

2024 PROJECT PEER REVIEW

U.S. DEPARTMENT OF ENERGY
BUILDING TECHNOLOGIES OFFICE

BTO Peer Review: Home Energy Score Gateway

Enabling nation-wide energy
disclosure statements for
homes at scale



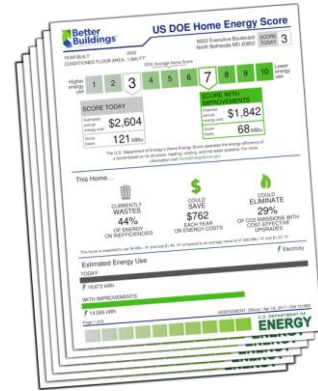
Project Summary

In coordination with NREL presentation, this one focuses on the Home Energy Score Gateway

OBJECTIVE, OUTCOME, & IMPACT

The Home Energy Score (HEScore) promotes residential energy efficiency upgrades by providing a score (from one to ten) that reflects the current energy efficiency of a home and a list of cost-effective recommendations for improving the score. The HEScore Gateway provides an integrated solution package that streamlines the process of home assessment, assessor training and certification, data tracking and sharing, and quality assurance and control. The goal of this project is for >50% of houses to require energy disclosure statements by 2035. So far, more than 250,000 HEScores have been produced.

The Home Energy Score Gateway has processed more than 250,000 Home Energy Scores - representing 25% growth in the last year alone.



TEAM & PARTNERS



STATS

Performance Period: FY21-FY25

DOE Budget: \$3,900k, Cost Share: \$0

Milestones:

FY21 Q4 – Beta Release of HEScore + API

FY22 Q4 – Opportunity for HES to increase energy equity using supporting quantitative analysis

FY23 Q4 – GUI revamp and database optimization for improved performance and reliability

FY24 Q3 – Developed user interface for multifamily / manufactured housing

FY25 Q2 – Complete development of training simulator

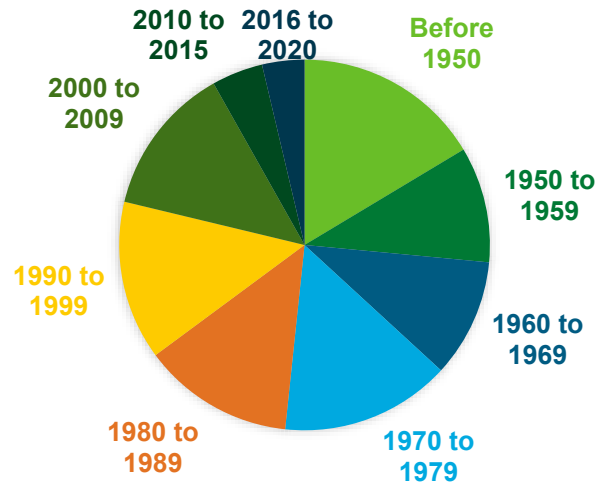


Problem

The variation in our nation's building stock is overwhelming and consumers have very little insight into how one homes' energy use compares to another

There are more than 120 million homes in the United States. Very few of them are the same, which means it is hard to make retrofit decisions at scale.

Also, energy efficiency is invisible to homeowners, renters, and buyers, who don't have the information or resources they need *when they need it* to make the decisions that will add up to the necessary emissions reductions.



Source: EIA, 2020



Source: Ohio Consolidated Plan



Alignment and Impact

By 2035, Building energy disclosure requirements are adopted in states and jurisdictions representing >50% of people in the United States and include point-of-sale/rental disclosure requirements for homes

Increase Building Valuation and Energy Efficiency

- Increase market value for home energy efficiency through standard data and metrics applicable to all existing homes
- Promotes energy efficiency upgrades through consistent reports for homeowners

Energy Equity

- Support low-and-moderate income (LMI) incentive programs, including the Infrastructure Investment and Jobs Act (IIJA) and Inflation Reduction Act (IRA)
- Inform renters of potential energy costs
- Leverage data to better understand housing stock in disadvantaged communities





