home may not have the most energy efficient features but still obtain a high score as a result of using less overall energy due to climatic conditions. This is an important consideration when deciding to use HES as a reach code exception.

Another consideration for codifying HES as an exception is the jurisdiction's preference for all-electric homes. As an energy efficiency rating, it evaluates the home's energy assets, including insulation, air sealing, windows, and the age and efficiency of space and water heating equipment. While national source energy is a factor of the score methodology, the efficiency of the equipment and overall energy consumption is the basis of the score, not GHG emissions. Therefore, a mixed-fuel home with high-efficiency gas appliances could receive a score equal to a home with the same envelope characteristics that has heat pumps installed. This is also a reflection of the use of national source energy factors, as an all-electric home in California where the grid has a high proportion of renewables would not have the same GHG emissions as an all-electric home in an area where a large amount of electricity is produced by coal. However, as heat pumps have higher efficiencies than natural gas appliances, they can aid a home in receiving a higher score.

To prove that a home qualified for an exception from an existing building reach code for previous upgrades, documentation submitted to the building department would include an HES report showing the minimum score and

date of the score. Since the specific HES of a home cannot be predicted before an assessment is completed, it could cause an increase in scores in a jurisdiction for those attempting to comply with the reach code. Some homes that anticipated reaching the threshold score for an exception (e.g., 7 or above) but fell short would still have to pursue another method of complying with the reach code. However, this still provides useful information to the homeowner about their home and what energy efficiency or electrification upgrades could be made to improve their score or comply with the code.

4 Technical Analysis – HES and CBECC-RES

The first step to evaluating HES in a reach code was to compare results from the modeling in HES to CBECC-Res, software developed by the CEC to demonstrate compliance with Title 24. To do this, Frontier Energy, Inc. developed a set of scenarios based on analysis conducted for the Reach Codes Team 2019 Cost-Effectiveness Study: Existing Single Family Residential Building Upgrades. The scenarios covered California Climate Zones 1, 3, 4, 7, 9, and 12, various efficiency upgrades, and both electric and gas appliances. A batch of the same homes was run through both tools to see how resultant modeled energy consumption in the HES tool compared to that from the reach code study which used CBECC-Res. Before comparison the CBECC-Res results were adjusted to better align assumptions between the two tools on thermostat setpoints, occupancy, lighting loads, and kitchen appliance fuel source. Careful attention was paid to the impacts of site energy, source energy, utility costs, and GHG emissions. As detailed below, the key outcomes of the investigation are:

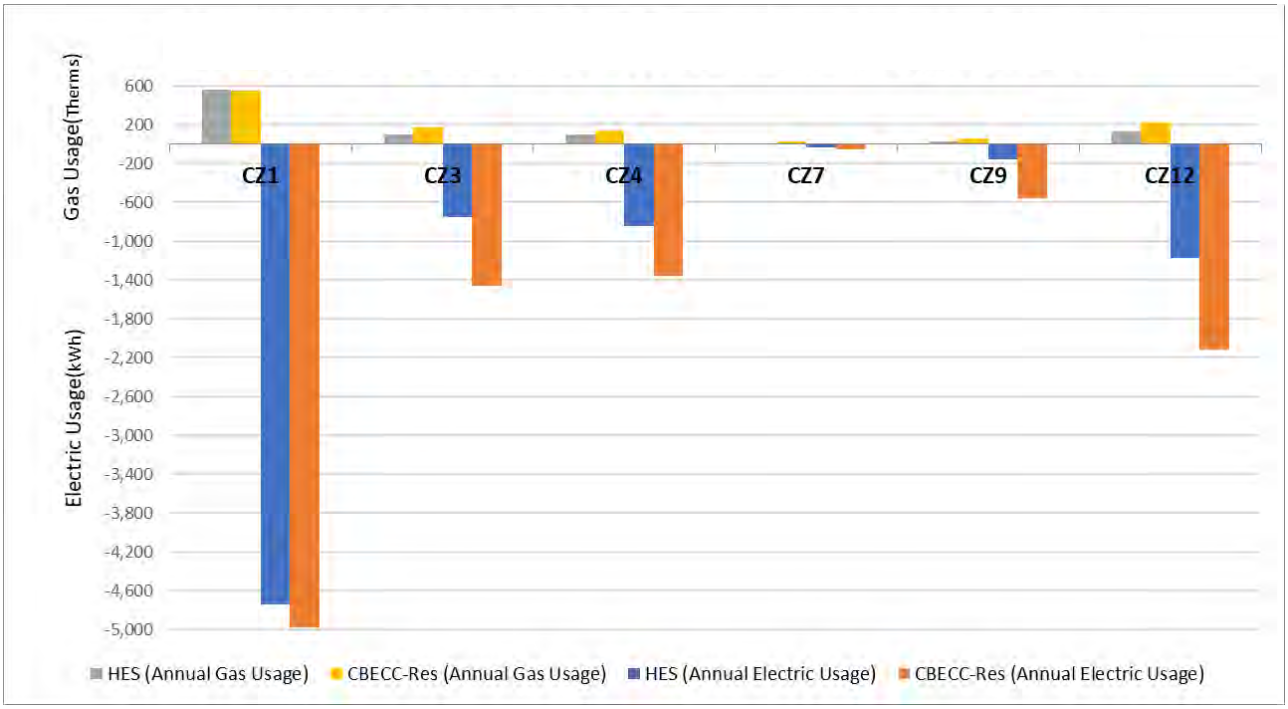
- There are differences in predicted energy usage between the two tools. The largest differences were with water heating. In some climates, the differences in predicted space heating energy use were also significant.
- The estimated energy usage may be made more accurate by applying California-based source conversion numbers (vs. national average) in post processing reports. This has the most significant impact on fuel substitution measures due to the cleaner electricity grid in California compared to national averages.
- The factoring of home size in HES is a fundamentally different approach than used for Title 24 code compliance.
- The impacts of some home improvements were not reflected in the 1-10 integer level of the score and therefore the score does not capture or encourage upgrades that don't provide enough benefit to incrementally move the score to the next whole number.

4.1 Energy Usage

The Home Energy Scoring Tool utilizes EnergyPlus for its modeling. This draws on data from ResStock, which is developed and maintained by the National Renewable Energy Laboratory (NREL). As a national standard, it can be used to compare one home to another anywhere in the country. However, a home that scores well in a mild climate may not achieve a similarly high score in a climate with greater heating or cooling loads. To enable this comparison, several national datasets are used, including national average site-to-source energy factors and housing size.

While energy use trends were similar in both tools for most energy efficiency measures, CBECC-Res modeled estimated higher energy consumption and savings for space and water heating. Figure 1 compares gas and electricity energy savings between HES and CBECC-Res for a heat pump space heater relative to a gas furnace and air conditioner across the six evaluated CZs. Both cases assume federal minimum efficiency equipment of 14 SEER and 8.2 HSPF for the heat pump and 14 SEER and 80 AFUE for the gas furnace/air conditioner.

Figure 1. Savings for Heat Pump Space Heater versus a Gas Space Heater



4.2 California-Based Source Conversions

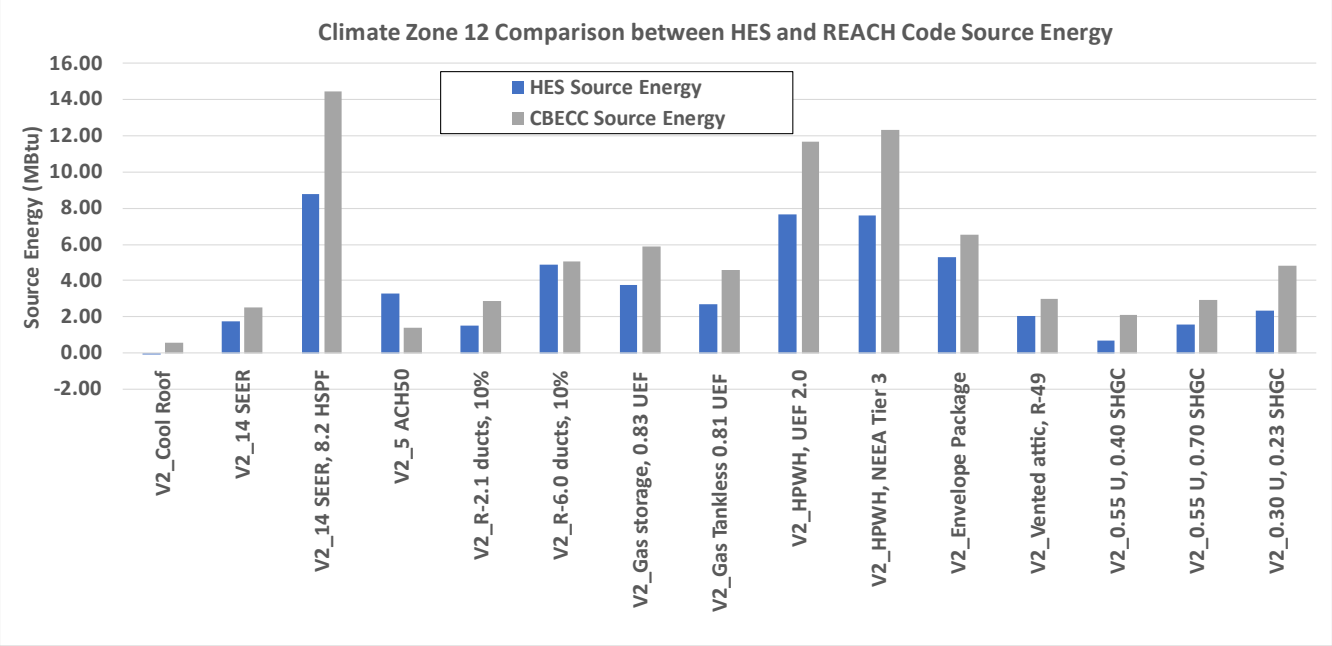
California has a cleaner energy grid and lower source energy than the national average which would not be as accurately reflected in the HES model compared to California-specific software. This may result in the energy and GHG benefits of high-efficiency electric appliances, such as heat pumps, being discounted in HES compared to CBECC-Res. The HES tool evaluates source energy based on a single annual factor for electricity, while CBECC-Res calculates it based on hourly multipliers which take into account the changing value of energy diurnally and seasonally.

The Project team met with the DOE HES team to better understand the HES methodology and options for customization. A summary of these findings is included in Table 5 of the Appendix. To maintain its national applicability, it would not be possible to use California site-to-source energy factors in the score calculation. However, one could provide additional, customized source energy adjusted estimates in the HES report. It would have to be clearly explained and may require approval so that it is not represented the same as the DOE HES.

