Home Energy Score™

Building Technologies Office

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Project Summary –OVERALL

Timeline:

Start date: 10/2010.

Planned end date: Conversion to "maintenance mode" 01/2021.

Key Milestones

1. Program implementation; 10/2012
2. API development; 01/2014
3. Home Energy Score Gateway; 10/2014
4. Simulation Training; 10/2015
5. Remote Quality Assurance; 01/2016
6. Updated Scoring Tool; 02/2019
7. Updated Simulation Training; 04/2019
8. Modeling Harmonization; 10/2020

Budget:

Total Project $ to Date:

- DOE: ~$10M/10 years
- Cost Share: $N/A

Total Project $:

- DOE: ~$12M/12 years
- Cost Share: $N/A

Key Partners:

Lawrence Berkeley National Laboratory (LBNL)
Pacific Northwest National Laboratory (PNNL)
National Renewable Energy Laboratory (NREL)
Allegheny Science & Technology
The Building People
Interplay Learning

Project Outcome:

Home Energy Score becoming a recognized, widely used and influential tool in the market that leads to an improved U.S. housing stock with better energy performance, lower costs and greater comfort as well as more efficient use of natural resources. The goal is to build market value for energy efficient single-family homes and townhomes that improve quality of life. Home Energy Score accomplishes this by:

- ✓ Providing homeowners and homebuyers knowledge of home energy efficiency and cost-effective improvements in order to reduce energy use and costs.
- ✓ Encouraging use of reliable, consistent home energy efficiency information in real estate transactions to inform decisions, and build a market value for comfortable, energy efficient homes.
- ✓ Integrating energy information into financing products to help drive the market for comfortable, energy efficient homes.

Team

DOE EERE:
- Program administration
- Partner and stakeholder communication
- Energy scoring policy and strategy subject matter experts

PNNL:
- Integration of energy modeling and program administration services
- Systems software engineering and web-based delivery expertise

LBNL:
- Residential energy scoring modeling codes (DOE2)
- Residential building science subject matter experts

NREL:
- Residential energy score modeling codes (Open Studio / Energy Plus)
- Building data transfer protocol (HPXML) subject matter experts

Allegheny Science and Technology:
- Building Science Application subject matter experts
- Program implementation and support

Interplay Learning:
- Online training services
- 3-D training subject matter experts

Challenges in Valuing Efficiency
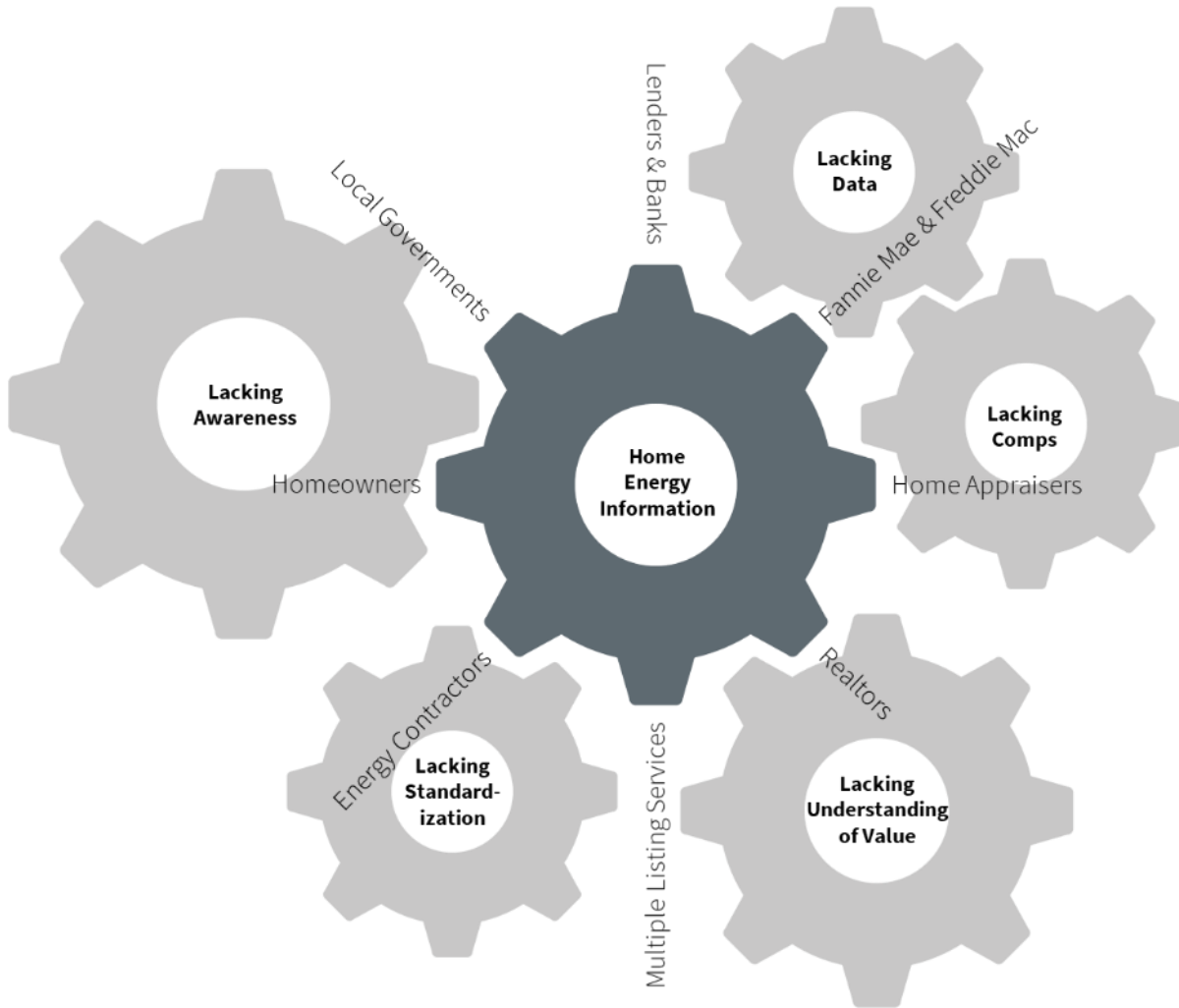
› Mortgage lenders and underwriters **lack data** to base energy efficiency financing.

› Appraisers **lack comps** to attribute value to energy efficient homes.

› Realtors and MLSs **lack building science knowledge**.