Alignment and Impact

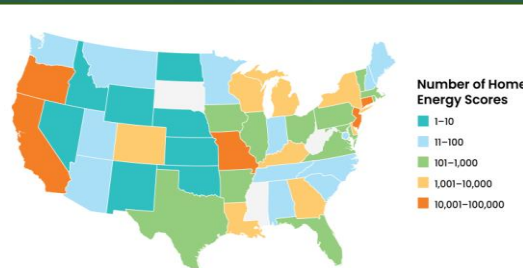
The Home Energy Score Gateway manages high volume throughput with ease

Home Energy Score is used in:

- Real estate and rental **disclosure ordinances** in 8 cities
- Statewide **labeling frameworks/programs** in 5 states
- **Reach codes** when major renovations are done in 3 cities
- **Utility programs** to encourage additional EE measures and document the value of improvements in 9 programs
- **LMI programs** by community action agencies and non-profits
- **Mortgage products** (Fannie Mae, Freddie Mac, FHA), **MLS listings**, and **appraisal forms**

Home Energy Scores Surpass 250,000

SEPTEMBER 5, 2024



Referenced in IRA- and IIJA-funded programs for use in:

- **Home Energy Rebates** as post-installation certificate and when utility bills aren't available (BPI 2400, Annex E)
- **EE Revolving Loan Fund Program**

Quick Stats

- ~255,000 Scores
- ~400 Assessors
- 27 Partners
- 14 API-Connected Software Providers



Alignment and Impact

Proof that Home Energy Scores support higher market valuation

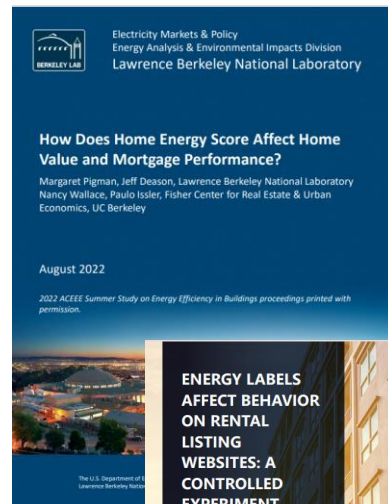
Home Energy Score Affects Home Value and Mortgage Performance

In cities that require Home Energy Score in real estate listings:

- Higher Home Energy Score was associated with higher purchase price (0.5% higher purchase price for each point increase on Home Energy Score scale)
- A \$100 increase in estimated annual energy bills was associated with a 0.4% decrease in purchase price

Energy Labels Affect Behavior on Rental Listing Websites

- Energy labels on a mock rental listing website encouraged renters to select the most efficient listings 21% more often
- Showing listings with a Home Energy Score and the corresponding scale and estimated energy costs led to higher “click” rates of energy efficient properties
- Builds off previous research (ACEEE, 2020) which showed **similar findings for prospective home buyers** on a mock real estate listing website