Similarly, partners could automatically re-score existing mixed-fuel homes as if they had made all of the recommended electrification upgrades to show how this could impact the score, energy costs, and GHG emissions and produce an "all-electric" score. This is also a way to model upgrade information outside of the DOE version where all measures must have a 10-year payback period. This is further discussed in Section 6.3.2. While adding additional scores to the HES report is possible and could meet certain reach code goals, each new score and explanation adds complexity and potentially increases customer confusion.

DOE confirmed that the process to provide hourly data to partners for calculations would be available soon. This could be modified by a Partner to apply California-specific hourly multipliers, including different multipliers by CZ, to calculate source energy, GHG emissions, and even utility cost estimates.

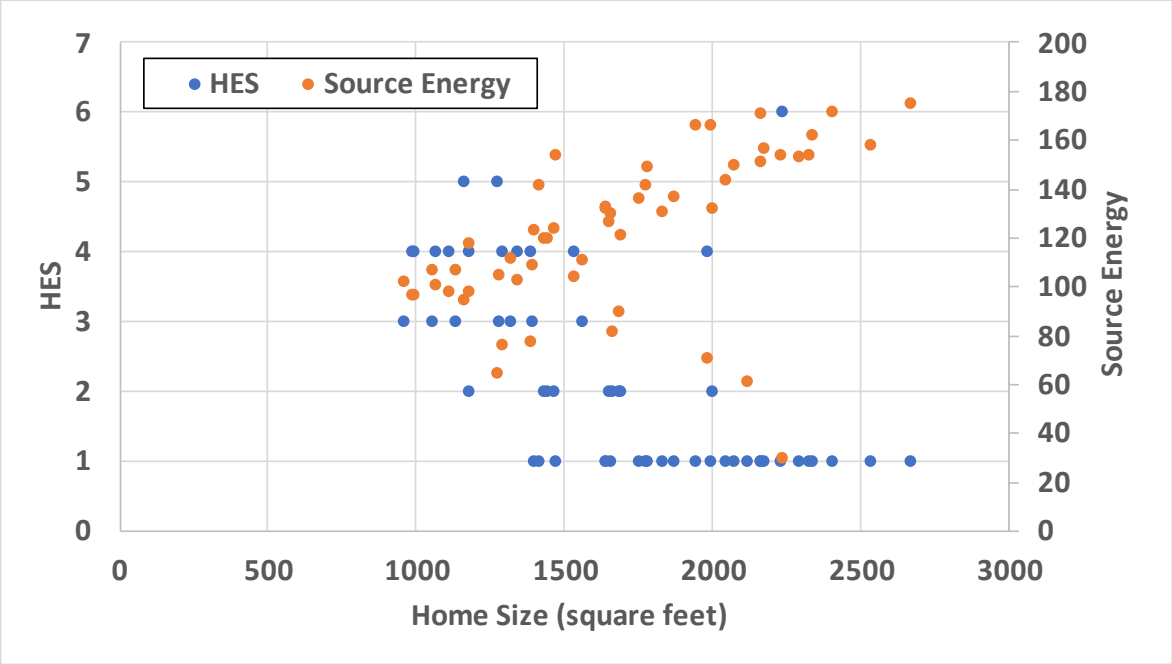
Figure 2. CZ 12 Comparison between HES and CBECC Source Energy Savings



4.3 Home Size

Home size is a factor in the HES model. In conversations with DOE it was determined that the score could not be reconfigured to be agnostic of house size, as this is fundamental to the scoring system. Figure 3 shows a set of results from the HES tool for homes in CZ 12 (Central Valley). Results are for homes of a range of sizes but with similar characteristics (gas space heating 78-83 AFUE, air conditioning 13-15 SEER, unvented attic, and minimal wall, floor, and attic insulation). The trend shows that the HES for these homes is generally higher for the smaller homes than for the larger homes, with scores ranging from 1 to 6.

Figure 3. Effect of Home Size on HES and Source Energy

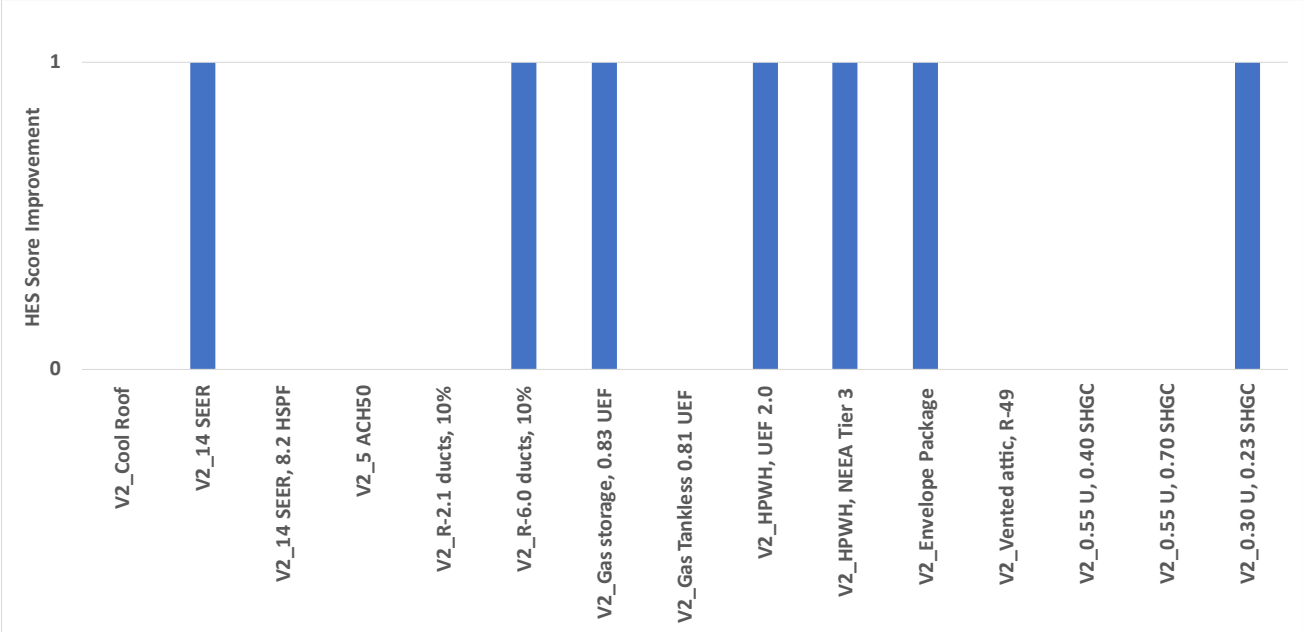


This means that very large homes that have undergone substantial energy efficiency improvements may score lower than smaller, moderately upgraded homes on the basis that larger homes consume more resources. Because of this, larger homes can get "stuck" at lower scores no matter what upgrades they make, and it may be that certain homes could never receive a 10. This structure may not be ideal for a mandatory policy such as an energy reach code, as it would potentially impose significantly inconsistent requirements rather than holding each home to its own standard without considering other homes. While a larger home modeled in CBECC-Res would also consume more energy compared to a similarly-upgraded smaller home, CBECC-Res normalizes results based on the area of the home (energy usage per square foot) to provide a fairer comparison of energy use.

4.4 Incremental Improvements

HES uses the number of bedrooms in a home to estimate home occupancy and energy consumption for features such as hot water heating. Smaller homes with fewer bedrooms are assumed to have fewer occupants and therefore it can be difficult to see large savings from installing certain measures, like high-efficient heat pump water heaters (HPWHs). This is further compounded by the fact that the HES is rounded to the nearest whole number, so some improvements will not be reflected in the score itself unless they result in a minimum one-point increase (as is shown in Figure 4).

Figure 4. CZ 12 HES Improvement by Measure



One potential strategy is to structure code requirements on an increase of HES (for example an increase in score of 1 or 2 points), rather than requiring a certain base score be met for all homes. The Project team also discussed with DOE the viability of customizing the recommended HES measures by creating cost-effective packages for Assessors to recommend that would align with reach code performance goals. This would involve additional training for Assessors to better understand the recommendations and when they apply or require a switch to fully automated recommendations based on the home's existing conditions. For full effectiveness these options could be combined with increased granularity to the HES calculation by adding a decimal point. While possible, these options were not viable in the timeframe of the Project but could be considered in the future.

Planned updates to the DOE tool may allow for better comparison to the California building stock, including a more climate-localized methodology for how each home may score within a CZ. These updates are anticipated to become available Fall 2023. More information on potential DOE tool modifications can be found in Sections 6.4 and 7.3.

5 City of Carlsbad Technical Support

Upon completion of Frontier Energy's analysis of the HES tool and its comparison to CBECC-Res, it appeared that developing a reach code entirely based on the HES was not advisable. However, the main application of HES in reach codes to-date is as an exception. HES provides a simple way for homeowners to receive credit for previous upgrades made to a home in a low-cost and easy to document format. It also circumvents the need for a local jurisdiction to analyze individual measures for equivalency as efficiencies and code requirements change over time.

To test this application, the Project team reached out to Piedmont, Carlsbad, Encinitas, and Chula Vista to understand how the HES exception has been used. Since Piedmont is located in BayREN territory, they have an active group of HES Assessors and have completed approximately 280 scores since their reach code went into effect. However, Piedmont also instituted a requirement for an energy audit (for which HES is one compliance pathway) at the time of a home's listing, therefore these scores are likely not all a result of their reach code.

In comparison, at the time this Project commenced there was only one active Assessor serving the San Diego region (where Carlsbad, Encinitas, and Chula Vista are located). Therefore, it was difficult for anyone in those jurisdictions to utilize the reach code HES exception even if they were eligible. For this reason, the Project team focused on providing technical support to the City of Carlsbad to train Assessors and develop an HES program in their region. The City of Carlsbad City Council adopted a Memorandum of Understanding (MOU) with StopWaste to participate in the Project. A detailed scope of work is provided in Section 7.4 of the Appendix. Assistance was also offered to Encinitas and Chula Vista, who expressed interest in having the Project support them, but due to the time-limited availability of funding chose not to participate.

5.1 City of Carlsbad Demographics

While the entirety of San Diego County was eligible for scores during the Project, 86 percent of scores were in the City of Carlsbad. This is likely due to the fact that Carlsbad staff had previously promoted HES in a pilot of their own to raise awareness of the score after their reach code went into effect.