› Energy contractors **lack data standardization** allowing for aggregation.

› Homeowners and local governments **lack awareness** about best-fit efficiency upgrades and benefits.

› **Result: Efficiency is persistently undervalued in the residential real estate market.**

Home Energy Score

U.S. DEPARTMENT OF ENERGY
Home Energy Score

Features

- ✓ "Miles per gallon" rating for homes*
- ✓ Scale for easy-to-understand interpretation
- ✓ Building energy model estimates annual energy use, costs, emissions
- ✓ Recommendations for cost-effective improvements
- ✓ Easily show energy features and expected costs of comp homes
- ✓ Backend tool for various home energy assessments
- ✓ Can be included in home inspections
- ✓ Useful information for consumers, Home Energy Score Partners, real estate agents, lenders, appraisers, city & state governments

*Applicable for single-family homes and townhomes only.

An Asset Rating
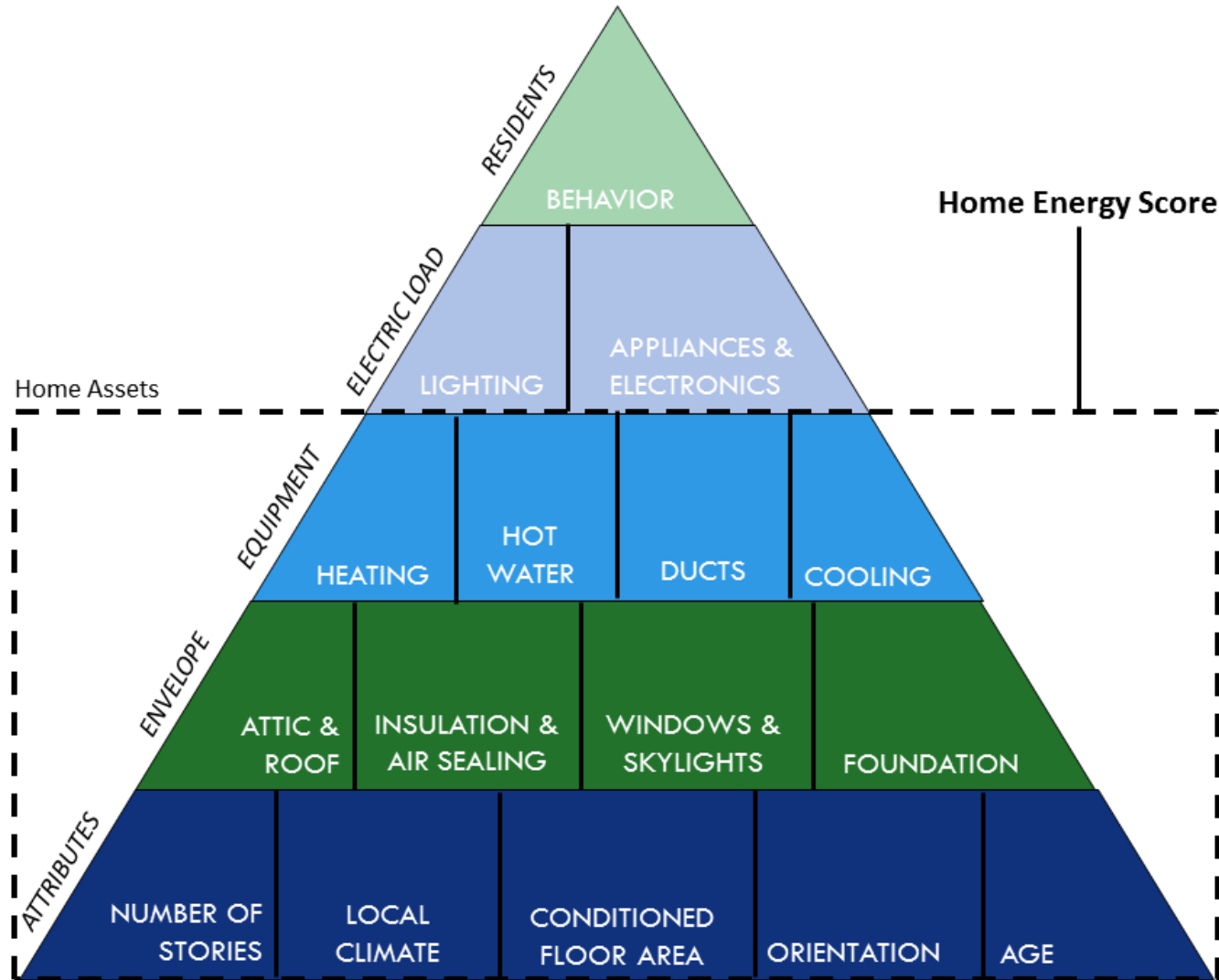
Methodology Highlights

- ~50 data points per house
- Energy per single-family home, not per square foot
- Standard & nationally applicable to existing homes

U.S. Home Energy Use (MBTUs)

Higher energy use   Lower energy use

50th percentile

15th percentile

90th percentile

Number of Homes

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

Homes that score a 1 are expected to use more energy each year than 85% of U.S. homes.*

Homes that score a 5 are expected to use more energy each year than 50% of U.S. homes.

Homes that score a 10 are expected to use less energy than 90% of U.S. homes.

*2009 U.S. Census data. Method normalizes for local weather conditions and standard operations assumptions.

Timeline of Progress

Scoring Tool & Scoring Program

- ✓ Scoring Tool Model
- ✓ Scoring Tool Gateway
- ✓ Simulation Training
- ✓ Admin Portal
- ✓ HPXML Translator
- ✓ API
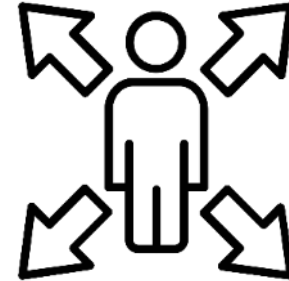
- ✓ Technical Assistance
- ✓ Communications
- ✓ Onboarding
- ✓ QA Verification
- ✓ Link with Financing
- ✓ Account Management

Engaging Stakeholders

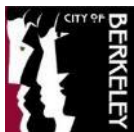# Milestones Accomplished To Date

- 550+ Assessors nationwide
  - Present in 31 states

- 35 active Partners

- 12 software tools use API

- System Infrastructure Established for:
  - Getting Assessors up and running anywhere in the country
  - Automating data review, transfer
  - Harmonizing data assumptions with other tools

