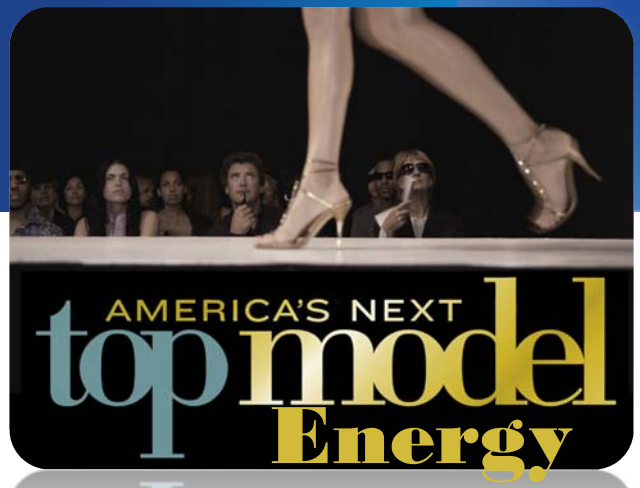
Better Buildings Residential Network Peer Exchange Call Series: *America's Next Top Energy Model: Tools and Best Practices (101)*

December 1, 2016

Call Slides and Discussion Summary

Agenda



- Agenda Review and Ground Rules
- Opening Polls
- Brief Residential Network Overview
- Featured Speakers
  - **Nora Wang,** Pacific Northwest National Laboratory
  - **Jennifer Thorne Amann,** American Council for an Energy-Efficient Economy (ACEEE) *(Network Member)*
  - **Ryan Moore,** OptiMiser
- Discussion
  - In what ways has your organization incorporated energy modeling tools and practices into your program offerings?
  - What are the benefits of energy modelling tools and practices?
  - What challenges have you encountered in identifying and incorporating new energy modeling tools and practices?
  - Other questions/topics related to modeling?
- Closing Poll and Upcoming Call Schedule

Better Buildings Residential Network

Better Buildings Residential Network: Connects energy efficiency programs and partners to share best practices and learn from one another to increase the number of homes that are energy efficient.

Membership: Open to organizations committed to accelerating the pace of home energy upgrades.

Benefits:

- Peer Exchange Calls 4x/month
- Tools, templates, & resources
- Recognition in media, materials
- Speaking opportunities
- Updates on latest trends
- Voluntary member initiatives
- Residential Program Solution Center guided tours

Commitment: Provide DOE with annual number of residential upgrades, and information about associated benefits.

For more information or to join, email bbresidentialnetwork@ee.doe.gov, *or go to* energy.gov/eere/bbrn *and click Join*

Peer Exchange Call Series

We hold one Peer Exchange call the first four Thursdays of each month from 1:00-2:30 pm ET

Calls cover a range of topics, including financing & revenue, data & evaluation, business partners, multifamily housing, and marketing & outreach for all stages of program development and implementation

Upcoming calls:

- December 8: Oh, the Weather Outside is Frightful: Weatherizing Manufactured Homes (301)
- December 15: Hibernation Mode: What Smart Thermostats Can Do for You (301)
- December 22 and 29: No calls – Winter break

We will resume our normal call schedule on Thursday, January 12!

Send call topic ideas to peerexchange@rossstrategic.com

See the Better Buildings Residential Network Program website to register

Best Practices:
Pacific Northwest National Laboratory

U.S. DEPARTMENT OF ENERGY

Pacific Northwest
NATIONAL LABORATORY
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Asset Score for Multifamily Buildings

Better Buildings Webinar
America's Next Top Energy Model: Tools and Best Practices (101)
1:00-2:30 ET / Dec 01, 2016

NORA WANG

Pacific Northwest National Laboratory

What is Asset Score?

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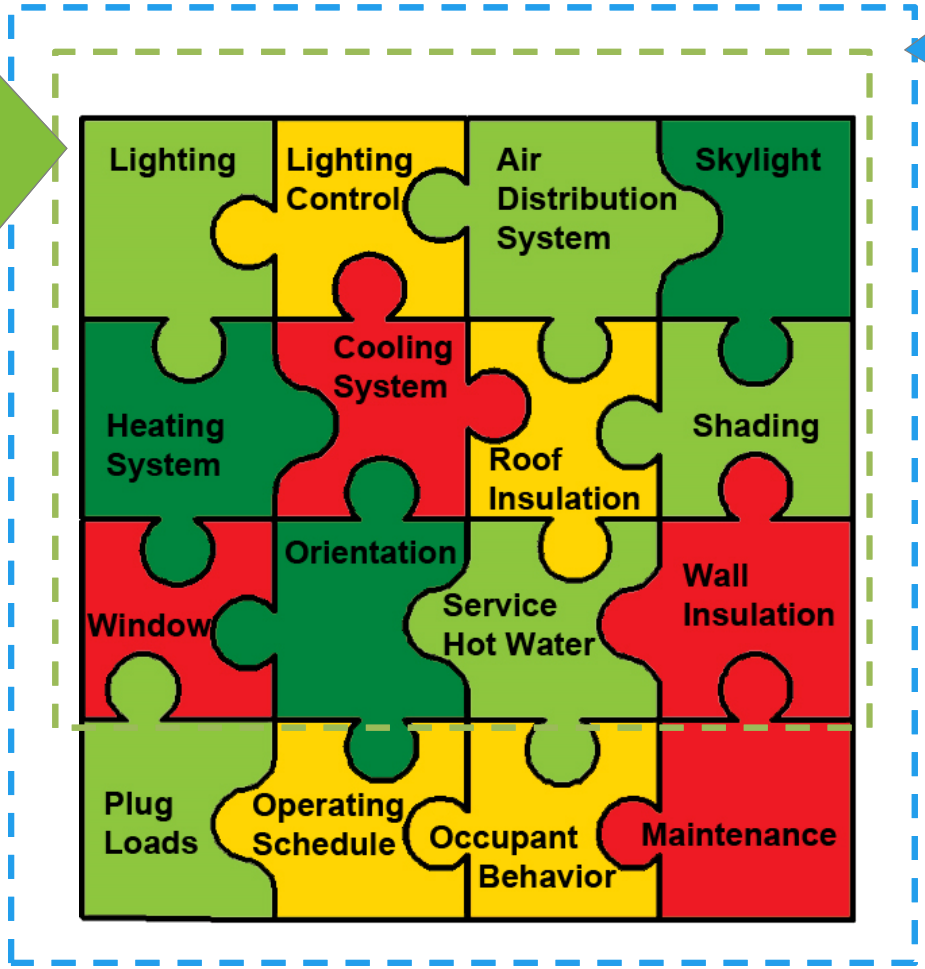
Asset Score evaluates the as-built physical characteristics (envelope, HVAC, lighting, service hot water) of a building and its overall energy efficiency, independent of occupancy and operational choices.



ENERGY STAR benchmarks the overall building performance against peers.