The City of Carlsbad is located in San Diego County in CZ 7 (mild, South Coast). According to California Department of Finance data, it has a population of 114,865 which is 3.5 percent of San Diego County. There are 48,385 total housing units, including 33,528 (69%) single detached and single attached homes, which are the most likely to be eligible for HES. The average household size is 2.5 persons. About 62 percent of housing units are owner-occupied.[12] In Carlsbad, the median household income is $124,669. For owner-occupied units, the median household income is $143,432 and for renter-occupied units is $98,750.[13]

In comparison, San Diego County has approximately 1.24 million housing units, of which 738,299 (59%) are single family detached or attached. Of those, about 54 percent are owner-occupied. The average household size is 2.7 persons. The median household income in San Diego County is $91,003. For owner-occupied units, the median household income is $117,007 and $66,729 for renter-occupied units.

5.2 HES Assessor Recruitment and Training

The HES is structured to work through Partners who uphold the DOE's program requirements, including training, mentoring, and QA. To enroll in the program, one must hold a valid credential as specified by DOE, pass an online test that includes scoring several virtual homes, and receive a mentoring session in order to become a Certified Assessor. The Partner is responsible for reviewing submitted scores and providing QA for 5 percent of all scores conducted, which involves either Partner staff scoring the home in-person with the Assessor or the Assessor submitting additional

[12] ACS 5-Year Estimates Detailed Tables, Table B25003, 2021
[13] ACS 5-Year Estimates Detailed Tables, Table S2503, 2021

documentation so that Partner staff can virtually conduct their own score. Partners can return a score for corrections or clarifications and a score may be rejected if there is more than a 1-point difference between the Assessor and Partner scores.

There are local HES Partners located throughout the country. Lacking a local Partner, there are several national Partners who have the ability to conduct all training, mentoring, and QA remotely. The City of Carlsbad passed their existing building reach code in the absence of a local Partner and with no active Assessors in the region. One Assessor company, Sustainrgy, was able to work with a national Partner to complete enrollment and mentoring and begin conducting scores. Before the Project, Sustainrgy had completed about 30 scores in Carlsbad through a City program offering free scores subsidized by City funding. At the time of the Project's start, that funding was no longer available. As part of the Project, a $400 incentive was available for scores conducted in San Diego County.

For the Project, Sustainrgy enrolled in StopWaste's Partnership, which is implemented by Earth Advantage, Inc. It is recommended to have more than one Assessor conducting scores. The Project team set a goal of enrolling at least five new Assessors. As many of the Assessors in the BayREN program are HERS Raters and home inspectors which both have statewide industry groups, StopWaste reached out to CHEERS (a California energy code compliance registry) and the California Real Estate Inspection Association (CREIA) to identify potential Assessors in the San Diego region. Through this outreach, seven new Assessors were successfully enrolled. A Project overview and introduction to HES and enrollment requirements were presented in a webinar on March 16, 2023, and culminated in a one-day in-person training on March 30, 2023. In between the webinar and in-person training, Assessors were tasked to complete the online DOE simulation training and were able to contact Earth Advantage with questions.

At the in-person training, the first half of the day was spent conducting a group mentoring session at a house in Carlsbad, identified by City of Carlsbad staff. The second half of the day was a classroom session where participants received access to the Home Energy Scoring tool and learned how to enter the data. Assessors who completed all requirements were eligible for a $400 enrollment bonus.

Upon completion of the Project, Assessors were offered the option to enroll in Earth Advantage's DOE partnership if they wished to continue offering scores in San Diego County.

5.3 Program Infrastructure and Database Buildout

In addition to the DOE Home Energy Scoring tool, the StopWaste Partnership uses a custom database created and maintained by Earth Advantage called HEFit. This database allows for streamlined QA of scores, processing of rebates, and provides the opportunity for score and report customization. As HEFit was previously only being used in the Bay Area, the database needed to be updated to include local utility and CZ information. HEFit also connects to Earth Advantage's Green Building Registry via API to map the location of homes that received a HES.

StopWaste also modified additional tools and forms for the City of Carlsbad and San Diego region. These included:

- Assessor Participation Agreement
- Score Application, including several questions on how they found out about HES and why they were receiving a score
- HES brochure and one-pager, including a version branded to match the City of Carlsbad's style guide
- List of Certified Assessors in the San Diego region

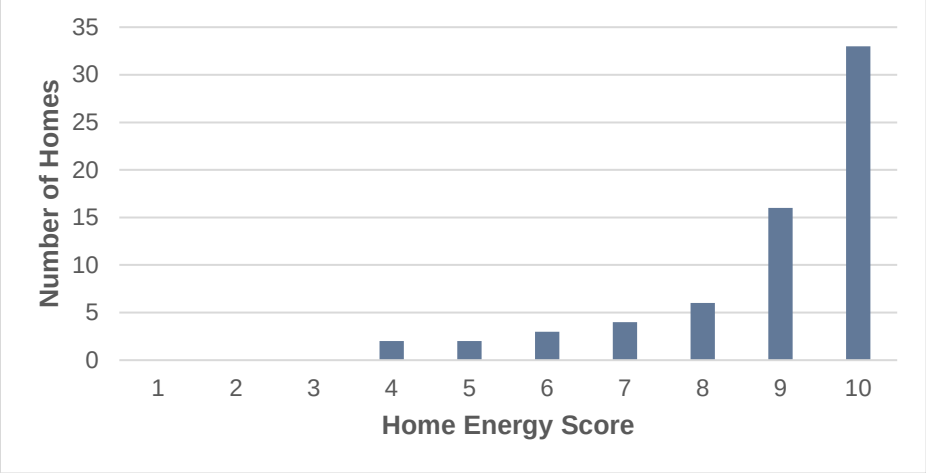
6 Findings

To assess the viability of HES in a reach code setting in California, the Project team evaluated how HES modeling compares to CBECC-Res, discussed with US DOE potential customizations to the Home Energy Scoring tool, conducted an analysis of policy options and use-cases for HES, and successfully trained Assessors and processed scores in San Diego County for approximately four months. This section summarizes the findings of the Project, including data collected in Carlsbad and elsewhere in San Diego County, and policy recommendations.

6.1 Summary of San Diego County Scores

From April 1 to July 31, 2023, the Project team processed 37 scores, 32 of which were within the City of Carlsbad. Two scores were located in the City of San Diego while Escondido, Santee, and Spring Valley each had one score. A total of $14,800 of incentives were distributed under the Project at $400 per score. The average score was 8.9 out of 10. Before the Project began, an additional 29 scores were conducted in the City of Carlsbad, also with an average score of 8.9. The Project team does not have detailed information on these scores, such as data on existing conditions and recommendations as they were done under a different HES Partner. Figure 5 below shows the distribution of all scores, including the scores in Carlsbad before the start of the Project.

Figure 5. Distribution of San Diego Home Energy Scores



When evaluating patterns for the low and high scores in San Diego County, it appears the major factors in a home receiving a 10 were having a solar photovoltaic system and a slab-on-grade foundation, which is considered more efficient than a crawlspace. Many of the high scoring homes had average space and water heating equipment and some level of insulation in the attic and walls, as discussed in Section 6.1.2.

The Project team also looked into the three scores conducted as part of the Project that scored the lowest (one 5 and two 6). The home that scored a 5 had zero attic or wall insulation and a vented crawlspace. The two homes that scored a 6 had five bedrooms, which would increase the occupancy count in the HES tool, and therefore modeled consumption. While one of these homes had a heat pump HVAC system, its larger size coupled with an electric resistance water heater with a storage tank negatively impacted the score.

6.1.1 Effect of Climate Zone on Score

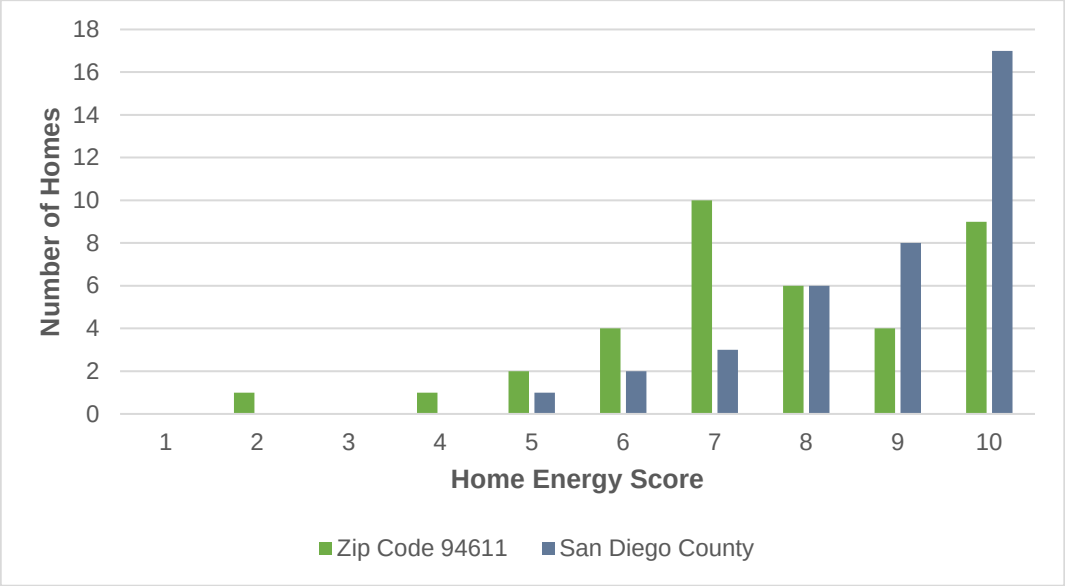
California's Energy Code modeling is based on 16 climate zones, as shown in Figure 8. In contrast, the Home Energy Scoring tool utilizes TMY3 weather station data which corresponds to zip codes. The tool defines each home's score by comparing its estimated source energy use to a defined energy use range based on the Energy Information

Administration (EIA)'s Residential Energy Consumption Survey (RECS) data adjusted for local weather data.[14] Weather stations are more granular than California CZs as there could be several weather stations within one CZ. This means that a home in a single CZ could have different modeled energy consumption depending on which zip code it is located within.

The homes scored in Carlsbad and San Diego (34 total) are located in California CZ 7. The homes in Escondido, Santee, and Spring Valley (3 total) are located in CZ 10. The Carlsbad and Escondido homes (33 total) correspond to the Carlsbad McClellan weather station according to the Home Energy Scoring tool. The San Diego and Spring Valley homes (3 total) correspond to the San Diego Montgomer weather station and the Santee home (1 total) to the San Diego Miramar NAS weather station.