Sample of 100,000+ Home Energy Scores Averages:

4.7
Score Today

7.3
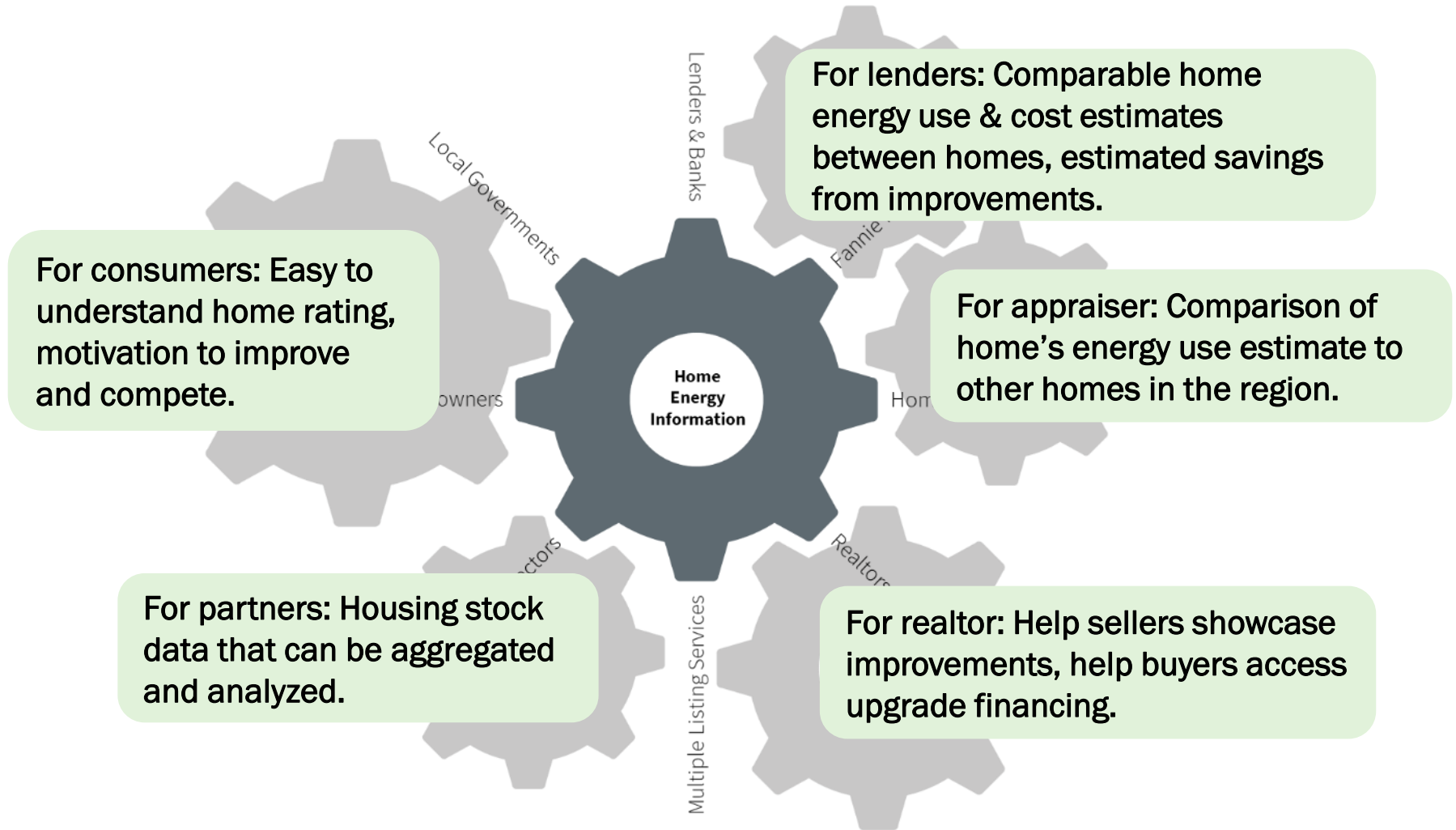Score with Improvements

Annual Savings Potential

22% **$600** **2.0**

Energy   Energy Bills TCO_2eq

Impact We're Working Toward

For lenders: Comparable home energy use & cost estimates between homes, estimated savings from improvements.

For consumers: Easy to understand home rating, motivation to improve and compete.

For appraiser: Comparison of home's energy use estimate to other homes in the region.

For partners: Housing stock data that can be aggregated and analyzed.

For realtor: Help sellers showcase improvements, help buyers access upgrade financing.