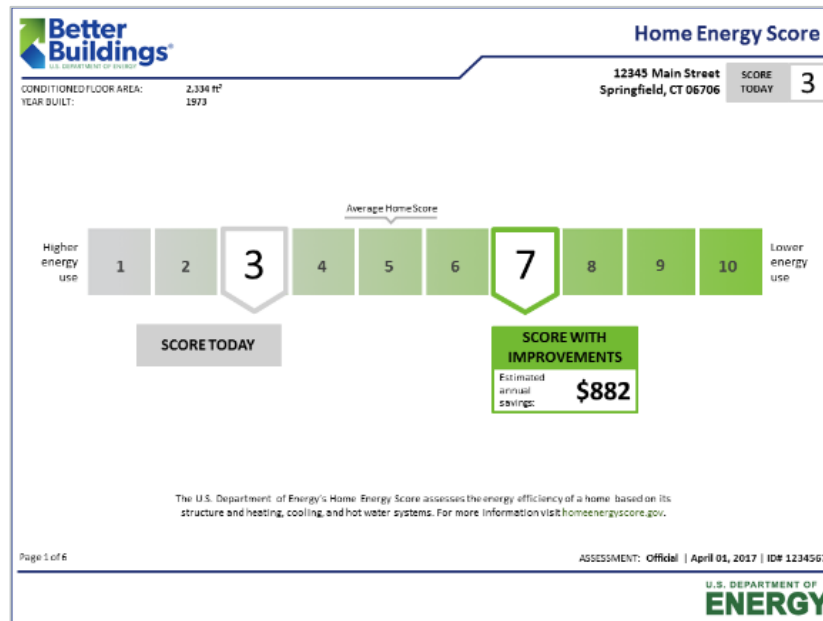




Approach

Home Energy Scores simplify energy use metrics for homeowners and realtors

- Simple score from 1 to 10
- Consumer-friendly display
- Makes energy efficiency **visible**, **valued**, and **actionable**
- Nationally recognized
- Cost-effective upgrade recommendations
- Energy cost estimates

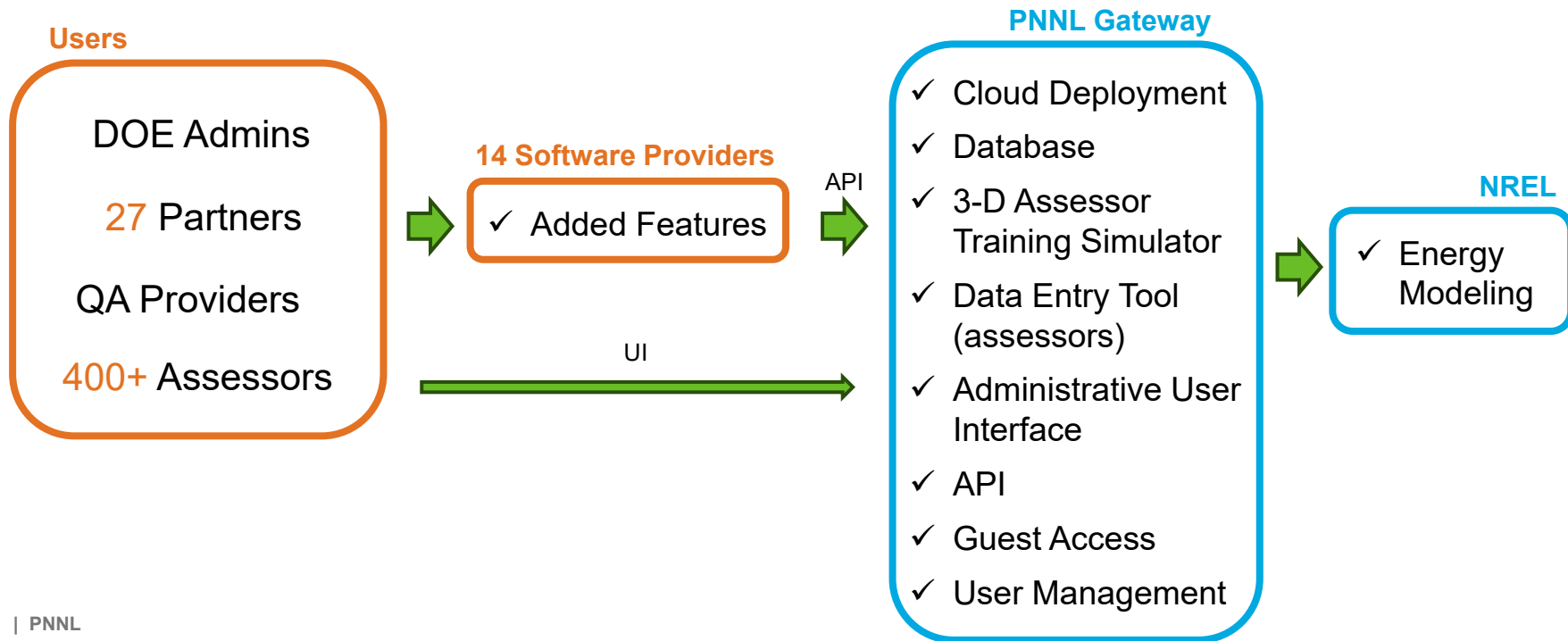


Source: Better Buildings Solution Center



Approach

PNNL manages the Home Energy Score Gateway, connecting the industry users with the backend engineering in a user-friendly way