How it Works

Asset Score runs an *energy simulation* using a powerful building energy modeling engine (EnergyPlus through OpenStudio)

- The simulation normalizes for building operations, occupancy and tenant behavior
- Users (owner, operator, service, provider, etc.) enter building information through an web interface
  - General information: # of floors, footprint dimension, orientation, use type
  - Envelope components: Roof, exterior wall, floor types, insulation levels
  - Fenestration: Skylights, windows, shading
  - Lighting: Fixture types, # of fixtures or % of served floor area, lighting controls
  - Mechanical components: Cooling/heating types, controls, equipment efficiency
  - Service water heating: Fuel type, distribution type, equipment efficiency

Asset Score Tool

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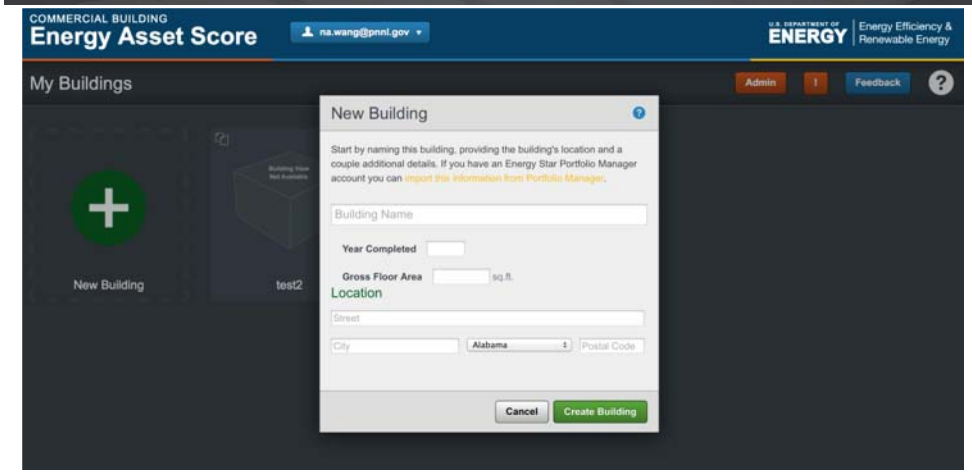
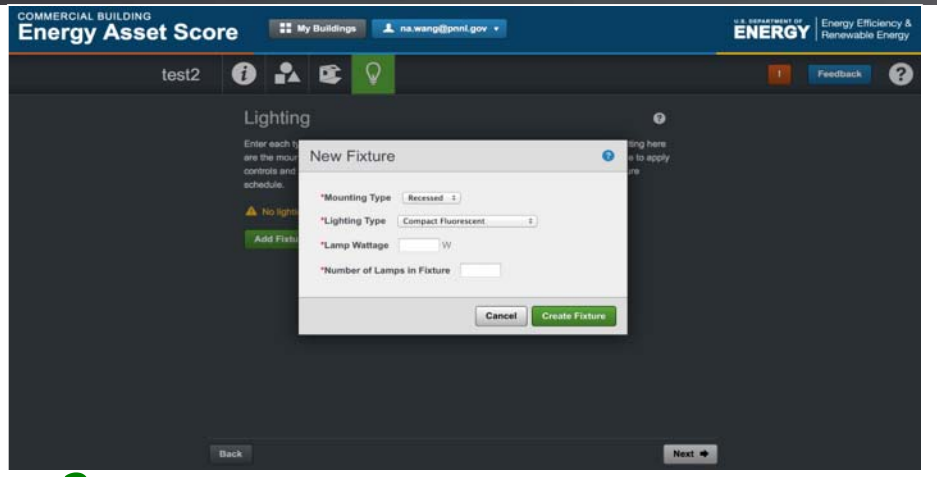
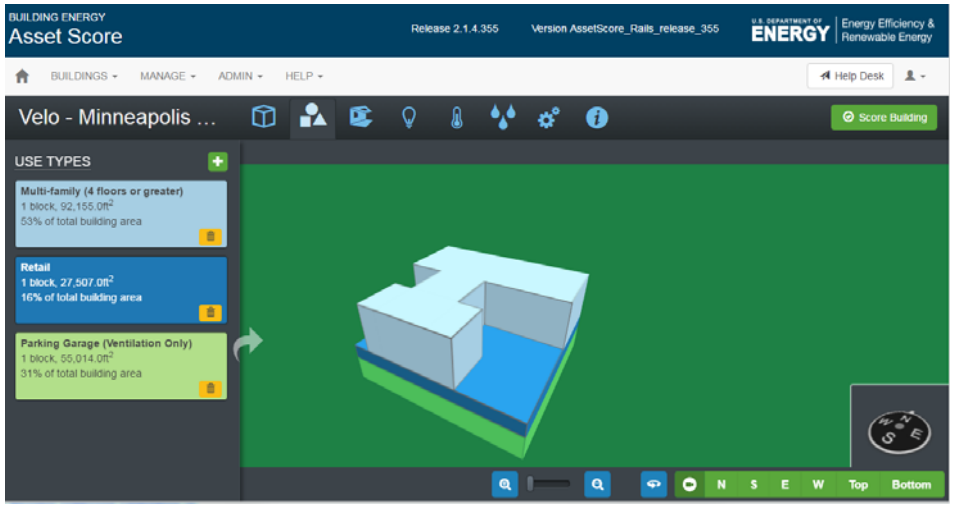


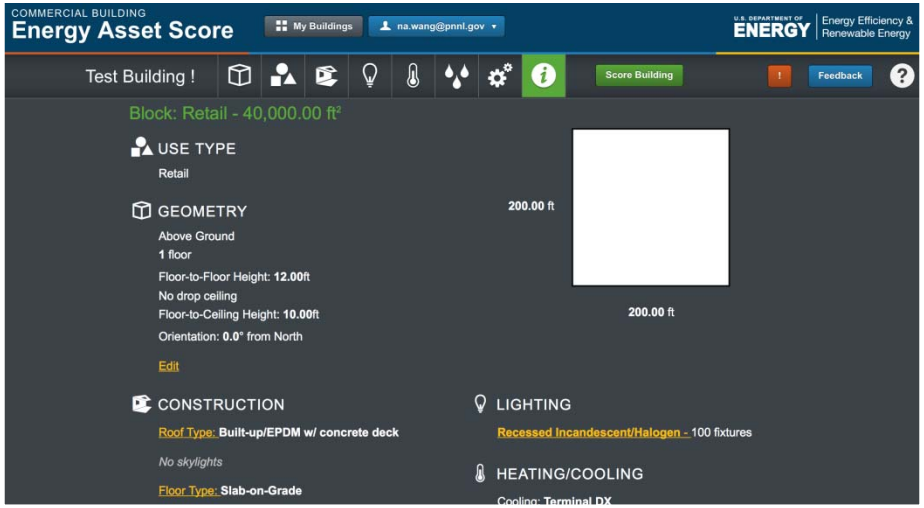
1. Create a new building and enter basic building information