As shown in Figure 5 above, the distribution of scores in San Diego County is skewed towards the higher end of the HES' 1 to 10 scale. A 5 is meant to represent the average home, with a 10 being most energy efficient. To understand the impact of CZ on San Diego County scores, the Project team re-ran the homes through the Home Energy Scoring tool holding all data points the same except changing the zip code to 94611 (Oakland hills and Piedmont). Zip code 94611 is located in CZ 3 and the Oakland Metro AP weather station. This zip code was chosen since the City of Piedmont also has an existing building reach code citing HES, there is a sample size of 253 homes scored in 2021 and 2022 in 94611 under the BayREN Home Energy Score program, and the 94611 weather station has more varied heating and cooling loads than those in the San Diego region. Figure 6 shows the results of this re-run.[15]

Figure 6. Comparison of San Diego County Scores to Zip Code 94611 Re-Run



Between 2021 and 2022, the average HES for zip code 94611 was 3.5 compared to 7.7 for the San Diego County scores re-run in zip code 94611. As a result of the re-run, 11 homes maintained the same HES, 16 had a one-point difference, and 10 had a two or more-point difference. This shows that while CZ has an impact on the score, a major factor in the higher-skewed homes in Carlsbad is their existing conditions. This is further discussed in Section 6.1.2 below

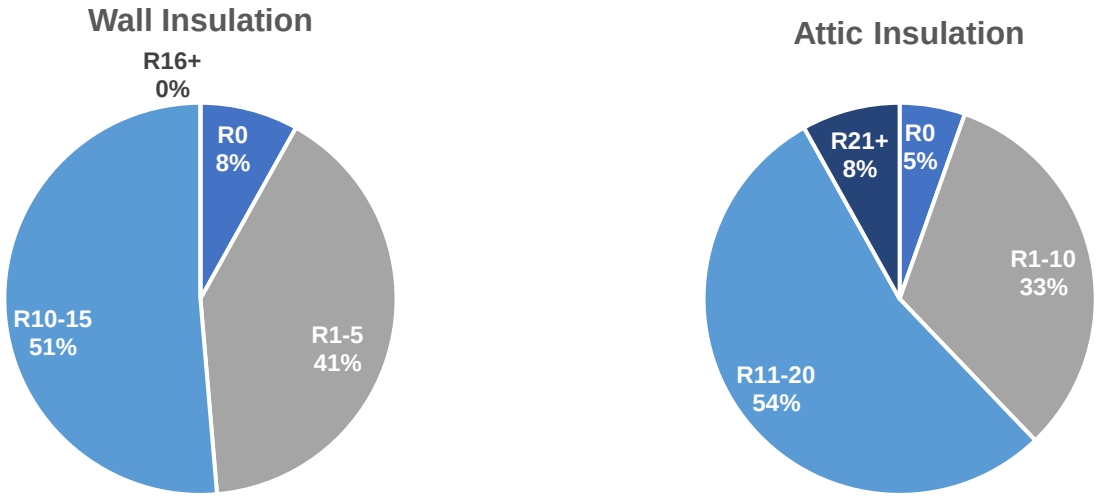
[14] Home Energy Score bin methodology and weather station information can be found at: https://betterbuildingssolutioncenter.energy.gov/sites/default/files/Home_Energy_Score_Scoring_Tool_Bins.pdf

[15] Figure 5 only includes scores conducted as part of the Project and does not include the 29 homes in Carlsbad scored before the Project as they were done under a different HES partnership and therefore complete data for these homes is not available.

6.1.2 Existing Conditions of Scored Homes

The HES is a useful tool to gather in-home data on envelope conditions and energy equipment. Without energy audits or assessments, jurisdictions rely on permit or parcel data which can be cumbersome to sort through and inaccurate. Reach codes often use home vintage as a proxy for this information, and while they can establish minimum energy features required by the corresponding code, many homes have undergone upgrades since construction and could have made retrofits for insulation, windows, and upgraded heating systems. Figure 7 below summarizes existing insulation conditions for the homes scored as part of the Project (including those outside of Carlsbad).

Figure 7. Summary of Existing Conditions



Most homes scored had lower- or standard-efficiency natural gas space and water heating systems. Thirty-four of the 37 homes scored had central gas furnaces for heat, with only three heat pumps. Of those with central gas furnaces, 16 homes had 80 percent efficient furnaces, three furnaces were rated lower and four were rated higher. Thirty-three of the homes scored had a gas water heater with a storage tank. Two homes had a gas tankless water heater and two had an electric resistance water heater with a storage tank. The gas water heaters with a storage tank had efficiencies ranging from 0.55 to 0.64 which are not considered high-efficiency equipment. Solar photovoltaic systems are factored into the HES model and 11 of the 37 homes scored included solar.

The majority of homes in the City of Carlsbad (67%) were built in 1980 or later and therefore would have some minimum energy efficiency measures installed at the time of construction. The decade with the most homes built is 2000-2009 (22%), which would have substantial energy efficiency measures installed. Only one percent of homes in Carlsbad were built before 1939. This is in stark contrast to homes in the City of Piedmont, where 62 percent of homes were built before 1939 and only 1.5 percent were built between 2000 and 2009. The newer condition of homes in Carlsbad likely contributes significantly to the higher scores observed as the HES is a comparison of homes throughout the country.

The data collected on existing conditions roughly aligns with the vintage tables that provide the underlying assumption for home conditions in Title 24 (see Table 1). For example, while all of the 13 scored homes built between 1992 and 2010 had some level of attic insulation, only one had insulation reported at higher than R-21, even though the vintage table would predict a home of that age having R-30 attic insulation. Of the 11 pre-1978 homes scored, two were reported to have no attic insulation, which aligns more closely with the efficiency characteristics outlined in Table 1.

Nine out of the 11 pre-1978 homes had hot water heaters with efficiency greater than 0.575 EF and eight had heating equipment with greater than 78 AFUE. Of the 12 homes scored built between 1978 and 1991, only five had hot water heaters with efficiency greater than 0.575 EF but all had HVAC equipment with greater than 78 AFUE. This

demonstrates the value of in-home data when evaluating which energy efficiency upgrades are needed or should be prioritized.

Table 1. Energy Efficiency Characteristics for Three Vintage Cases

Building Component Efficiency Feature	Vintage Case		
	Pre-1978	1978-1991	1992-2010
Envelope			
Exterior Walls	2x4, 16 inch on center wood frame, R-0[a]	2x4 16inch on center wood frame, R-11	2x4 16inch on center wood frame, R-13
Foundation Type & Insulation	Uninsulated slab (CZ 2-15) Raised floor, R-0 (CZ 1 & 16)	Uninsulated slab (CZ 2-15) Raised floor, R-0 (CZ 1 & 16)	Uninsulated slab (CZ 2-15) Raised floor, R-19 (CZ 1 & 16)
Ceiling Insulation & Attic Type	Vented attic, R-11 @ ceiling level Vented attic, R-5 @ ceiling level (CZ 6 & 7)	Vented attic, R-19 @ ceiling level	Vented attic, R-30 @ ceiling level
Roofing Material & Color	Asphalt shingles, dark (0.10 reflectance, 0.85 emittance)	Asphalt shingles, dark (0.10 reflectance, 0.85 emittance)	Asphalt shingles, dark (0.10 reflectance, 0.85 emittance)
Radiant Barrier	No	No	No
Window Type: U-factor/SHGC[b]	Metal, single pane: 1.16/0.76	Metal, dual pane: 0.79/0.70	Vinyl, dual pane Low-E: 0.55/0.40
House Infiltration	15 ACH50	10 ACH50	7 ACH50
HVAC Equipment			
Heating Efficiency	78 AFUE (assumes 2 replacements)	78 AFUE (assumes 1 replacement)	78 AFUE
Cooling Efficiency	10 SEER (assumes 2 replacements)	10 SEER (assumes 1 replacement)	13 SEER, 11 EER
Duct Location & Details	Attic, R-2.1, 30% leakage	Attic, R-2.1, 25% leakage	Attic, R-4.2, 15% leakage
Whole Building Mechanical Ventilation	None	None	None
Water Heating Equipment			
Water Heater Efficiency	0.575 Energy Factor (assumes 2 replacements)	0.575 Energy Factor (assumes 1 replacement)	0.575 Energy Factor
Water Heater Tank	40-gallon uninsulated tank	40-gallon uninsulated tank	40-gallon uninsulated tank
Pipe Insulation	None	None	None
Hot Water Fixtures	Standard, non-low flow	Standard, non-low flow	Standard, non-low flow

[a] Pre-1978 wall modeled with R-5 cavity insulation to better simulate uninsulated wall performance with field data and not overestimate energy use.

[b] Window type selections were made based on conversations with window industry expert, Ken Nittler. If a technology was entering the market during the time period (e.g., Low-E during 1992-2010 or dual pane during 1978-1991) that technology was included in the analysis. This provides a conservative assumption for overall building performance and additional measures may be cost-effective for buildings with lower performing windows, for example buildings with metal single pane windows in the 1978-1991 vintage.

Source: California Energy Codes and Standards 2019 Cost-Effectiveness Study: Existing Single Family Residential Building Upgrades

Each HES report includes recommendations for a homeowner to improve their energy efficiency based on the home's existing conditions. The recommended measures for homes scored during the Project are summarized in Table 2 below. Without a custom report that can provide custom recommendations, Assessors utilize default recommendations from the Home Energy Scoring tool. These recommendations must have a maximum 10-year payback period for an individual measure or a package of measures. In San Diego County homes that were below code, many of the measures, such as increased insulation, would not produce a 10-year payback period. Therefore, while these are improvements that could increase the efficiency of a home, they were not recommended in most cases.

Table 2. Summary of HES Recommendations

% of Scores Receiving Recommendation	Feature to Be Improved	Recommendation
84%	Water Heater	Gas storage tank with Energy Star label
19%	Cooling System	Install a central air system rated CEE Tier 1
5%	Water Heater	Heat pump water heater with Energy Star label
3%	Heating System	Central gas furnace with Energy Star label
3%	Attic Insulation	Increase attic floor insulation to at least R-19
3%	Roof Insulation	Add rigid insulation sheathing

It should be noted that in the HES Scoring Tool, the recommendations for space and water heating default to the home's current fuel type. An Assessor would have to amend the default recommendation of a high-efficiency gas appliance to a heat pump HVAC system or HPWH in the case of fuel-switching. In the BayREN program, due to a combination of electrification training and offering a bonus incentive for completing additional electrification-readiness information, this has become common practice. In the BayREN program heat pump recommendations began to outnumber gas appliance recommendations in 2022. The same electrification-specific training was not conducted with San Diego Assessors, which is the likely reason why many homes received recommendations for gas appliance upgrades.

6.1.3 Homeowner Motivations

The application form (Figure 11 in the Appendix) for the score and incentive included three questions to better understand the motivation behind a homeowner receiving an HES and how they found out about the score. Results of the survey can be found in Figure 12. The questions asked were:

1. What is your motivation for receiving a Home Energy Score?
2. Are you having other work done at your home?
3. How did you find out about the Home Energy Score Program?