Home Energy Information

Lenders & Banks

Local Governments

Fannie
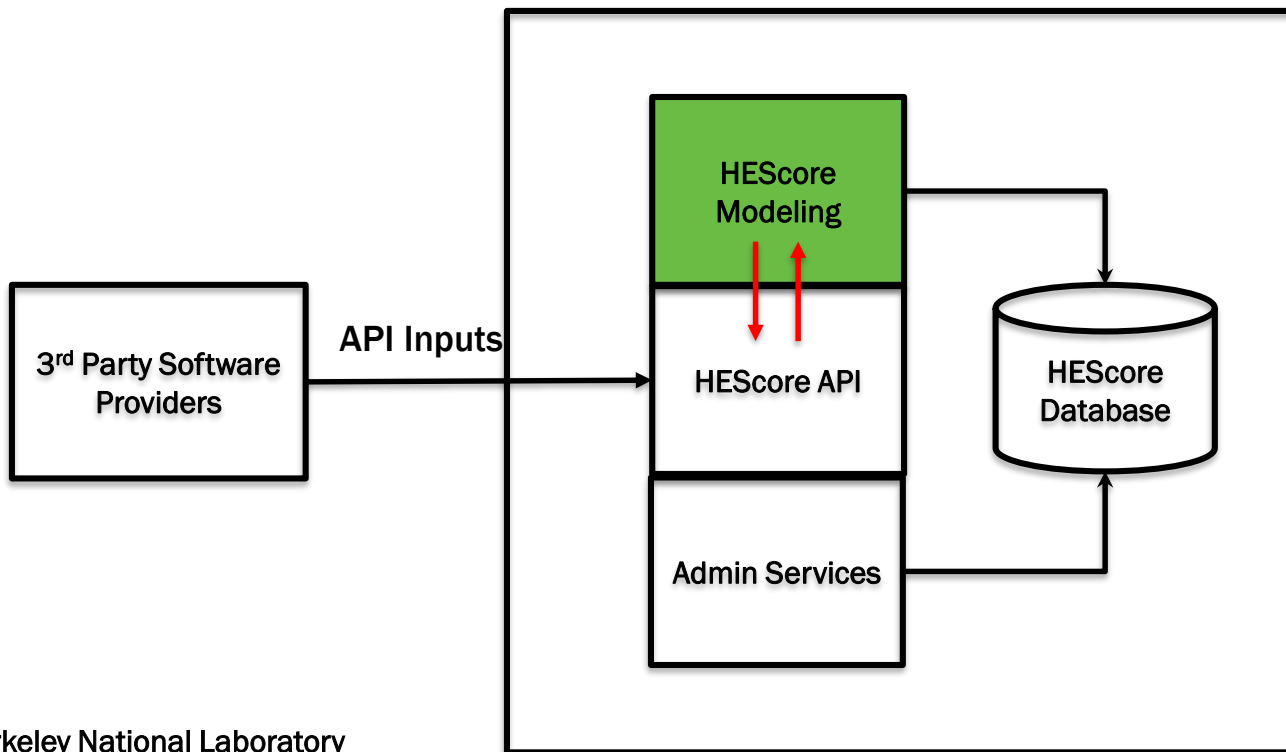
Owners

Hom

Multiple Listing Services

Realtors

ctors

Presentations from Implementers

- **Leo Rainer, Lawrence Berkeley National Laboratory**
  - Scoring Tool Enhancements

- **Dave Millard, Pacific Northwest National Laboratory**
  - Home Energy Score Gateway

- **Glenn Dickey, Allegheny Science & Technology**
  - Technical Assistance & Stakeholder Engagement
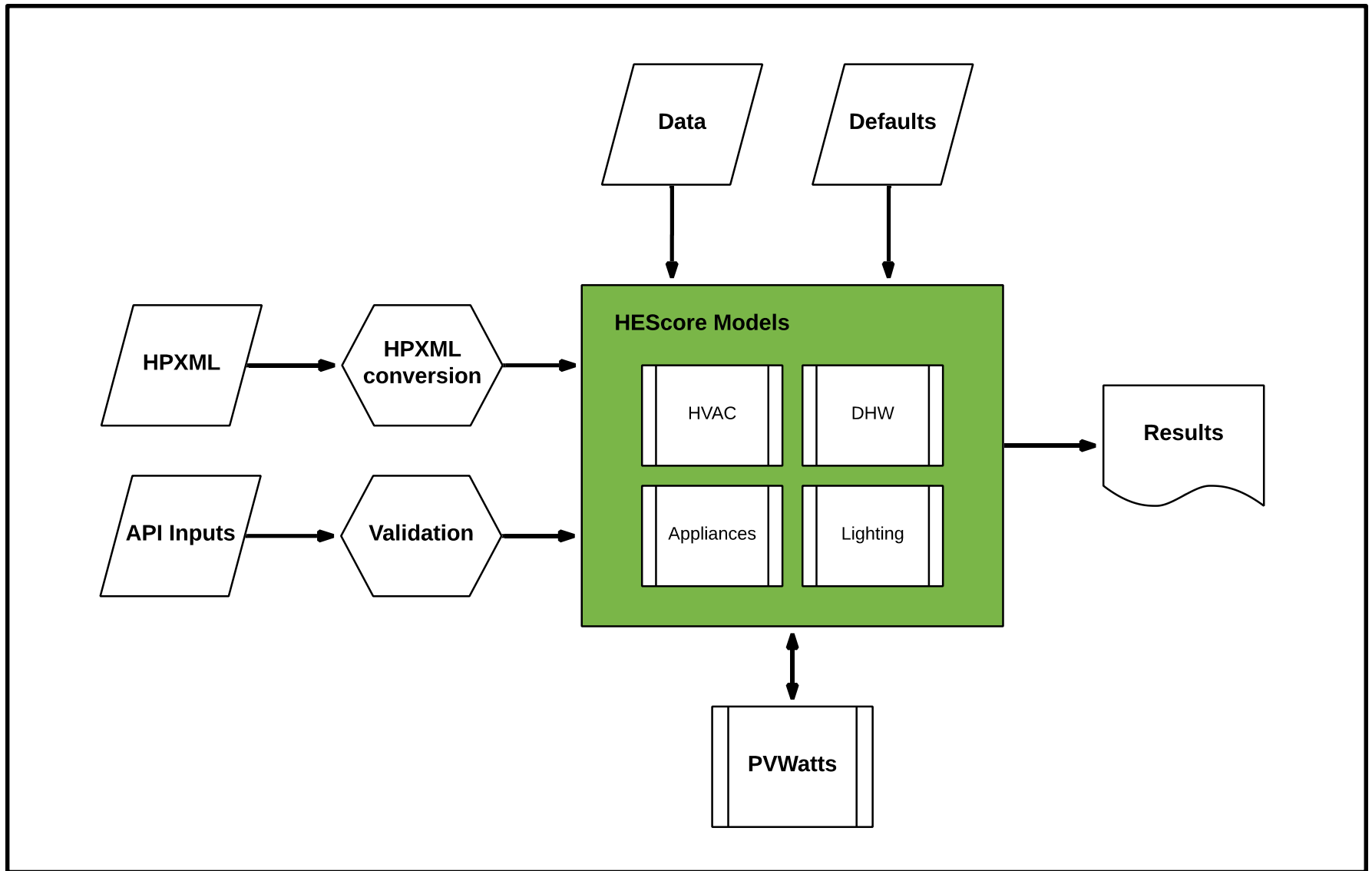
LBNL SUB SECTION

3rd Party Software Providers

API Inputs

HEScore Modeling

HEScore API

Admin Services

HEScore Database

Lawrence Berkeley National Laboratory

Leo Rainer

lirainer@lbl.gov

Energy Score Modeling

Energy Score Modeling Goals

- **Add capabilities**
  - New equipment
- **Harmonization**
  - RESNET / ERI 301 / Building America
- **Accuracy**
- **Performance**
  - Run times
  - System load
- **Ease of use**
  - Number of inputs
  - Assessor ability