2. Identify building use type(s) and create an inventory of your building features (HVAC, windows, etc.)



3. Create 3-D block(s) of your building and apply use type(s) and features to your building block(s)



4. Score your building and receive your Asset Score Report

Asset Score Report

The Asset Score generates a report with the following information:

- 10-point score based on the EE of the building envelope and the mechanical, electrical, and service hot water systems
- EE assessment of the building's individual systems
- Total estimated building energy usage and energy use by end use under standard operating conditions
- Opportunities to upgrade building efficiency, and a "potential" energy efficiency score based on identified upgrades

Asset Score Report

Pacific Northwest NATIONAL LABORATORY

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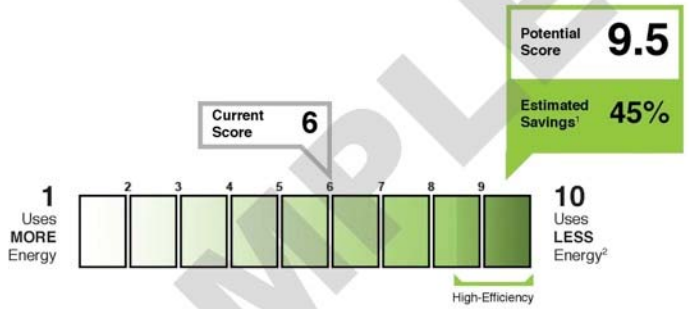
BUILDING ENERGY
ASSET SCORE
OVERALL BUILDING SCORE
1

BUILDING INFORMATION

Example Building - Single Use
2000 A Street
Chicago, IL 60601

Building Type: **Office**
Gross Floor Area: **100,000 ft²**
Year Built: **2005**

Score Date: **09/22/2015**
Building ID #: **XXXXX**



Building Use Types	Estimated Source Energy Use (kBtu/ft²)		Energy Use Intensity by Fuel Type
Office: 100,000 ft²	Current Building	143	Site Energy Use (kBtu/ft²)
This report includes a Score for the entire building as well as individual Scores for each of the separate use types.	Upgraded Building	79	Source Energy Use (kBtu/ft²)

Fuel Type [Site EUI , Source EUI]
Gas [8.1, 8.5]
Electricity [42.8, 134.5]
District Heating [0.0, 0.0]
District Cooling [0.0, 0.0]

The **Building Energy Asset Score** is a national rating system developed by the U.S. Department of Energy. The **Score** reflects the energy efficiency of a building based on the building's structure, heating, cooling, ventilation, and hot water systems. The building's **Structure and Systems** are individually evaluated and ranked. The **Upgrade Opportunities** page provides recommendations for how to improve the building's energy efficiency, increase the building's Asset Score, and save money.

¹ Savings reflect the reduction in source energy that would result from undertaking all of the efficiency improvements identified on the **Opportunities** page. Actual savings will depend on a variety of factors including actual operating conditions.

² A score of 10 represents lowest expected energy usage using current energy efficiency technologies. A score of 8.5 represents a high-efficiency building that uses approximately 30% less energy than a building built to the AHSRAE 90.1-2004 energy code.

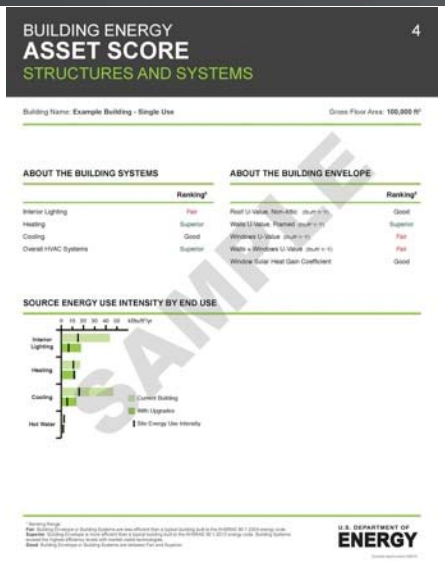
This report is based on self-reported building information. http://energy.gov/eere/buildings/building-energy-asset-score

U.S. DEPARTMENT OF ENERGY

Example report version 9/30/15

Four sections

- Score
- Upgrade Opportunities
- Structure and Systems
- Building Assets



Asset Score Preview

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Asset Score Input Mode

PREVIEW

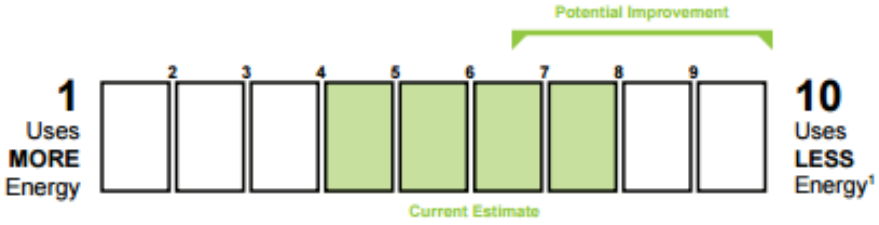
Select this mode to obtain an estimated score range and an Asset Score report preview based on a limited amount of inputs.
Learn More

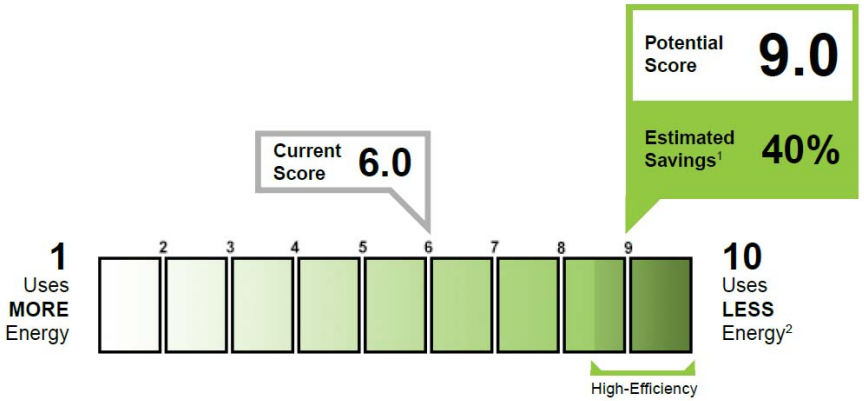
Preview

Full Report

Select this mode to obtain a full Asset Score report with current and potential scores, total energy use values, building upgrade opportunities, and system evaluations.
Learn More