For the first question about motivation homeowners were able to pick as many choices as applied to them. Based on their responses, the top three reasons for receiving an HES were wanting to save money on utility bills, saving energy and reducing GHG emissions, and interest in finding out more about their home. No homeowners reported getting an HES to comply with a reach code as part of a renovation project. This is consistent with the responses for question #2 about whether or not other work was being done on the home. Seventy-four percent of respondents received just an HES. Twelve percent were installing or replacing HVAC equipment. Overwhelmingly homeowners found out about HES from the City of Carlsbad website or promotions (82%).

6.2 Feedback from Assessors

The Project team contacted the eight enrolled Assessors to gather feedback on the process and obtained three responses. Sustainrgy, who had been conducting scores before the Project began and who conducted 97 percent of scores during the Project, reported the importance and demand for energy efficiency information as the top reason for participating, along with the $400 incentive. They reported that 75 percent of the time homeowners contacted them directly for the score as opposed to the company offering it to a homeowner themselves; and often they provide a custom energy assessment along with the score. They expressed interest in continuing to conduct scores after the Project ends.

Sustainrgy did mention that the HES can sometimes be misleading of the home's actual conditions, such as getting a high score even if ducts are damaged or if there are issues such as carbon monoxide exposure. The HES model only has options for whether or not ducts are sealed and insulated, but not the condition of the ducts. Leakage is estimated based on home vintage in the HES model unless duct blast testing is conducted. The Project team has discussed this issue with DOE and hope to have options for duct conditions included in HES in the future. It is also true that the score itself does not include potential health issues, but Assessors are encouraged to provide this information in the comments section of the HES report.

Of the other two responses, one survey was collected from an Assessor who conducted one score and the other from an Assessor who did not complete any scores during the Project. Both cited the opportunity to expand their business, professional development, and the incentive as reasons to enroll. Both of these Assessors were HERS raters hoping to add HES as an additional service. For the Assessor who did score a home, they did a HERS rating in tandem with

HES. Both are interested in continuing to offer scores after the Project ends and note that while the onboarding was simple, the short time between onboarding and the Project ending was a major limitation in offering scores.

6.3 HES in Reach Code Application

Based upon the results of the HES to CBECC-Res analysis, it would be inadvisable to develop an existing building reach code that utilizes HES as its main modeling tool because the results don't reflect savings from some measures, and may result in significantly inconsistent requirements for homes within a jurisdiction. However, it could be useful to evaluate existing conditions and provide prescriptive options designed for a particular home's conditions. As an example, in addition to using it as an exception, the City of Piedmont existing building reach code contains an option for a homeowner to complete at least one recommended measure in an HES report with Building Official approval, offering additional flexibility beyond the list of cost-effective measures.

HES could also be appropriate to use as a reach code exception under certain circumstances. This Project revealed the need to be aware of the impacts of CZ on the HES. Jurisdictions should also consider how the vintage and conditions of the existing housing stock may result in higher or lower scores. The skewing of scores towards the high end as a result of the combination of low heating and cooling load in CZs 7 and 10 and overall newer housing stock in San Diego County was not something previously observed in the 20,000 scores conducted in the Bay Area (which includes CZs 1, 2, 3, 4, and 12 and generally older homes). This skewing revealed that the threshold in the Carlsbad ordinance is likely set too low to create significant impacts based on the local conditions. Lastly, it is not possible to include more detailed local utility data and customized recommendations without a custom report.

For these reasons, the Project team would only recommend using the HES in an existing building reach code if a jurisdiction first takes the following steps, further explained below:

1. Pilots the score on a representative sample of the housing stock located within the area to understand the distribution of scores.
2. Customizes the HES report and recommendations to better align with local and State goals.
3. Establishes and provides support for a local HES Certified Assessor workforce.

6.3.1 Understanding HES in the Local Context

Before adopting a code referencing HES, a jurisdiction should understand how HES performs in their local context. To do this, it is recommended that jurisdictions first score a sample of homes. In 2015, before passing the BESO, the Center for Sustainable Energy (CSE) conducted 73 scores in the City of Berkeley. This represented approximately 0.3 percent of the eligible housing stock for an HES. The Project team recommends scoring at least 50 or 0.1 percent, whichever is greater, of single-family homes. Ideally these homes would be selected to comprise a representative sample of the housing stock, including size (both area and number of stories) and vintage. If possible, scoring homes that have recently undergone renovations or energy efficiency improvements would also help a jurisdiction understand how this affects the score.

Despite not aiming to provide a representative sample of Carlsbad homes by vintage, the scores conducted during the Project closely match the distribution of homes by vintage for all homes in the City, as shown in Table 3 below. As the census does not collect data on the area of homes, the Project team looked at number of bedrooms as a proxy to understand how the size of the homes scored in Carlsbad compare to the overall housing stock (Table 4). While the distribution is comparable, the scored homes skew larger. This is likely because the census data combines multifamily and single-family units, and it is unlikely for a single-family home to have zero or one bedroom.

Table 3. Distribution of Homes by Vintage

Year Built	Percent of HES Homes	Percent of All Carlsbad Homes*
2020 or later	0%	0%
2010 to 2019	3%	6%
2000 to 2009	22%	22%
1990 to 1999	19%	16%
1980 to 1989	22%	22%
1970 to 1979	25%	21%
1960 to 1969	6%	6%
1950 to 1959	3%	4%
1940 to 1949	0%	1%
1939 or earlier	0%	1%

* Source: ACS 5-Year Estimates Detailed Tables, Table B25034, 2021

Table 4. Distribution of Homes by Number of Bedrooms

Number of Bedrooms	Percent of HES Homes	Percent of All Carlsbad Homes*
No bedroom	0%	2%
1 bedroom	0%	8%
2 bedrooms	6%	28%
3 bedrooms	50%	30%
4 bedrooms	41%	23%
5 or more bedrooms	3%	9%

* Source: ACS 5-Year Estimates Detailed Tables, Table B25041, 2021

Carlsbad's existing building reach code provides an exception for homes that receive an HES of 7 or above. If the scores conducted through the Project comprise a representative sample, the majority of homes would qualify for a reach code exception, even though there are opportunities for energy efficiency improvements based on their existing conditions, especially for hot water heating and HVAC equipment. Based on the data collected and the overall vintage of the homes in Carlsbad, the majority will have some minimal amount of wall and attic insulation. There are opportunities to upgrade insulation to meet current code, though in a milder CZ, it may not be cost-effective.

In CZs with very little heating or cooling load, an exception for HES may inadvertently allow many homes that should be captured by a reach code to be exempt. In this case, it is important to consider the goal of the reach code. If the purpose is to prioritize the least energy efficient homes in an area, it may be acceptable for comparatively less resource consumptive homes to be exempt, even if there are improvements that could be made as they may not actually save much energy or GHG emissions. In this instance, allowing an exception only for homes that receive an HES of 10 may be advisable. However, if the goal were to upgrade all homes with energy assets below code, a minimum HES would not be as effective without substantial customization. In this scenario, a jurisdiction could use HES to inventory all of the below-code features of a home, create custom recommendations, and require a home to complete cost-effective recommendations from the HES report.

In comparison, the Bay Area average score for over 5,000 homes in 2022 was a 5.4, more aligned with the ideal of the average home nationwide having an HES of 5. In the City of Piedmont, the average score in 2022 was a 3.8, therefore

an HES of 7 may accurately represent a home that has undergone substantial improvements. However, the score selected as a threshold should also be reasonably attainable. In Piedmont, a 7 may be an appropriate threshold for a reach code exception but score data, including energy features of the scored homes, should be continually tracked to make sure it isn't too high to render the exception impractical.

6.3.2 Importance of Custom Report

The report that is produced by the DOE Home Energy Scoring tool (see Figure 9 in the Appendix for an example report) uses many national defaults for calculating home information, including energy consumption, utility bill data, and GHG emissions savings. It is possible to use local data to calculate these figures through customization. This framework was established in the HEFit tool for the BayREN program and was modified to include San Diego Gas & Electric (SDG&E) utility information for this Project. Other jurisdictions would need to consider this before passing a policy if they want to use local inputs.

DOE uses several default assumptions for its recommendations. Default DOE recommendations use national energy code efficiencies. As Title 24 in California exceeds the national code, recommended measures could be below code. It would not be advisable to provide homeowners with potential upgrades that do not meet code. Recommended measures are also tied to a 10-year payback period for either a single measure or a package of measures. In order for Assessors to provide homeowners with recommendations aligned with California standards, options that have greater than a 10-year payback (like often is the case for heat pumps or wall insulation), or measures that align with local climate goals, custom recommendations must be established. These can be customized to align with code minimums, available incentive programs that may go above code, or all high-efficiency electric measures. In the BayREN program, recommendations align with the above-code requirements for the BayREN Home+ rebate program.

As stated earlier, the tool defaults to recommendations for space and water heating that align with the home's current fuel source. As many local jurisdictions and the state of California place a greater emphasis on electrification to reduce GHG emissions from its building stock, either the default needs to be customized to be a high-efficiency electric option, such as a heat pump, or Assessors need to be trained on basic installation needs for a heat pump and why they should be prioritized as a recommendation, unless not feasible. In the Bay Area, this is done through an addendum to the HES called the "Electrification Checklist"[16] that has Assessors collect additional datapoints related to a home's suitability for electrification measures, such as evaluating the electrical panel, recording the volume of the space where the hot water heater is located, and looking at the fuel sources for stoves and dryers. This has helped train the local Assessors on when a home is a good fit for electrification measures and encourages them to be made over gas recommendations, where appropriate.

6.3.3 Local Support Key to Success

The cities of Carlsbad, Chula Vista, and Encinitas passed their existing building reach codes before there were Certified HES Assessors in their region and without an identified HES Partner to oversee Assessor training, mentorship, and QA. Carlsbad did issue a Request for Qualifications for HES Assessors and qualified two individuals who passed the DOE HES online simulation exam but were initially not able to complete their mentoring. Eventually, Sustainrgy was able to work with a national Partner to receive virtual mentoring, but the other potential Assessor did not complete enrollment.

To encourage uptake of the HES in Carlsbad, the City provided funding for free scores and signed up interested homeowners to get scored by Sustainrgy. Before this Project began, and before the City's funding ran out, they were able to score 29 homes as a result of the City's promotion of the HES program. Sustainrgy was able to continue scoring homes under the Project as they had more lead time to build the HES into their business model and explain its value. They were also successful at expanding to score homes outside of Carlsbad.