Harmonize

Increase
Capabilities

HEScore Model

Increase
Accuracy

Improve
Performance
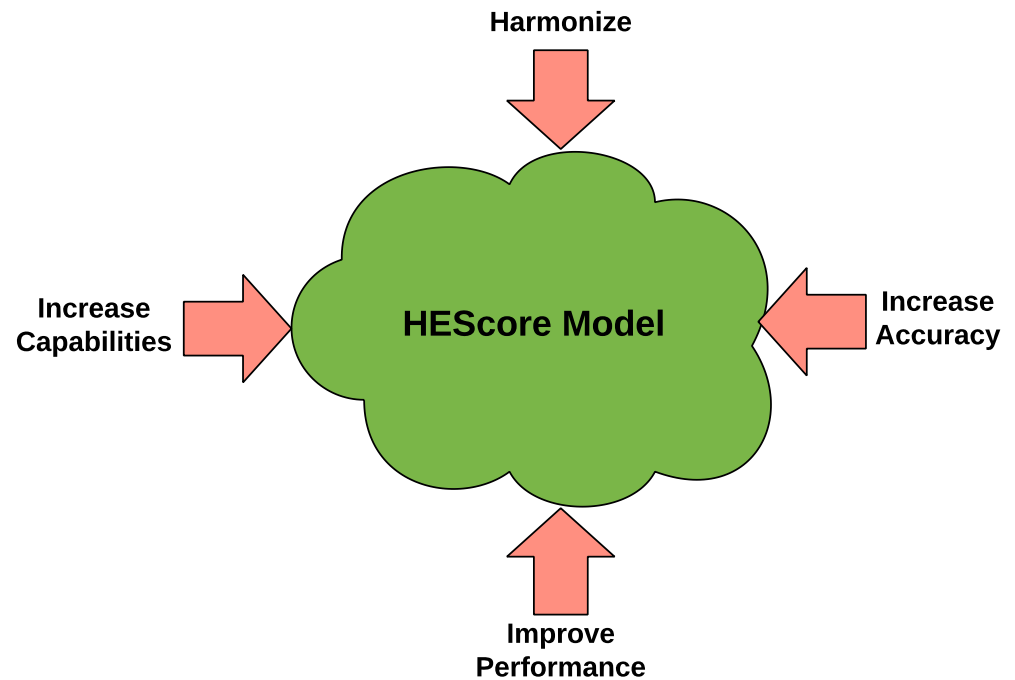
Input Validation Improvements

- **Duct locations**
  - Not allowed to be located in zones that are not modeled
- **Heat pumps**
  - Now allowed to only provide heating or cooling
- **Air sealing**
  - Can now specify duct condition and duct leakage together
- **Moving to a common validation class model**
  - PNNL GUI & API, LBNL API

Changes to Defaults and Input Additions

- Use different thermostat setting for zonal heating and cooling

- Add tankless (demand) water heater

- Add Uniform Energy Factor (UEF)

- Add solar screens

- Revise interior shading assumptions

Data Updates
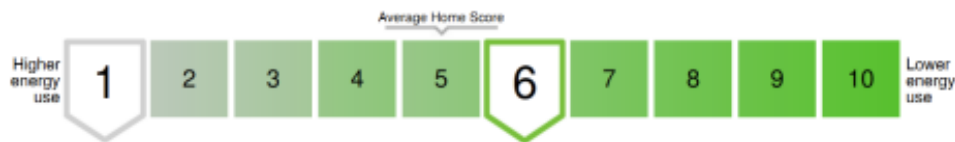
- **Scoring bins**
- **Fuel costs**
  - EIA State Energy Data System (SEDS) 2016
- **Upgrade costs**
  - NREL National Residential Efficiency Measures Database v3.1.0
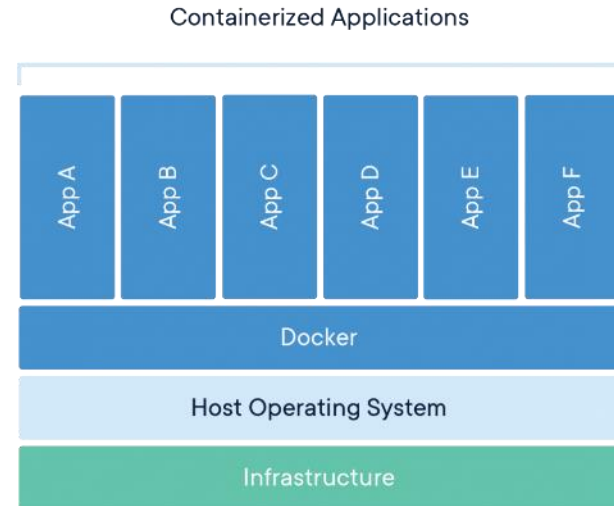- **Carbon factors**
  - eGRID 2016
- **PVWatts**
  - Version 6

System Updates

- **Move to Docker**
  - Local development
  - Efficient scaling
  - Continuous integration
  - Hosting flexibility

Containerized Applications

App A | App B | App C | App D | App E | App F

Docker

Host Operating System

Infrastructure

- **New code framework (Laravel)**
  - Fully supported by PHP community
  - Many other apps available
  - Easier to train new developers

laravel

Current and Future Work

- **Support PNNL**
- **Improve weather file selection**
- **Add low-e storm windows**
- **Open Studio / Energy Plus transition**
  - Working closely with NREL
  - Generate HPXML output file
  - Align defaults and modeling assumptions

PNNL SUB SECTION

Pacific Northwest National Laboratory
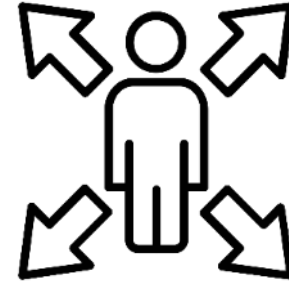
Dave Millard

Dave.Millard@pnnl.gov

Challenge: Align Services & Operational Needs
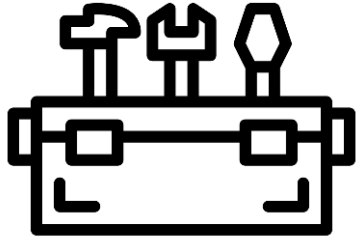
- ✓ Scoring Tool Gateway
- ✓ Simulation Training
- ✓ Administration Portal
- ✓ API

- ✓ Assessors
- ✓ Mentor / Mentees
- ✓ QA performers
- ✓ Training Providers
- ✓ QA providers
- ✓ Software Providers
- ✓ DOE Administrators
- ✓ Partners*