Asset Score





Asset Score Preview

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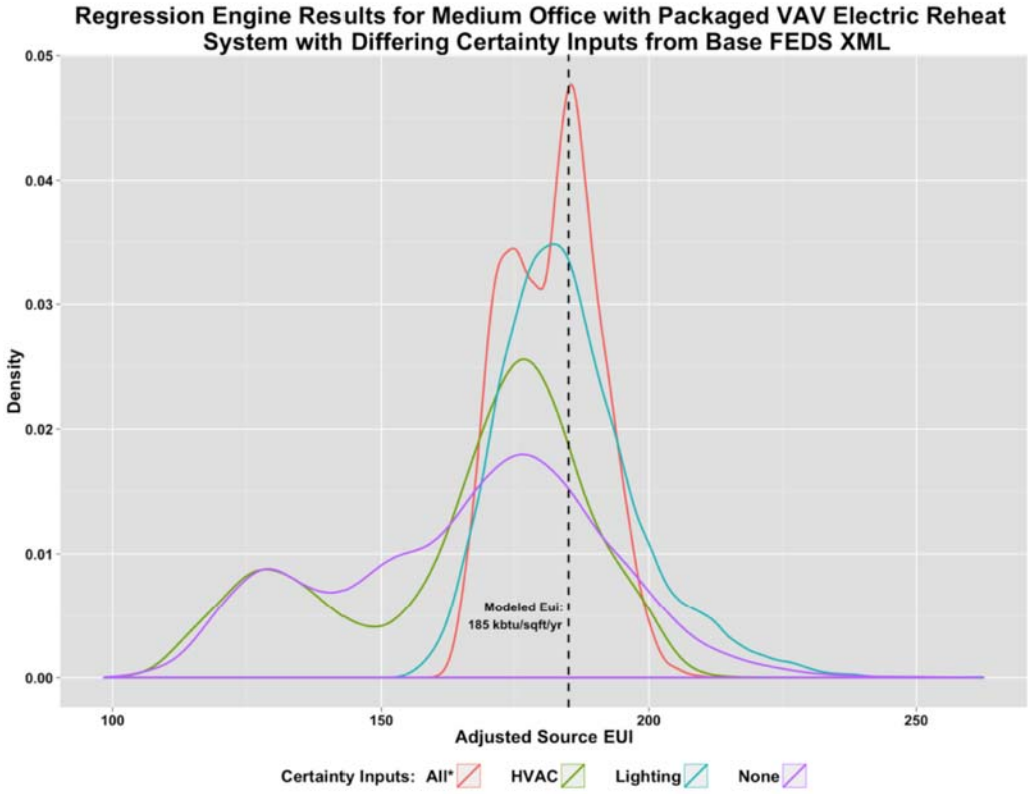
- Provides a quick assessment of a building, based on a minimum of 7 inputs
- Uses a pre-simulated database and regression analysis
- Providing additional inputs improves accuracy of results



Asset Score Preview: Workflow

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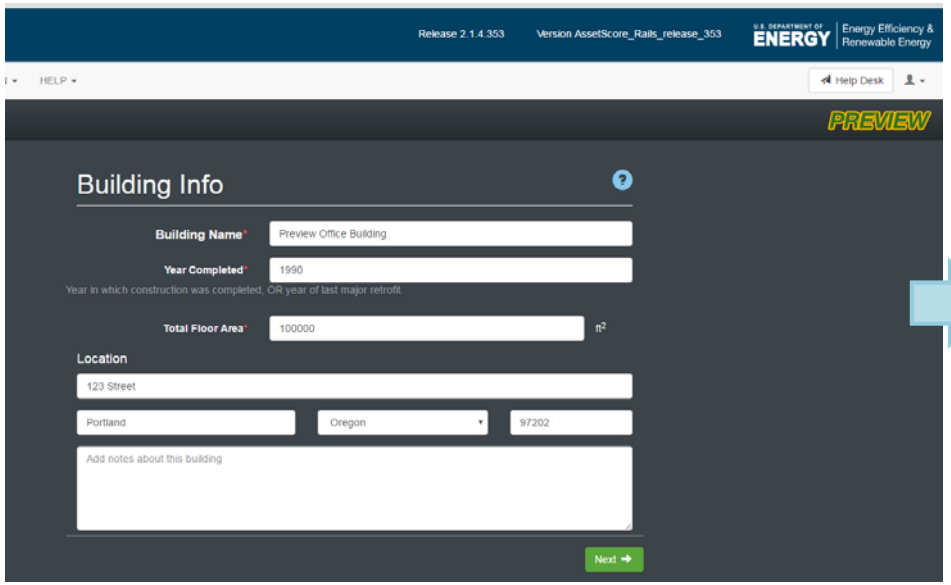
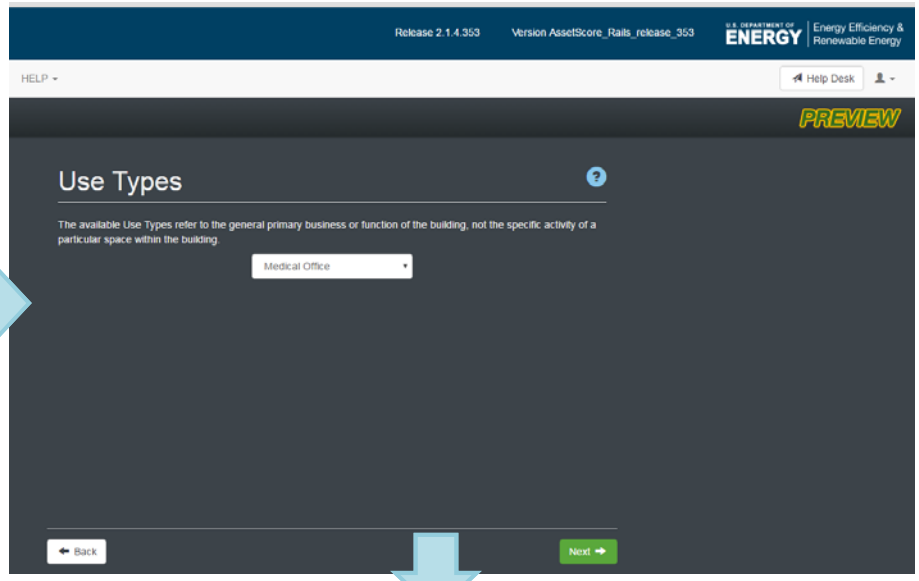
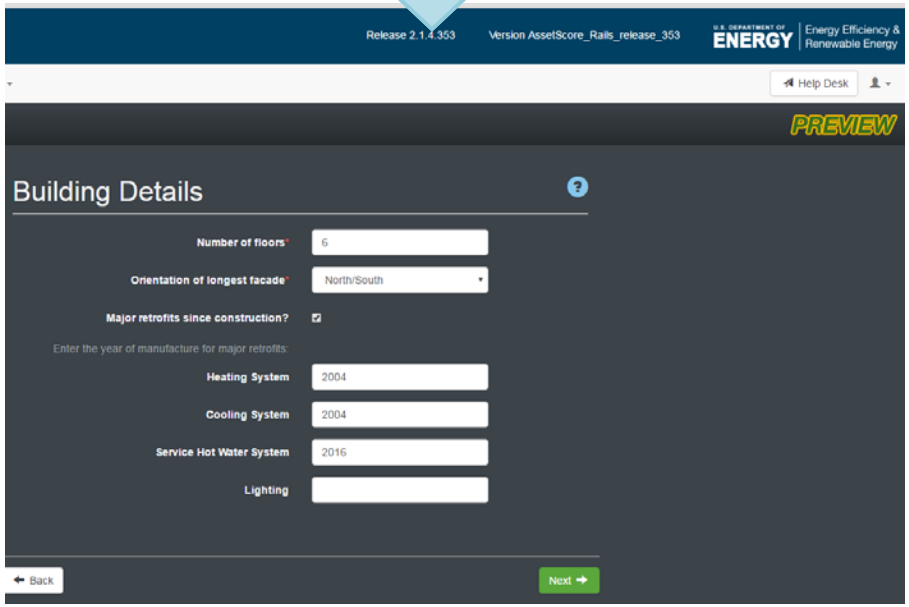