[16] Results of the first 18 months of the BayREN HES Electrification Checklist can be found at: https://www.bayren.org/sites/default/files/2022-03/BayREN%20Electrification%20Checklist%20Report_03.07.2022.pdf

While the Project team was able to train seven additional interested participants, including two employed by one of the most active Assessor companies in the Bay Area program, these new Assessors did not have as much success finding customers who wanted to receive an HES, even free of charge. Main barriers identified were lack of knowledge of the HES, uncertainty relating to the short-term nature of the Project, and some confusion over the participants in the Project (example: being led by a Northern California local government Agency and funded through the Statewide Reach Codes Program, both being unfamiliar to many participants). It is possible that another outreach push by the City and updating the Certified Assessors on their web page could have generated leads to the new Assessors. Long-term stability for funding, familiar local actors, and Assessor support is vital to a successful HES program.

6.4 Next Steps

Throughout the country, the most common application of the HES is to provide information about a home and encourage upgrades to improve energy efficiency. This is implemented through voluntary programs and through mandating scores at the time of a real estate transaction. A newer and less common use case is in an existing building reach code. In the past few years four jurisdictions in California have included HES in their reach code as a way to improve the energy efficiency of existing single-family homes. This Project aimed to understand the applicability of HES in a reach code and, as recommended in Section 6.3 above, it may be appropriately applied in a reach code if certain actions are taken first. It is critical that a jurisdiction first understand how the HES functions in the local context, including the CZ and vintage/conditions of the single-family housing stock, by conducting a sample of scores. A jurisdiction must also identify specific goals for the reach code, such as how many and what types of homes are meant to be captured by the code or be exempt. If those steps are taken, the jurisdiction must also investigate how the HES report could be customized to meet the jurisdiction's needs and be prepared to provide adequate local support for Assessors.

However, it is important to note that the limited applicability of an HES in a reach code does not change the value of the tool to provide energy information to residents. It may also be a helpful tool to support a policy that begins with disclosure and layers on upgrade requirements over time. For example, the City of Berkeley is considering expanding their BESO to require a home to install at least one heat pump and allowing for either an exception for a very high HES or assigning a home a certain number of "points" towards an exception for a moderately high score in order to provide credit for previous upgrades. The City of Gainesville plans to continue adding minimum energy efficiency upgrades to their time of rental HES requirements over time.

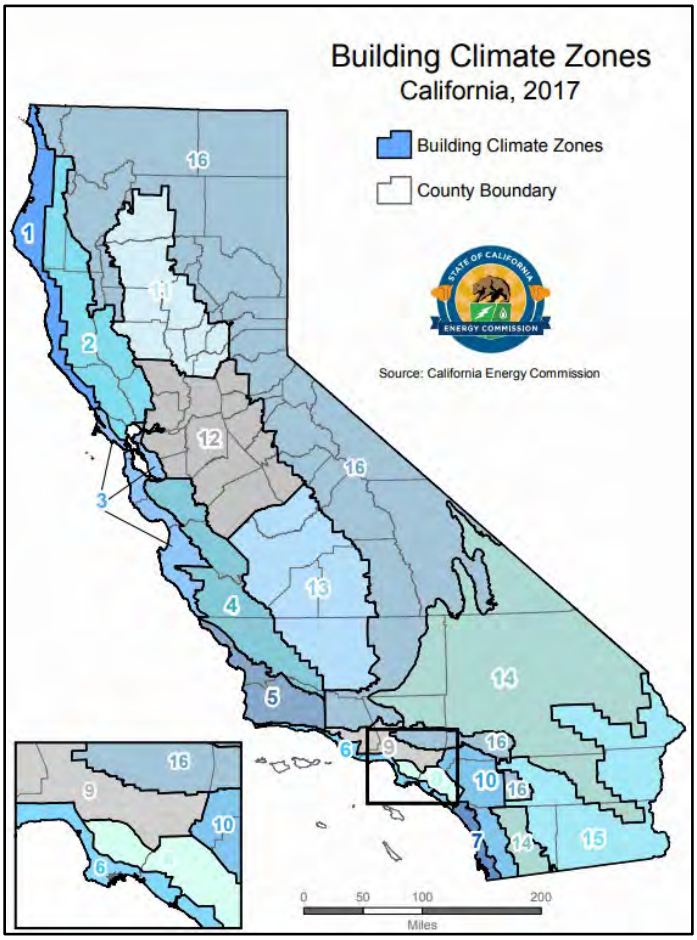
As part of this Project, StopWaste and Earth Advantage have already begun conversations with US DOE to identify potential upgrades to the tool that could make it a better fit for a reach code application. Having a larger dataset of homes in San Diego County climate zones can help DOE understand how very low heating loads affect the score and explore adjustments, including using finer-grain weather data. There are also ongoing discussions about utilizing California-specific source energy factors and incorporating time-of-use rates into the scoring methodology. Lastly, the HES model targets energy savings rather than GHG emission reductions. A heat pump system for space or water heating may help a home achieve a higher score as a more efficient appliance, but the score does not favor high-efficient electric appliances over gas ones for their reduced GHG emissions. As California and many local governments increase their focus on electrification as a means to meet climate goals, StopWaste and Earth Advantage are exploring ways for the HES to accurately reflect emissions reductions as well as energy savings. This may entail further customizing recommendations or the report template to emphasize electrification and explain its benefits. If these changes are made, it could increase the applicability of HES in a reach code application in the future.

7 Appendices

7.1 Map of California Climate Zones

Climate zone geographical boundaries are depicted in Figure 8. The map in Figure 8 along with a zip-code search directory is available at: https://ww2.energy.ca.gov/maps/renewable/building_climate_zones.html

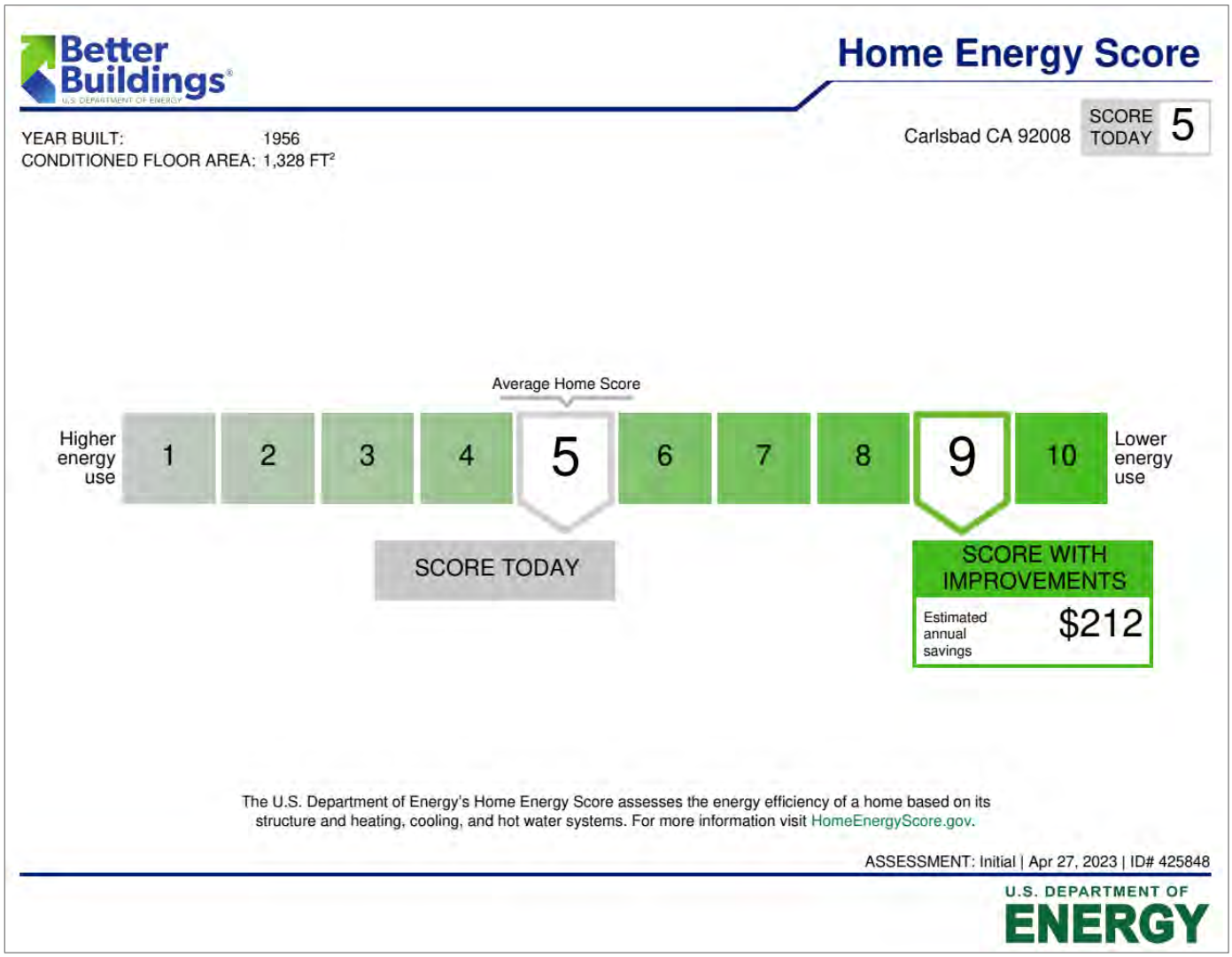
Figure 8. Map of California Climate Zones



7.2 Example HES Reports

Figure 9 is an example of the standard HES report produced by the DOE Home Energy Scoring Tool. Figure 10 is an example of the custom report available in the Bay Area HES program.

Figure 9. Sample DOE Home Energy Report



Better Buildings
U.S. DEPARTMENT OF ENERGY

Home Energy Score

Carlsbad CA 92008 SCORE TODAY 5

Home Facts

The Home Energy Score's Home Facts includes details about the home's current structure, systems, and estimated energy use. For more information about how the score is calculated, visit our website at HomeEnergyScore.gov.