Home Energy Score: Administration Portal

Provides web-based services and processes for DOE to:

- Administer partners, assessors, training, mentoring, quality assurance, and software providers
- Report statistics and activities in support of DOE's Home Energy Score Better Buildings effort

Amazon Web Services
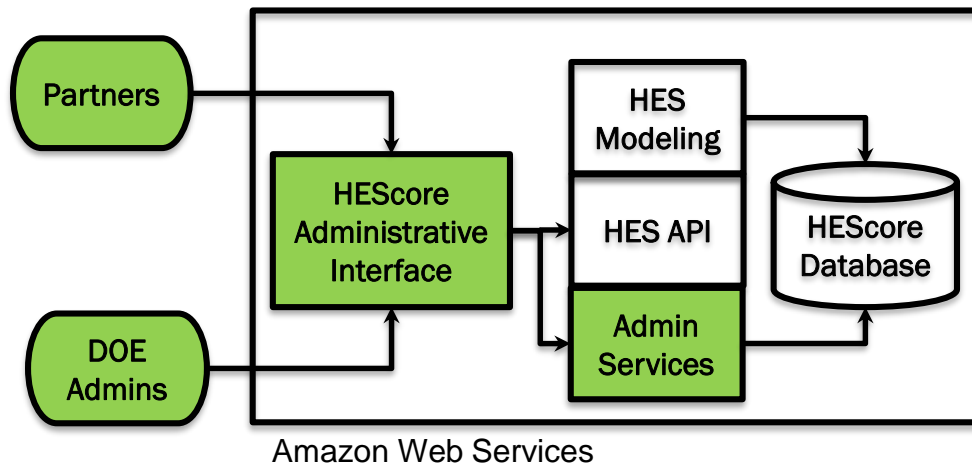
Home Energy Score Portal

Millard

Logout

Assessors

Score Homes
Edit Account
Edit Public Profile

Moderate

Partners
Assessors
QA Providers
Software Providers
API Keys
Unblock Users
All Users
Views

Partner

Test-May-10
Edit Partner Settings

QA Providers

- Add qa provider

Label
Earth Advantage QA
ASHI QA
Test-Opt
NJNG
CWL
PSEG
CCI
BPI
CEEF
CSE
CLRS-NP
EWEB
FOE
GCEA

Home Energy Score: Gateway
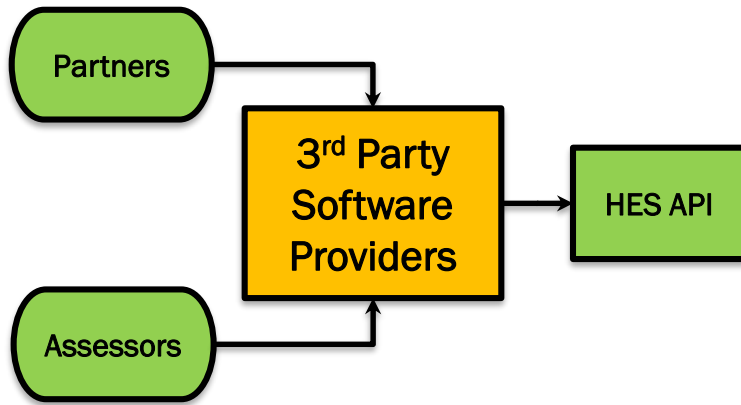
- Role-specific dashboards for Training, Mentors and Quality Assurance
- Role-based process flow to create, copy, and examine assessments

Amazon Web Services
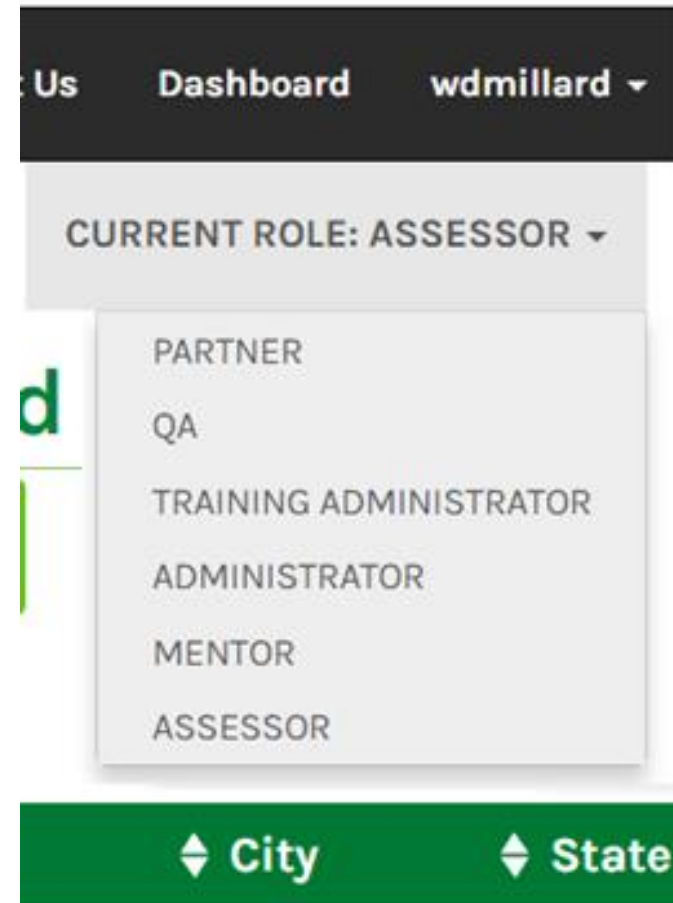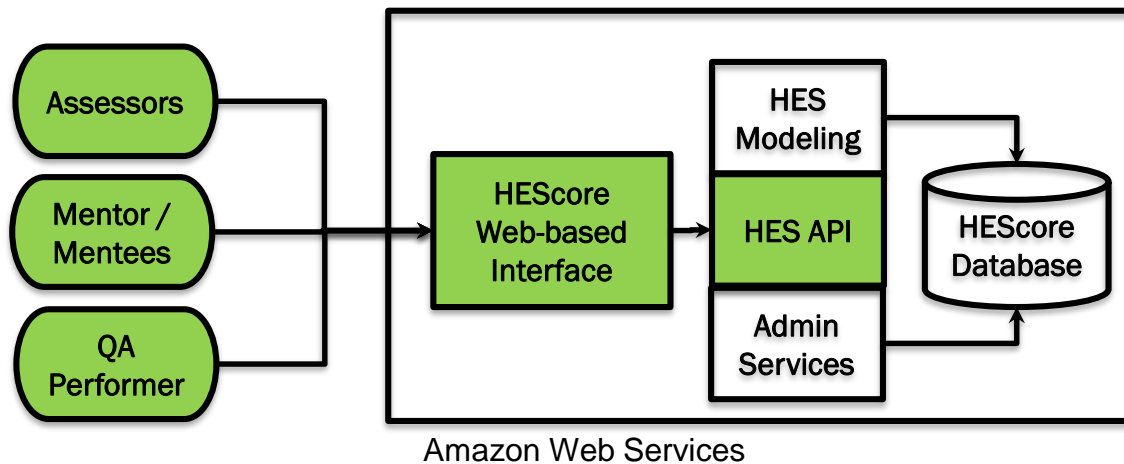
Home Energy Score: API