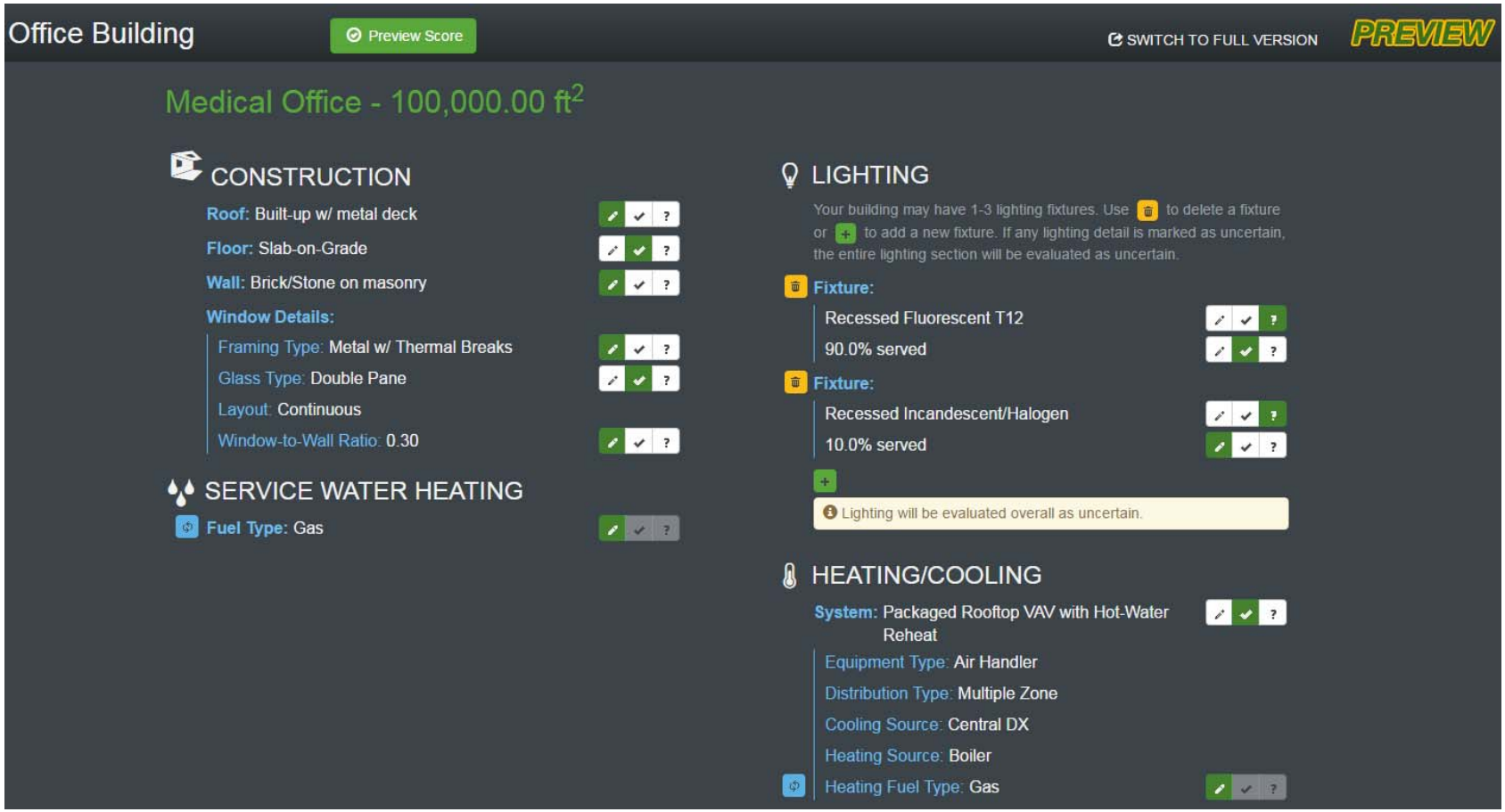


Preview requires high level building inputs:

1. Building name
2. Location
3. Year of construction
4. Conditioned floor area
5. Predominant use type
6. Number of floors
7. Building orientation

Asset Score Preview: Workflow

- Defaults can be edited, verified, or marked as unknown. User verification will affect the uncertainty model.
- Preview building can be converted to a Full building.



As of August 2016…

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952 Buildings scored

124M Square feet

44 States

1413 Registered users

Buildings in Asset Score Tool

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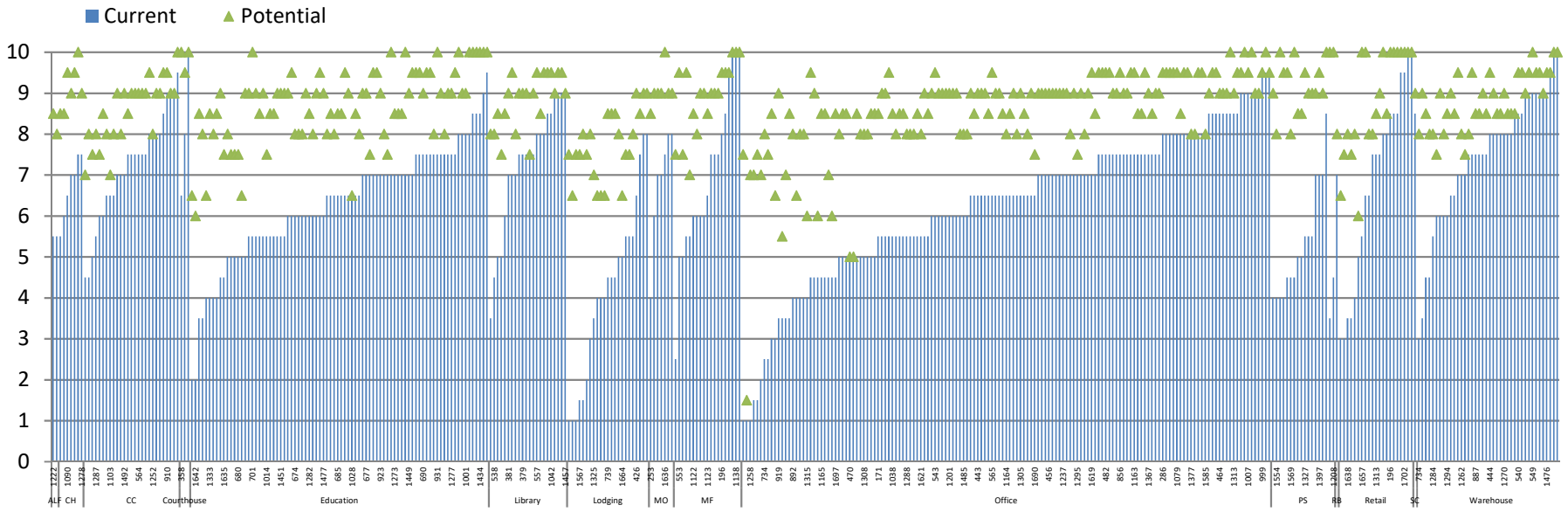
Average energy savings identified range from 20-40%