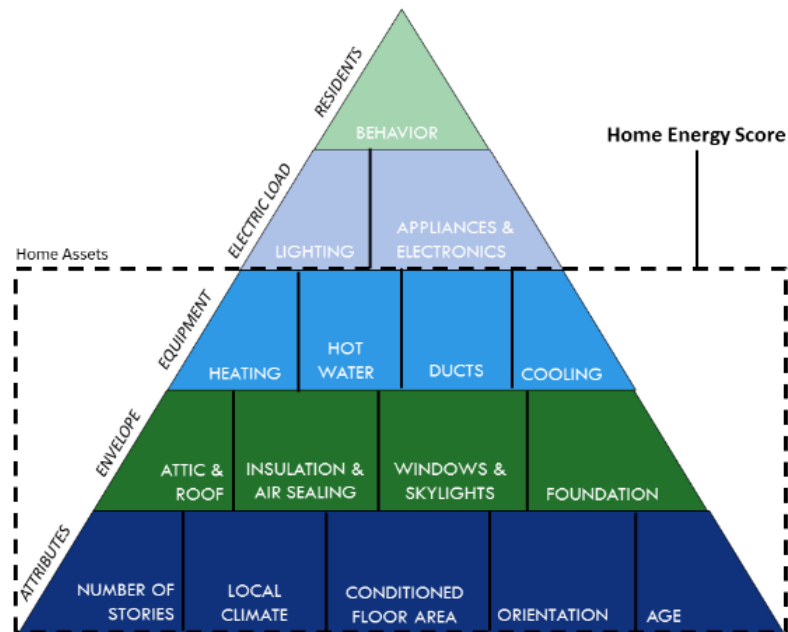




Approach

Prominent novel features of the Home Energy Score Gateway help achieve the right balance between detailed energy audits and large-scale representative models

- Based on home assets (permanent elements of a home, regardless of occupants)
- Uses state-of-the art energy modeling with OpenStudio/EnergyPlus
- Two modes of use:
 - Free User Interface (UI)
 - Application Programming Interface (API) used by the private-sector
- Low-cost assessments approximately twice as fast as full energy audits
- Rich national house-by-house dataset



Source: Better Buildings Solution Center



Approach

Successfully managing growth with modern backend support

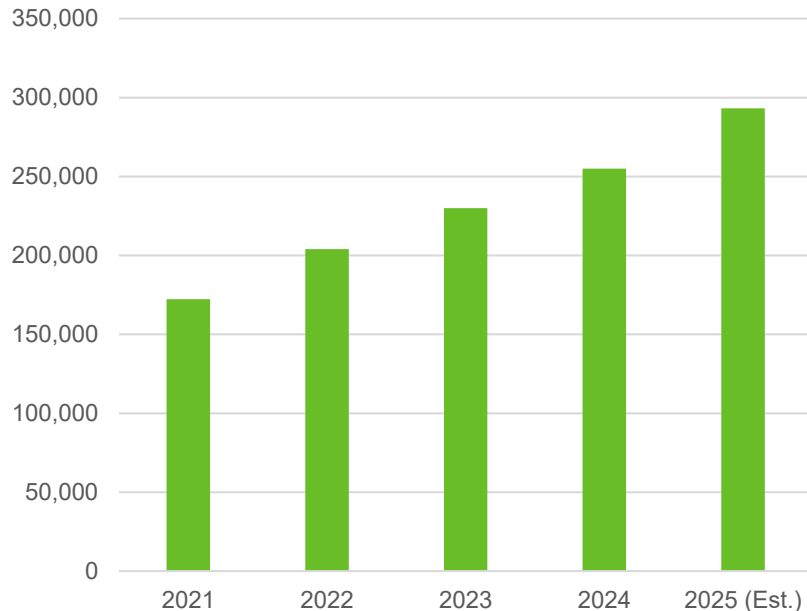
Challenges

- Handling increasing usage
- Older parts of the software are difficult to maintain
- Users in the field do not always have an internet connection
- Steep learning curve for new API users