About This Home

HOME CONSTRUCTION	
Year built	1956
Number of bedrooms	3
Stories above ground level	1
Interior floor-to-ceiling height	8 ft
Conditioned floor area	1,328 ft²
Direction faced by front of house	West
House Shape	Rectangle
Air sealed?	No

ASSESSMENT	
Type	Initial
Assessor name	CA-SWST-0256
Scoring tool version	2022.3.0

Estimated Annual Energy Use

ENERGY USE BY TYPE	
Total	89 MBtus
Score basis	39 MBtus
Energy use per square foot	42 kBtu / ft²
Electricity	5,771 kWh
Natural gas	361 therms

ENERGY COSTS	
This home's annual energy cost estimate	$1,509
This home's energy cost per square foot	$1.14 / ft²
Electricity rate	$0.176 / kWh
Natural gas rate	$1.368 / therm
Comparable Reference energy cost estimate*	$1,300

DEFINITIONS & CONVERSIONS	
MBtu	Million British thermal units; generic energy unit
kBtu	Thousand British thermal units; generic energy unit
kWh	Kilowatt-hour; electricity unit
Therm	100,000 Btu; heat energy unit
Electricity conversion	1 MBTU = 293 kWh
Heat conversion	1 MBTU = 10 therms

*Reference number for similar homes for appraisers to assess efficiency value

Page 2 of 6 ASSESSMENT: Initial | Apr 27, 2023 | ID# 425848

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Home Energy Score

Carlsbad CA 92008 SCORE TODAY 5

Home Facts

The Home Energy Score's Home Facts includes details about the home's current structure, systems, and estimated energy use. For more information about how the score is calculated, visit our website at HomeEnergyScore.gov.

Roof / Attic

ROOF / ATTIC 1	
Attic floor area	1,328 ft²
Roof construction	Standard / Composition Shingles or Metal / R-0
Roof color	Medium dark
Attic / ceiling type	Unconditioned attic
Attic floor insulation	R-0

Foundation

FOUNDATION / FLOOR 1	
Floor area	1,328 ft²
Foundation type	Vented crawlspace / R-0
Foundation walls insulation	R-0

Walls

WALL CONSTRUCTION	TYPE / EXTERIOR FINISH	INSULATION VALUE
All	Wood frame / Stucco finish	R-0

Page 3 of 6 ASSESSMENT: Initial | Apr 27, 2023 | ID# 425848

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Home Energy Score

Carlsbad CA 92008 SCORE TODAY 5

Home Facts

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Windows & Skylights

WINDOW AREA	
Front	81 ft²
Back	61 ft²
Right	22 ft²
Left	54 ft²

WINDOW CONSTRUCTION	PANES	FRAME	GLAZING	SOLAR SCREEN
Front	Double	Wood or vinyl	Clear	No
Back	Single	Wood or vinyl	Clear	No
Right	Double	Wood or vinyl	Clear	No
Left	Double	Wood or vinyl	Clear	No

SKYLIGHTS ROOF / ATTIC 1	
Present?	No

Page 4 of 6 ASSESSMENT: Initial | Apr 27, 2023 | ID# 425848

U.S. DEPARTMENT OF ENERGY

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Home Energy Score

Carlsbad CA 92008 SCORE TODAY 5

Home Facts

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Systems

HVAC SYSTEM 1		
Percent conditioned area served	100%	
Heating type	Central gas furnace	
Heating efficiency value	78% AFUE	
Duct system sealed	No	
Duct Location	Insulated	Percent of Ducts in this Location
Vented crawlspace	Yes	100%
HOT WATER		
System type	Natural gas storage	
Efficiency value	0.63 EF	

Page 5 of 6 ASSESSMENT: Initial | Apr 27, 2023 | ID# 425848

U.S. DEPARTMENT OF ENERGY

Better Buildings
U.S. DEPARTMENT OF ENERGY

Home Energy Score

Carlsbad CA 92008 SCORE TODAY 5

Recommendations

The Home Energy Score's Recommendations show how to improve the energy efficiency of the home to achieve a higher score and save money. All together, these improvements are estimated to pay back in about ten years based on national average installation costs; items marked with a ★ are modeled to pay back in ten years or less on their own. When making energy related upgrades, homeowners should consult with a certified energy professional or other technically qualified contractor to ensure proper sizing, installation, safety, and adherence to code. Learn more at HomeEnergyScore.gov.

Recommended Improvements

REPAIR NOW. These improvements will save you money, conserve energy, and improve your comfort.

- Attic 1: Increase attic floor insulation to at least R-19 to save **$173** / year ★
- Ducts 1: Have your ducts professionally sealed to reduce leakage to save **$14** / year

REPLACE LATER. These improvements will help you save energy when it's time to replace or upgrade.

- Furnace 1: Pick one with an ENERGY STAR label to save **$39** / year ★
- Water heater: Pick one with an ENERGY STAR label to save **$15** / year ★

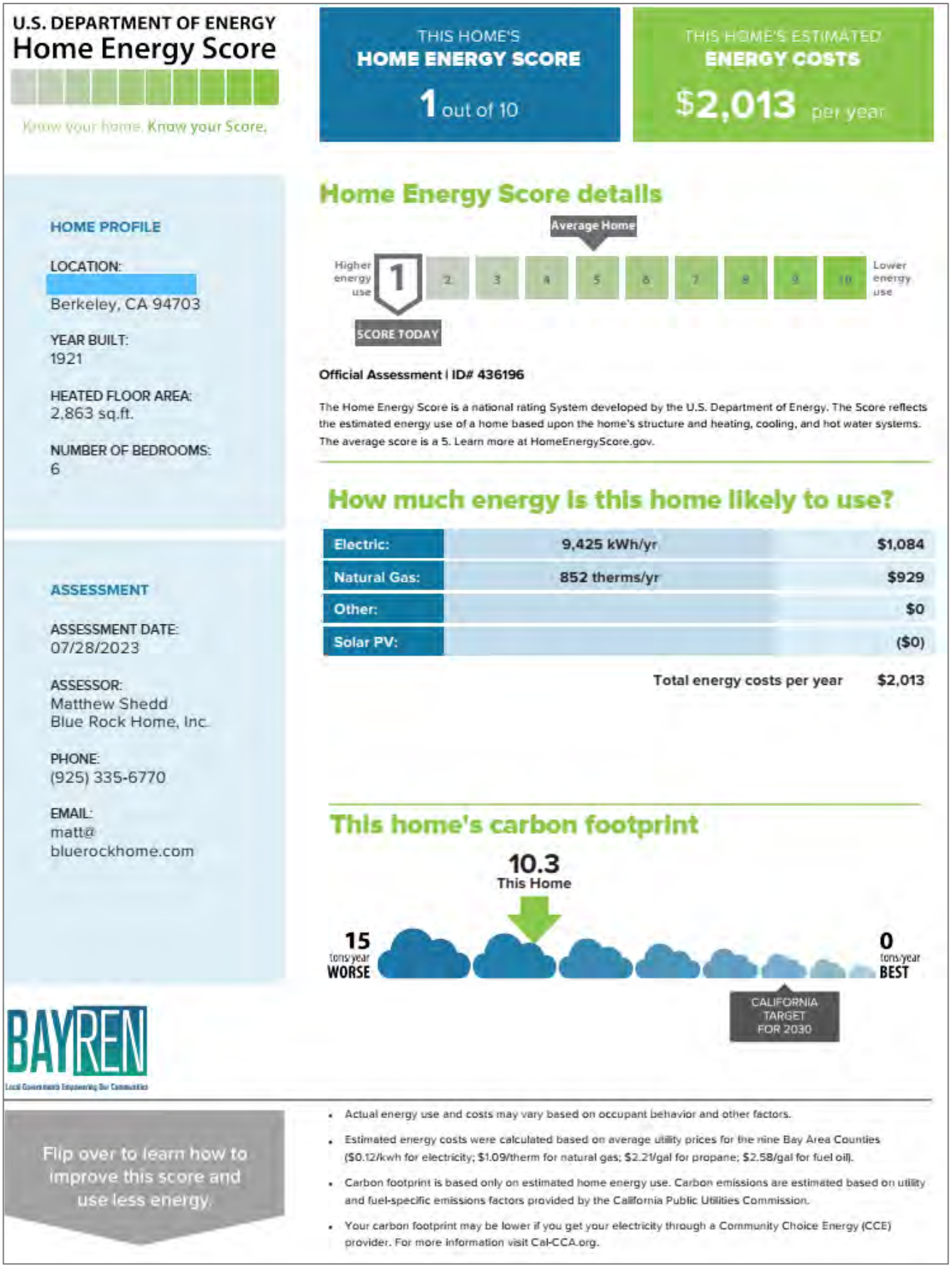
Comments

Bayren/Carlsbad

Page 6 of 6 ASSESSMENT: Initial | Apr 27, 2023 | ID# 425848

U.S. DEPARTMENT OF ENERGY

Figure 10. Sample BayREN Home Energy Score Report



U.S. DEPARTMENT OF ENERGY
Home Energy Score

Know your home. Know your Score.

THIS HOME'S
HOME ENERGY SCORE
1 out of 10

THIS HOME'S ESTIMATED
ENERGY COSTS
$2,013 per year

HOME PROFILE

LOCATION:
Berkeley, CA 94703

YEAR BUILT:
1921

HEATED FLOOR AREA:
2,863 sq.ft.

NUMBER OF BEDROOMS:
6

ASSESSMENT

ASSESSMENT DATE:
07/28/2023

ASSESSOR:
Matthew Shedd
Blue Rock Home, Inc.

PHONE:
(925) 335-6770

EMAIL:
matt@
bluerockhome.com

BAYREN
Local Governments Empowering Our Communities

Flip over to learn how to improve this score and use less energy.

Home Energy Score details

Average Home

Higher energy use | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Lower energy use

SCORE TODAY

Official Assessment | ID# 436196

The Home Energy Score is a national rating System developed by the U.S. Department of Energy. The Score reflects the estimated energy use of a home based upon the home's structure and heating, cooling, and hot water systems. The average score is a 5. Learn more at HomeEnergyScore.gov.

How much energy is this home likely to use?

Electric:	9,425 kWh/yr	$1,084
Natural Gas:	852 therms/yr	$929
Other:		$0
Solar PV:		($0)
	Total energy costs per year	$2,013

This home's carbon footprint

10.3
This Home

15 tons/year WORSE

0 tons/year BEST

CALIFORNIA TARGET FOR 2030

- Actual energy use and costs may vary based on occupant behavior and other factors.
- Estimated energy costs were calculated based on average utility prices for the nine Bay Area Counties ($0.12/kwh for electricity; $1.09/therm for natural gas; $2.21/gal for propane; $2.58/gal for fuel oil).
- Carbon footprint is based only on estimated home energy use. Carbon emissions are estimated based on utility and fuel-specific emissions factors provided by the California Public Utilities Commission.
- Your carbon footprint may be lower if you get your electricity through a Community Choice Energy (CCE) provider. For more information visit Cal-CCA.org.

Tackle energy waste today!

Enjoy the rewards of a comfortable, energy efficient home that saves you money.

SCORE TODAY
1
out of 10

- ☑ Get your home energy assessment. Done!
- ☐ Choose energy improvements from the list of recommendations below.