Provides a single, DOE-certified method for

- scoring homes
- Transitioning partner-specific assessments
- that can be applied by third-party, value-added providers

Progress: Increased ability, security, and validation

Do you know the actual cooling system efficiency?

◉ Yes ○ No

Efficiency Value

```
13
```

How many ducts does the system have?

○ 1 ○ 2 ◉ 3

Duct 1

Duct Location 1

| -Select- ▼ |

This is a mandatory duct field

Percentage of ducts in this location

```
30
```

Fraction values must add to 100%

Are the ducts insulated?

○ Yes ◉ No/Don't Know

Are the ducts sealed?

◉ Yes ○ No/Don't Know

Duct 2

Duct Location 2

| Unconditioned Basement ▼ |

Percentage of ducts in this location

```
0
```

Fraction values must add to 100%

Are the ducts insulated?

◉ Yes ○ No/Don't Know

Are the ducts sealed?

○ Yes ◉ No/Don't Know

Duct 3

Duct Location 3

| Conditioned space ▼ |

Percentage of ducts in this location

```
0
```

Fraction values must add to 100%

Are the ducts insulated?

◉ Yes ○ No/Don't Know

Are the ducts sealed?

◉ Yes ○ No/Don't Know

Progress: Role-based dashboards & Comparison Labels

Progress: Streamlining the assessor training admin

Home Energy Score Portal

Assessors » Assessor Review

Assessor Review

Millard

Logout

Assessors

Score Homes
Edit Account
Edit Public Profile

Moderate

Partners
Assessors
QA Providers
Software Providers
API Keys
Unblock Users
All Users
Views

Partner

Test-May-10
Edit Partner Settings

Resources

Getting Started Packet

| Assessors | Candidate | *Trainee* | Mentee | Lapsed |

Passed Training

Operations

(Trainee assessor passes evaluation)

☐	Name ⌄	Assessor ID	Partner	Initial Training Access Date	Retraining access date
☑	Verify Dokes	WA-OKD-0009	Test-May-10	2019-03-15	

Failed Training

Operations

(Trainee assessor fails evaluation)

No Results

In Progress

				15
☐	test-candidate-assessor-c6828af7-3f8d-4fcf-94e8-	test-candidate-assessor-c6828af7-3f8d-4fcf-94e8-	partner-test-dc38d8ef-4df5-4e0a-96e9-	2018-01-

Progress: Mentee / Mentor dashboards

Remaining Project Work

- Harmonization of HERS / HEScore modeling environment (OS/E+)
- End-to-end integration of new residential modeling tools
  - Transition HEScore GUI to apply refactored API
  - Integration with SEED
- Adding process flow features to the HEScore API
- Provide HPwES related roles, dashboard, and process flow
- Expand features to support QA administration and reporting
- Replace end-of-life administration database management system
- Decrease modeling response time

Contracted Support for Home Energy Score:

Technical Assistance, Stakeholder Engagement, and Industry Partnerships

Allegheny Science & Technology | Glenn Dickey | Gdickey@alleghenyst.com

Approach

- **Use tools from PNNL, LBNL & Interplay to implement the Home Energy Score program**

- **Create user documentation, perform software testing, define software enhancements**

- **Work with 3rd party software providers to connect to the Home Energy Score calculator through API/web services**

  - Communicate with the API users about changes/upgrades

- **Technical assistance for Home Energy Score stakeholders**

  - Ongoing account management and technical assistance

  - Software tools facilitate user self-service
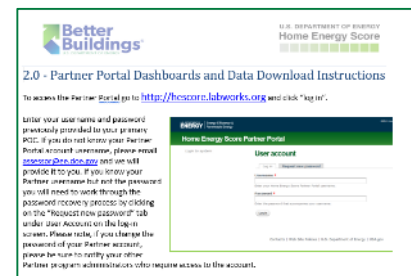
Approach

- **Data quality assurance to assure Score consistency and relevance**
  - Provide Partners and Assessors feedback about troublesome Scores

- **Help Partners address data entry issues, explain confusing Score reports**

- **Program metrics and ad hoc data analysis**
  - Conduct testing to extend Home Energy Score use
  - Provide program metrics

- **Provide direct account management and technical assistance to partners and their assessors**

Stakeholder Engagement

- *This project is considered late stage*

- Support integration of Home Energy Score into relevant mortgage products, home appraisal, and loan officer processes

- Participate in regional and national residential conferences to engage potential Home Energy Score Partners

- Provide technical assistance to state and local governments considering, designing, or implementing Home Energy Score programs or policies

Stakeholder Engagement

- **Implemented Remote Mentoring and QA to expand the assessor base and make rural areas accessible**
  - Three Remote Service providers on-board
- **Outreach to state/local organizations e.g., NASEO, Urban Sustainability Directors Network, National League of Cities**
- **Outreach to and training for home inspectors**
  - ASHI Newsletter support
  - Direct contact with large multi-inspector firms
  - Technical assistance for home inspector trainings

Progress

- ✓ **550+ Home Energy Score assessors**
- ✓ **~115,000 Home Energy Scores**
- ✓ **This year:**
  - Five new Home Energy Score Partners, a sixth in the works
  - Two new API users, a third in the works