Solutions

- Scaling using cloud computing services methods
- Update to modern technologies
- Develop an offline version for data collection
- Provide a more modern API option

Cumulative Official Home Energy Scores





Progress and Future Work

Summary of major FY24 accomplishments

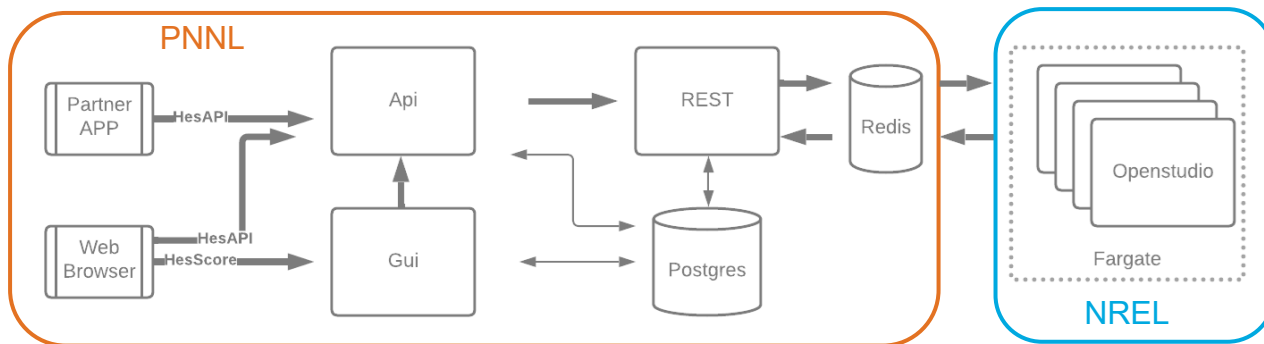
- Completed a major system overhaul
- Created a system metrics dashboard
- Redesigned the HEScore Data Entry Tool (for assessors)
- Began work on a new 3-D assessor training simulator
- Added support for multifamily building units
- Added support for manufactured homes
- Began redesign of the administrative user interface





Progress and Future Work

Completed a major system overhaul to support faster score generation at scale and lower future upkeep costs



Improvements

- Improved inter-lab code connections
- Simplified building data validation
- Replaced old code for determining upgrade packages
- Smaller, stronger, faster database
- More parallel modeling runs

Benefits

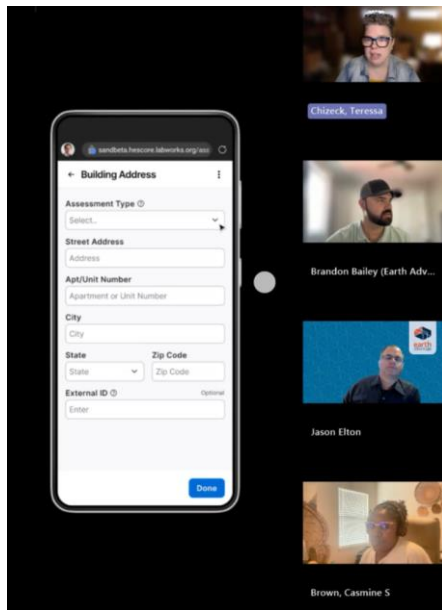
- **3x faster score generation!**
- More **scalable**
- **Quicker to add modeling features**
- Ready to tackle UI overhaul