  Need help deciding what to do first? The BayREN Home Upgrade Advisors offer free phone consults with independent expert home advisors. **Call 866-878-6008.**
- ☐ Check out **bayren.org/rebates-financing/single-family-homeowners** for information on BayREN energy efficiency programs and financing opportunities.
- ☐ Select a contractor (or two, for comparison) and obtain bids.
- ☐ Perform upgrades and enjoy a more comfortable and energy efficient home.

Energy Improvements, customized for your home.

FEATURE	TODAY'S CONDITION	RECOMMENDED IMPROVEMENTS
Attic Insulation	Ceiling insulated to R-03	Insulate to R-44 or higher and air seal
Wall Insulation	Insulated to R-00	Insulate to R-13 or higher
Envelope/Air Sealing	Not professionally airsealed	At least 30% leakage reduction from vintage table defaults
Ducts (Duct Repair)	Insulated & Un-sealed	No recommendation
Floor Insulation	Insulated to R-00	Insulate to R-19 or higher
Heating Equipment	Natural gas furnace,82% AFUE	Electric Heat Pump 9.4 HSPF/17 SEER or higher
Water Heater	Standard natural gas tank	Heat Pump Water Heater 3.24 UEF or higher
Windows	Single-pane	Double-pane or other high-efficiency windows
Cooling System	N/A	No recommendation
Appliances: Induction Cooking	Gas Range/Cooktop	Induction electric range/cooktop replacing a natural gas range/cooktop
Appliances: Heat Pump Dryer	Gas Dryer	Heat pump clothes dryer 4.5 Combined Energy Factor (CEF) replacing a natural gas clothes dryer

ADDITIONAL COMMENTS AND RECOMMENDATIONS:

7.3 Summary of HES Customizations Discussions with US DOE

Table 5 below summarizes the conversations with US DOE's HES team about potential customizations to the tool that could increase its applicability for use in a California reach code setting. The Project team evaluated options for the change to be made to the DOE's HES methodology, meaning the HES in California would be calculated differently than elsewhere in the country, or post-processing, meaning that the 1-10 score coming from the Home Energy Scoring tool would remain the same, but either separate calculations or report design could accomplish a similar goal. It should be noted that this is a summary of a snapshot in time and that the US DOE HES team is consistently updating the HES, scoring methodology, and Home Energy Scoring tool. It is possible that the customizations requested may be possible in the future if priorities for modifications shift, such as other states requesting similar changes or to meet requirements of federal funding, such as the Inflation Reduction Act (IRA).

Table 5. Summary of HES Customization Options

Customization	DOE Change?	Post-Processing Option?
California Source Energy Factors	No. To maintain consistency across the country and for ease of maintaining the tool using state-specific source energy conversion factors would not be possible at this time.	Yes. Partners could post-process scores using CA-specific data. Could not be presented as a US DOE HES and would need to consider if two scores are shown and how it could be communicated to the customer.
Use of Hourly Multipliers	Yes. DOE is currently in the process of providing hourly data to allow for TOU calculations for utility rates and GHG emissions. These would still be national averages and not state-specific data.	Yes. When available, DOE's hourly data could be modified by a Partner to apply California-specific hourly multipliers, including different multipliers by CZ.
Remove Normalization of Housing Size	No. This is an integral part of the HES methodology.	No. DOE confirmed that it would not be appropriate to normalize the score to the CA housing stock instead of the national housing stock since the HES is meant to be a comparison of homes nationwide. A workaround could include coming up with an HES per square foot (similar to Energy Use Intensity) for a home, but this might be too confusing for a homeowner to understand.
Custom Recommendations	No. The DOE already provides recommendations based on national energy code requirements and recommendations must meet a 10-year individual or package payback period.	Yes. Partners can already customize their recommendations to match local energy codes, climate goals, and rebate programs.
Calculation of Post-Improvement Information	No. The DOE already provides post-improvement information including a score and estimated energy and utility bill savings if upgrades are made. However, this is done using the default DOE recommendations which may not be applicable to CA.	Yes. A Partner could build a function to re-run the score as if the custom recommendations were done, which would provide this information.
Prioritize Electrification Measures	Possibly. DOE is working on how to accurately reflect the value of high-	Yes. It is possible for a Partner to customize recommendations to default

	efficiency electric equipment, such as heat pumps. While these appliances are more efficient, the GHG emissions of their usage is highly dependent on the electricity mix of a region, which varies greatly throughout the country.	to or require electrification. Layout and features of the custom report can also emphasize electrification.
De-Emphasize Role CZ Plays in Score	No. The HES is meant to reflect how much energy is consumed by one home compared to another. This is highly influenced by CZ. However, DOE is looking to improve the quality of weather station data that may better reflect regional climate information.	No. For similar reasons provided for why this would not be a DOE modification, providing this information in a post-processing scenario could be at odds with some of the fundamental assumptions of the HES.
Add a Significant Digit to the HES	Unsure. DOE acknowledged that rounding the score to a whole number does hide the impact that some recommendations can make but are not planning to change it at this time.	No. Since the Home Energy Scoring tool only provides the whole number, it would not be possible to add a significant digit to the score report.
Create Measure Packages with Minimum Savings	Yes. DOE is currently investigating this option so that HES can be a compliance tool for the IRA HOMES rebate program.	Yes. Packages of measures could be determined by a Partner.
Collect Data on Duct Conditions	Yes. Currently data on whether the ducts are sealed and insulated is collected but it is a yes or no answer. Duct leakage can be added to improve the accuracy of the score if a duct blasting test is performed. The DOE is considering a modification to the data collected in the score to account for duct condition, which would indicate if ducts are partially or completely disconnected.	No. This change would have to be made to the score collection methodology.

7.4 City of Carlsbad and StopWaste MOU

The following scope of work was included in the MOU between the City of Carlsbad and the Energy Council (dba StopWaste) approved at the January 10, 2023 City Council Meeting:

Energy Council will provide the following services to the City:

- Set a goal for number of assessors needed to meet the City's program goals;
- Utilize DOE HES partnership to enroll and support local assessors to complete scores, process scores, and comply with the DOE requirements for QA of scores;
- Train assessors (in-person) and provide required DOE mentorship (in person or virtual) to grow a pool of qualified assessors in the North County San Diego region;
- Create and maintain a qualified professionals list of assessors;
- Advise on the design of and funding incentives to kickstart use of the pilot program;

- Determine database customization needs, and customizing existing HES database for generating and tracking scores to include climate zone, utility, and other information as needed;
- Develop a custom HES report with jurisdiction branding, desired recommendations, and connections to local incentive or upgrade programs;
- Design collateral and messaging for HES program outreach;
- Publish monthly dashboards highlighting program participation and accomplishments; and
- Draft pilot program reporting, including evaluation, accomplishments, suggestions for improvements, and creating a transition plan for implementation of HES program at the conclusion of pilot program.

City staff will coordinate with Energy Council as follows:

- Engage City decision-makers and seek to secure relevant approvals for pilot program implementation;
- Coordinate with City staff responsible for Reach Code implementation, such as building departments, sustainability staff, and permit counter staff;
- Present the policy before City Council and key stakeholder groups, as needed;
- Implement the requirements of the City's Reach Code, including processing HES projects when they are triggered by existing Reach Code policies;
- Help coordinate logistics of in-person assessor trainings, including contacting local work force and securing training locations;
- Design and seek to offer pilot program incentives;
- Determine database and report customization needs;
- Utilize and co-branding outreach materials provided by Energy Council;
- Participate in regularly scheduled project team meetings; and
- Determine whether to phase-out or continue implementation of HES program after the pilot program concludes.

The entirety of the MOU can be found at:
https://records.carlsbadca.gov/WebLink/DocView.aspx?id=6386150&dbid=0&repo=CityofCarlsbad

7.5 Homeowner Application Information

Figure 11. HES Application

HOME ENERGY SCORE REBATE APPLICATION

CUSTOMER INFORMATION		
Homeowner (Full Name)	Tenant (Full Name - if different)	
Assessment Street Address		
City	State	Zip Code
Homeowner Phone Number	Homeowner Email	

1. What is your motivation for receiving a Home Energy Score? (Check all that apply)

- ☐ I am interested in finding out more about my home
- ☐ I want to save energy and reduce greenhouse gas emissions
- ☐ I want to save money on my utilities bills
- ☐ I have questions about the thermal comfort of my home
- ☐ I am doing a renovation project and want to comply with Carlsbad's existing building reach code
- ☐ It was free/reduced cost
- ☐ Other _____

2. Are you having other work done at your home? (Check all that apply)

- ☐ Yes, completing a renovation or addition
- ☐ Yes, installing new or replacing a heating/cooling system
- ☐ Yes, installing a new hot water heater
- ☐ Yes, other _____
- ☐ No, just the Home Energy Score

3. How did you find out about the Home Energy Score Program?

- ☐ It was offered by a professional doing work at my home (i.e., contractor, energy auditor, or home inspector)
- ☐ The City of Carlsbad website or promotions
- ☐ Word of mouth
- ☐ Other _____

ASSESSMENT INFORMATION	
Date of Assessment	Qualified Assessor Name or Assessor ID No.
HES Label Number	Home's Home Energy Score

Turn over to complete this form

STOPWASTE at home • at work • at school

U.S. DEPARTMENT OF ENERGY Home Energy Score™ Partner

PAYEE INFORMATION

☐ Check if payee is same as homeowner ☐ Check if payee is assessor company If neither, enter payee info below

Payee (Full Name)

Mailing Street Address

City | State | Zip Code

Payee Phone Number | Payee Email

Homeowner certifies that:

1. The rebate is payable to either the homeowner or the Assessor and the payee selected is listed in the Payee Information section.
2. I authorize the release of Home Energy Score-related information to funding partners for rebate payment authorization.
3. I understand that I may be contacted for program evaluation purposes only. I authorize this contact to be made via US mail or email only, and for the limited purpose of program evaluation.
4. I understand that StopWaste will not, under any circumstances, sell my information for commercial purposes or to a third-party.
5. I agree to allow to have the Home Energy Score report listed publicly on the Green Building Registry®. Publicly listing your home's Home Energy Score allows this information to be contained real estate listings if you ever choose sell your home in the future. No personal information is listed on the Green Building Registry, just the Home Energy Score report.

☐ I hereby opt-in on a public listing on the Green Building Registry. (*check box to agree*)

Homeowner Signature Date

Assessor certifies that:

1. The U.S. Department of Energy Home Energy Score was performed on the assessment address listed under Customer Information by the referenced assessor.
2. The rebate is payable to either the homeowner, assessor company, or payee listed above in the Payee Information Section.

Assessor Signature Date

STOPWASTE

U.S. DEPARTMENT OF ENERGY
Home Energy Score™ Partner

Figure 12. Summary of Homeowner Application Responses