ALF : Assisted Living Facility
CH : City Hall
CC : Community Center
MO : Medical office
MF : Multifamily
PS : Police Station
PO : Post office
SC : Senior Center

Example of Multifamily Building Model

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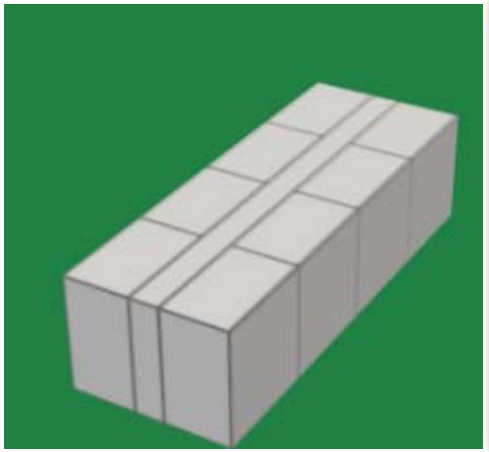
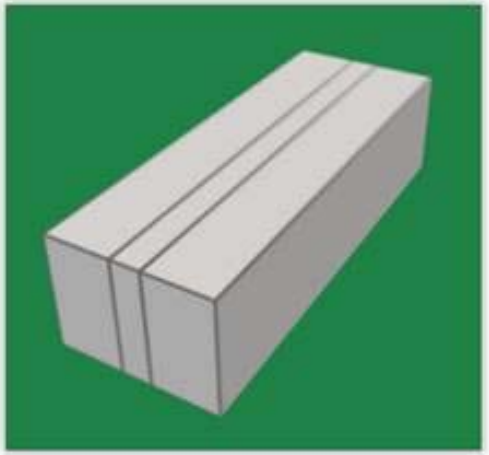




Building Name: **MidRise Apartment Example**

Gross Floor Area: **34,048 ft²**

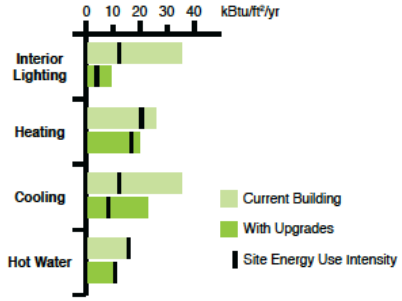
ABOUT THE BUILDING SYSTEMS

	Ranking[5]
Interior Lighting	Fair
Heating	Superior
Cooling	Good
Overall HVAC Systems	Superior

ABOUT THE BUILDING ENVELOPE

	Ranking[5]
Roof U-Value, Non-Attic (Btu/ft² h °F)	Fair
Walls U-Value, Framed (Btu/ft² h °F)	Good
Windows U-Value (Btu/ft² h °F)	Good
Walls + Windows U-Value (Btu/ft² h °F)	Good
Window Solar Heat Gain Coefficient	Good

SOURCE ENERGY USE INTENSITY BY END USE

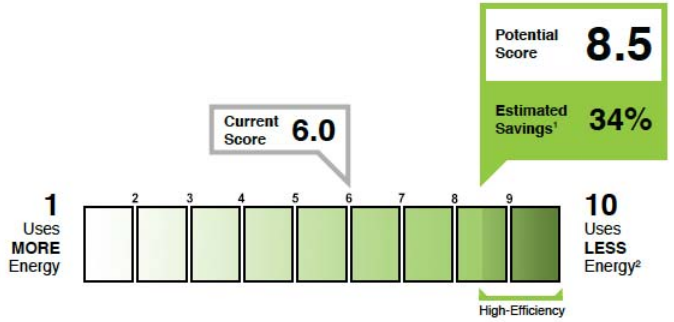


BUILDING ENERGY
ASSET SCORE
OVERALL BUILDING SCORE

1

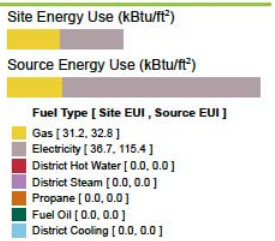
BUILDING INFORMATION

MidRise Apartment Example	Building Type:	**Multi-family (4 floors or greater)**	Score Date:	**11/18/2016**
ABC street Baltimore, MD 21201	Gross Floor Area: Year Built:	**84,360 ft²** **1996**	Building ID #: Software Release:	**4943** 2.2.0.378



Standard Occupancy and Operating Conditions		Estimated Source Energy Use (kBtu/ft²)	
Number of Assumed Occupants	89	Current Building	148
Hours of Operation	115.0 hrs/wk	Upgraded Building	98
Cooling Set Point	75° F		
Heating Set Point	70° F		
Misc. Energy Loads	0.62 W/ft²		

Energy Use Intensity by Fuel Type



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This report is based on self-reported building information. http://energy.gov/eere/buildings/building-energy-asset-score