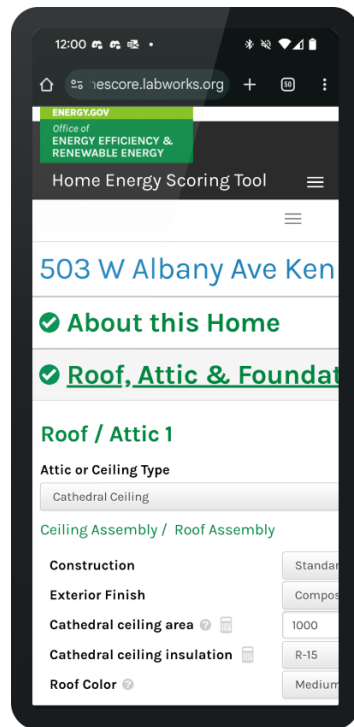
Progress and Future Work

In FY24, PNNL redesigned the HEScore data entry tool

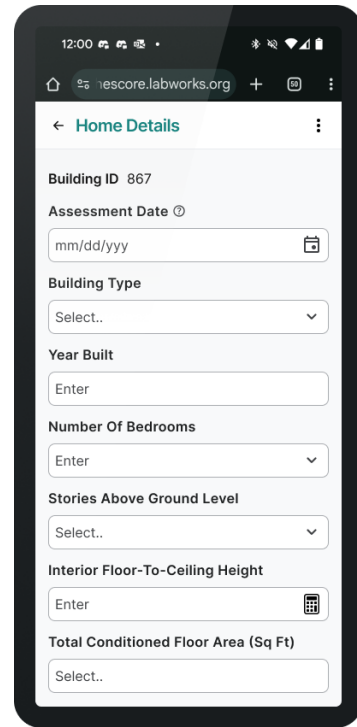
- Improved usability
- Phones, tablets, laptops
- No internet connection required during data entry
- Modern backend and look



User Feedback



Before



After



Progress and Future Work

In FY24, PNNL began work on a new 3-D assessor training simulator

- Minimizing future carrying costs compared to subcontractor
- Improved integration with the rest of the system





Progress and Future Work

Planned for FY25

- Add elements that support electrification (fuel switching)
- Implement modeling improvements from NREL
- Implement the redesigned HEScore Data Entry Tool
- Integrate the new 3-D training simulator into the system
- Provide a modernized, more user-friendly API
- Allow API users to upload a simplified building data format
- Provide data aggregation and visualization services for the Home Energy Score dataset
- Finish design and then implement a new administrative user interface

Thank you

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WBS # 66749.1.5.1.48

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Reference Slides





Project Execution

| | FY2023 | | | | FY2024 | | | | FY2025 | | | |
|---|-----------|----|----|----|-----------|----|----|----|-----------|----|----|----|
| Planned budget | \$731,000 | | | | \$766,000 | | | | \$945,000 | | | |
| Spent budget | \$686,000 | | | | \$785,000 | | | | - | | | |
| | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| Past Work | | | | | | | | | | | | |
| Incremental HEScore Release (GUI and Admin Portal) | ◆ | | | | | | | | | | | |
| Semi-annual HEScore status report (FY23) | | ◆ | | ◆ | | | | | | | | |
| Code base update for multifamily and manufactured home modeling | | | | ◆ | | | | | | | | |
| Database optimization for performance and reliability | | | | ◆ | | | | | | | | |
| Multifamily and manufactured home usecase testing | | | | | | | ◆ | | | | | |
| Semi-annual HEScore status report (FY24) | | | | | | ◆ | | ◆ | | | | |
| Dashboard for real-time system status | | | | | | | | ◆ | | | | |
| Current/Future Work | | | | | | | | | | | | |
| Implement DOE-identified and prioritized improvements | | | | | | | | | | ◆ | | |
| Semi-annual HEScore status report (FY25) | | | | | | | | | | ◆ | | ◆ |
| Data visualization and analysis capabilities from GUI | | | | | | | | | | | | ◆ |



Team



Charlie Holly

Principal Investigator



Prescott Davis

Lead Developer



Matt Macduff

Cloud Computing

Additional PNNL team members:

- Yan Zhao
- Anshe Hsiao
- Michael Roper
- Martin Pratt
- Brandon Deguia
- Nyan Prakash
- Theresa Chizeck
- Casmie Brown
- Zimo Wang

NREL:

- Noel Merket
- Scott Horowitz
- Benjamin Park
- Yueyue Zhao

DOE:

- Megan "Gilly" Plog