- ✓ **2 staff process more than 3,100 assessor/partner support requests a year through the DOE portal**
  - Score explanations
  - Software queries
  - Assessor handling outside normal process flow
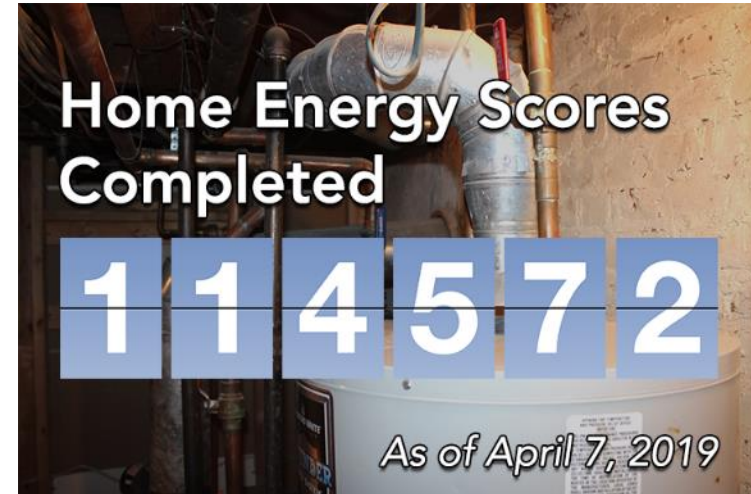
Progress

✓ Local and state governments are beginning to use the Home Energy Score to facilitate ordinances/programs
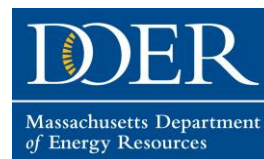
✓ Working with the US Navy to incorporate Home Energy Score as a possible solution to the Navy's Residential Energy Conservation Program (RECP) billing challenges

✓ Working on financing integration pilots seamlessly including Home Energy Score with banks, mortgage underwriters

Cross-Program Interactivity

- **Incorporate Home Performance with ENERGY STAR data fields into Home Energy Score to streamline programs**
  - ✓ More comprehensive data collection
  - ✓ Less Sponsor reporting
  - ✓ Potentially lower cost installation QA
- **Add new technologies into Home Energy Scoring Tool based on latest DOE research, i.e., low-e storm windows**
- **Provide project support to SEP Competitive projects related to home energy labeling, e.g., EMPRESS and HELIX**
- **Incorporate Universal Building IDs into Home Energy Score, which were developed through Asset Score & CBI research**

Energy Metrics to Promote Residential Energy Scorecards in States (EMPRESS)

A Guide for State and Local Governments Learn how to establish a home energy labeling program in your jurisdiction

EnergyPlus Migration / Harmonization

Home Energy Score™ 3rd Party Software Providers

SnuggPro · ID Energy · Design Avenue · Franklin Energy · AjO · OptiMiser · Pearl · Energy Savvy

HPXML · API · Output

Home Energy Score™ Scoring Tool

HERS® Software Providers

Ekotrope · PSD · Wrightsoft · Pivotal

Weatherization Assistance Program's NEAT Tool

HPXML · API · Output

ANSI/RESNET 301 Energy Rating Index Ruleset / Agreed Upon Rulesets (As Applicable)

HPXML

OpenStudio/EnergyPlus Building Energy Model Simulations

Scoring Tool & Scoring Program

Move toward "Maintenance Mode"
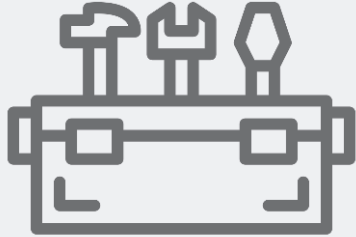
- ✓ Scoring Tool Model
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Reduce need & minimize government support

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- ✓ Onboarding
- ✓ QA Verification
- ✓ Link with Financing
- ✓ Account Management

Questions Moving Forward
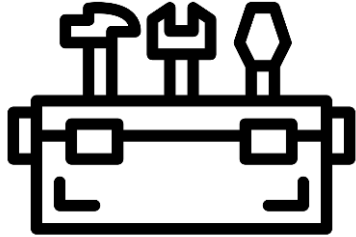
How do we make the tools more accurate, more streamlined, and less burdensome?
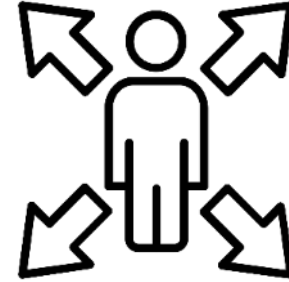
How do we increase efficiency and automation of program management processes?

What things need to stay under DOE purview? What things could be managed effectively in the market?

Who do we need to engage in these efforts to ensure programmatic sustainability?

Question & Answer Period

Thank You

U.S. Department of Energy

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Pacific Northwest National Laboratory

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Allegheny Science & Technology

Glenn Dickey– Project Manager

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REFERENCE SLIDES

Project Budget - LBNL

Cost to Date: $4.3M
Additional Funding: Not applicable.

Budget History					
2010 – FY 2018 (past)		FY 2019 (current)		FY 2020 – 2021 (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
$4.1M	N/A	$150K	N/A	$300K	N/A

Project Budget - PNNL

Project Budget: $2.8M received since FY15
Cost to Date: $2.55M through 3/2019
Additional Funding: Not applicable.

Budget History					
FY 2015– FY 2018 (past)		FY 2019 (current)		FY 2020 – TBD (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
$2.35M		$.45M		TBD	$0

Project Budget - AST

Budget History					
FY 2018 (past)		**FY 2019 (current)**		**FY 2020 (planned)**	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
$416,727	N/A	$427,210	N/A	TBD	N/A

Project Plan and Schedule - AST

Project Plan
- Start date 2010; ongoing
- Continue to on-ramp Partners and Assessors
- Support state and local governments while assessing Home Energy Score effectiveness
- Engage additional stakeholders

Project Schedule												
Project Start: 2010	🟦 Completed Work											
Projected End: Ongoing	⬛ Active Task (in progress work)											
	🔴 Milestone/Deliverable (Originally Planned)											
	◆ Milestone/Deliverable (Actual)											
	FY2018				FY2019				FY2020			
Task	Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)	Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)	Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)
Past Work												
100,000 Home Energy Scores				◆								
500+ Home Energy Score Assessors				◆								
30+ Home Energy Score Partners				◆								
Current/Future Work												
175,000 Home Energy Scores								◆				
600+ Home Energy Score Assessors								◆				
35+ Home Energy Score Partners								◆				
175,000 Home Energy Scores												◆
700+ Home Energy Score Assessors												◆
40+ Home Energy Score Partners												◆