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Thank You

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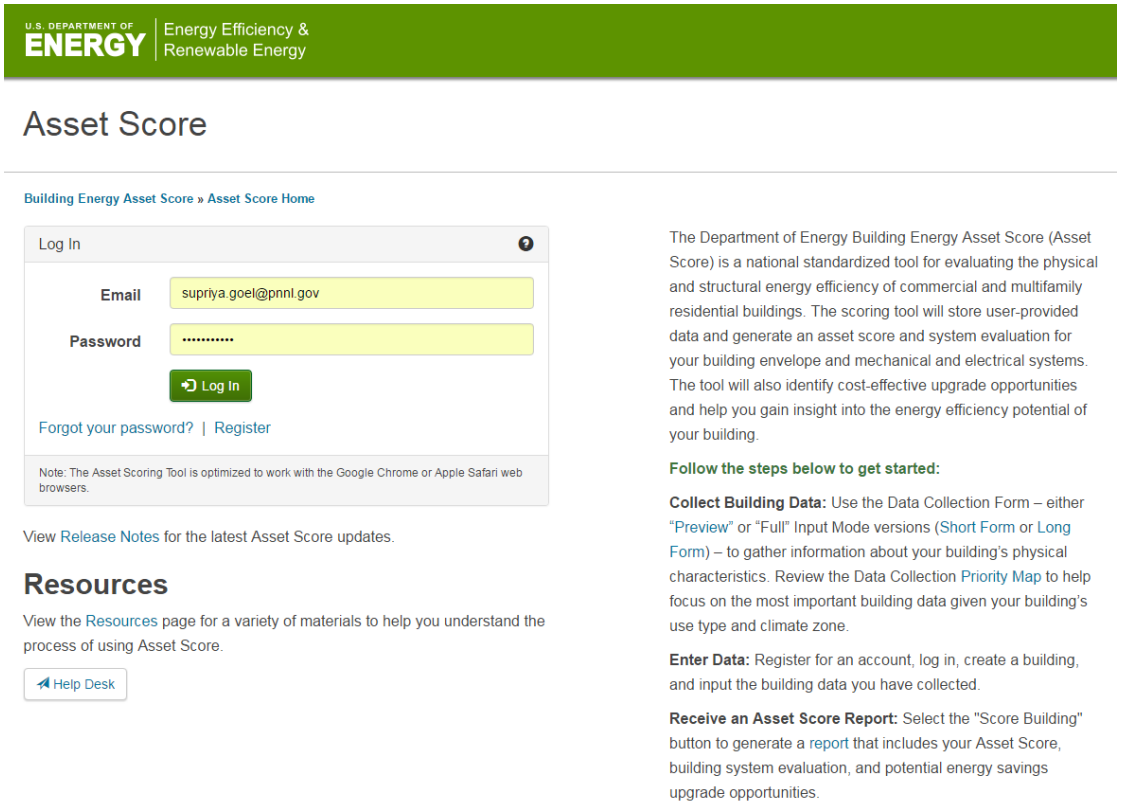
- Asset Score Website
  http://www1.eere.energy.gov/buildings/commercial/assetscore.html
- Asset Scoring Tool
  buildingenergyscore.energy.gov/
- Asset Score Email Box
  asset.score@ee.doe.gov



Presentation Highlights: Pacific Northwest National Laboratory

- The Building Energy Asset score helps building owners to make **informed decisions on building upgrades** and **inform real estate transactions**.
- Energy modeling tools need to balance **accuracy and usability**.
  - The Asset score requires only key data from users and generates **a model that can be further tailored** if more information is known.
- Users can also compare between multiple buildings' energy efficiency performances through an **Asset score batch analysis**.
- In some cases, **residential energy aggregated data** can be made publicly **available by the local utilities**, for information and educational purposes only.
- **The Asset score can also be used outside the U.S.**, in which case the respective climate zone should be chosen, for an accurate analysis.

Best Practices: American Council for an Energy-Efficient Economy (ACEEE)

U.S. DEPARTMENT OF ENERGY

ACEEE
American Council for an Energy-Efficient Economy

Narrowing the Gap Between Predicted and Actual Energy Savings

BBRN Webinar: America's Next Top Energy Model: Tools and Best Practices

Jennifer Amann

Buildings Program Director, ACEEE

December 1, 2016

The American Council for an Energy-Efficient Economy is a nonprofit 501(c)(3) founded in 1980. We act as a catalyst to advance energy efficiency policies, programs, technologies, investments, & behaviors.

Our research explores economic impacts, financing options, behavior changes, program design, utility work, international needs as well as US national, state, & local policy.

Our work is made possible by foundation funding, contracts, government grants, and conference revenue.

Home performance delivers proven energy savings and other benefits

Yet,

- market growth is slow
- program participation remains low
- project/program energy savings fall short
- program cost-effectiveness is hard to prove

What solutions can address the challenges facing programs and the industry at large?

How do we narrow the gap between predicted and actual energy savings?

ACEEE
American Council for an Energy-Efficient Economy

Getting accurate savings estimates from models

Standardize project data collection

- avoid duplicative modeling practices
- reduce data gathering/sharing cost
- accelerate approval of work scopes

Include operational use characteristics

- don't rely on preset/standard values
- key data: thermostat set points, hours/frequency of operation for appliances, electronics, etc.

ACEEE
American Council for an Energy-Efficient Economy

Getting accurate savings estimates from models (2)

Expand access to energy use data

- better understanding of energy use
- allow for model calibration (BPI-2400)

Project year and fuel	Total number of projects	Contractor reported savings (sum)	Calibration adjusted savings (sum)	Percent change due to calibration	Reported realization rate (median)	Adjusted realization rate (median)
2007–2008 gas (therms)	903	312,366	201,075	–36%	0.69	1.00
2009–2011 gas (therms)	1,241	316,880	225,585	–29%	0.63	0.86
2007–2008 electricity (kWh)	482	508,190	535,295	5%	1.65	1.40
2009–2011 electricity (kWh)	572	336,673	390,675	16%	3.18	2.84

Source: Gagliano 2015

Achieving expected project savings

Evaluate projects in real-time

- understand project & contractor performance
- gauge progress toward program goals
- diagnose and address problems

Incorporate home energy management tools

- smart thermostats, smart meter data

Pay-for-performance

- tie incentives to actual energy savings

ACEEE
American Council for an Energy-Efficient Economy

Program Opportunities for Scaling the Residential Retrofit Market

Rachel Cluett and Jennifer Amann

October, 2016

Available at: http://aceee.org/research-report/a1605

Thank you!

Jennifer Amann

ACEEE
American Council for an Energy-Efficient Economy

Presentation Highlights: American Council for an Energy-Efficient Economy (ACEEE)

- There are **many factors that might affect the accuracy of energy savings estimates** like the occupants' behavior or the duplicative modeling practices.
- Increasing accuracy of savings estimates can encourage **more participation in programs**.
- **Some of the solutions that could address the current barriers:**
  - **Data standardization**: through which homeowners see the financial benefits of energy efficient upgrades recognized when they sell their homes.
  - **Calibrating energy models to actual energy use.**
  - **Real-time evaluation of project performance**: addressing potential improvements while the program is in progress and incentivizing contractors to further improve the accuracy of their predictions.
  - **The use of other data collection tools** like smart thermostats.

Best Practices: OptiMiser

U.S. DEPARTMENT OF ENERGY

OPTIMISER®

power | simplicity | accuracy

Advances in audit software for productivity and quality management

1. OptiMiser software overview and recent advances
2. Integrated quality management example

OptiMiser Software Design Criteria

1. **Fast:** Efficient data entry - no guesswork or double-entry
2. **Auto-Calibrated:** Automatically calibrate to bills
3. **Accurate:** Advanced physics-based, hourly modeling
4. **Convenient:** Touch tablet optimized with photo capture
5. **Reporting:** Homeowner-friendly report out of the box
6. **Customizable:** Reports, forms, inputs, interface
7. **Exchanges Data:** Integrate with your database
8. **Automates Workflow:** Schedule, track and review jobs
9. **Extensible:** Home Energy Score, custom modules

OptiMiser Quick Facts

Founded 2007 in Colorado

Used across the country for hundreds of audits each week, including in:

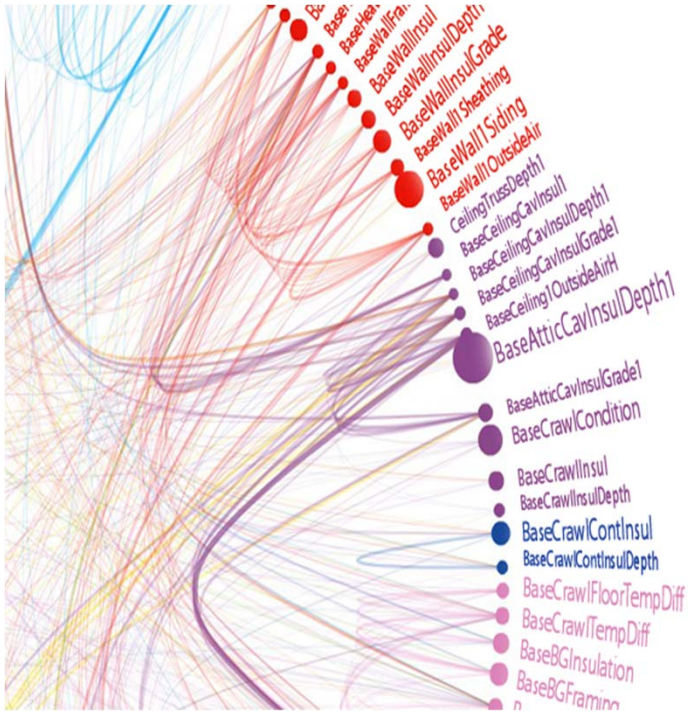
- Arizona (APS and SRP Home Performance with ENERGY STAR)
- New York (NYSERDA Home Performance with ENERGY STAR)
- California (Energy Upgrade California Home Upgrade)
- And through implementation partners like GoodCents

Distributed team, spread across U.S.

Develops residential audit software, commercial audit software, program management platform

Custom software and analysis (e.g. utility data)

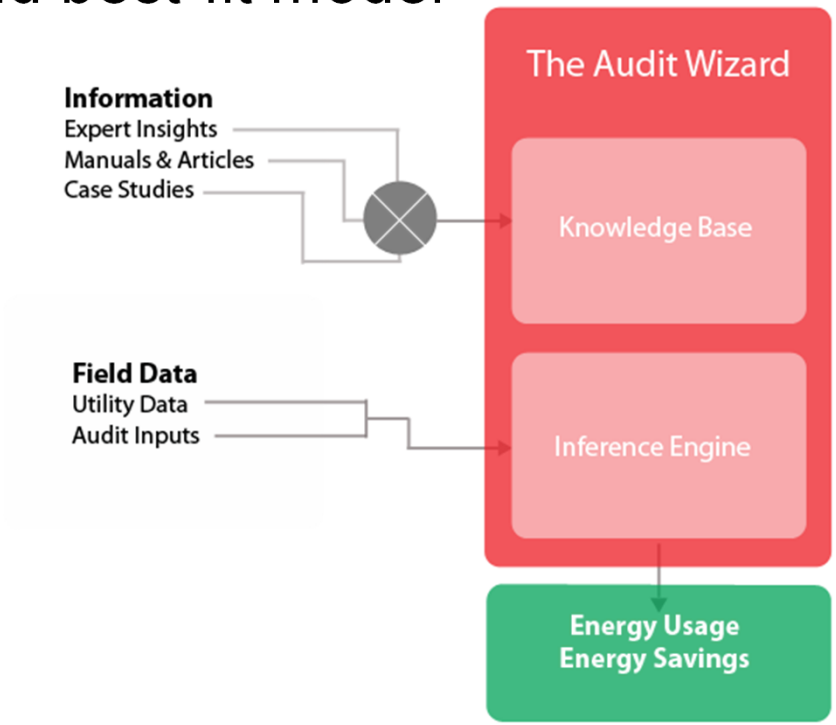
Audit approach:
leverage information, minimize data entry



- Hybrid hourly/degree-day real-time modeling engine
- As detailed as you need
- Automated utility bill calibration
- Instant feedback on audit completeness, quality, incentive qualifications

The Audit Wizard

- Takes the guesswork out of true-up
- Enter only information you *know*
- OptiMiser works within known boundaries to find best-fit model



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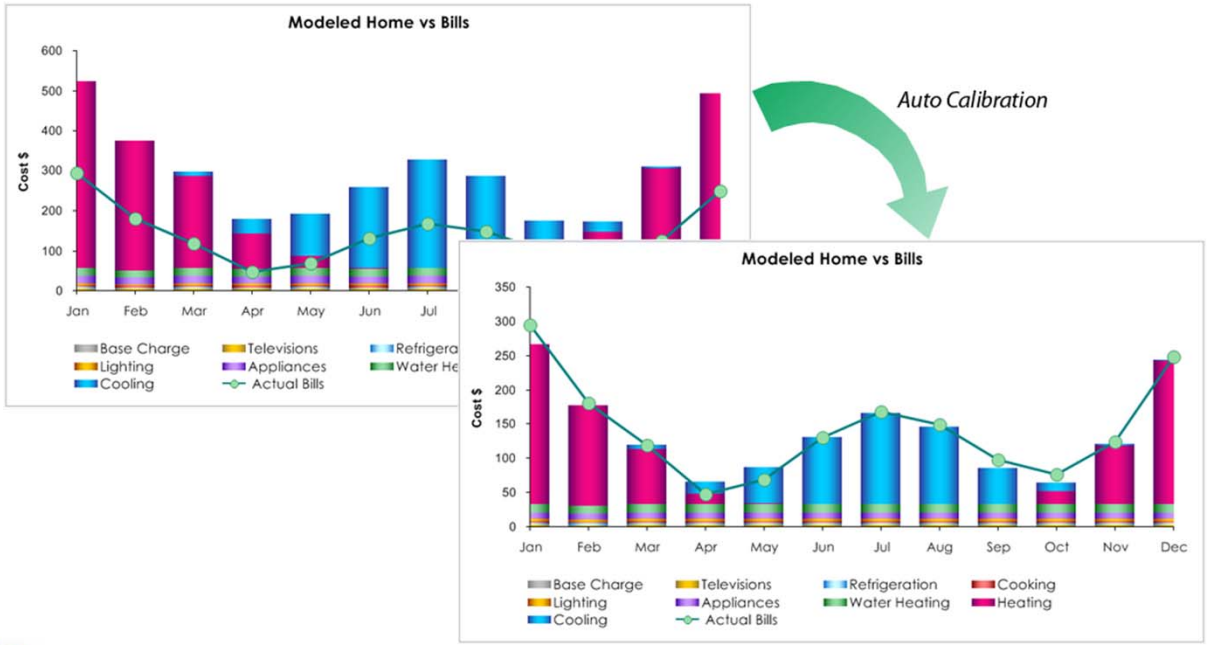
Audit Wizard: auto-calibration

- Inputs allow for uncertainty
  - Categorical controls (insulated wall, uninsulated wall)
  - Numerical ranges (attic insulation between 8" and 12")
  - Use regional/age defaults as starting points
- Range of models consistent with user inputs
- Identifies model with best fit to utility bills



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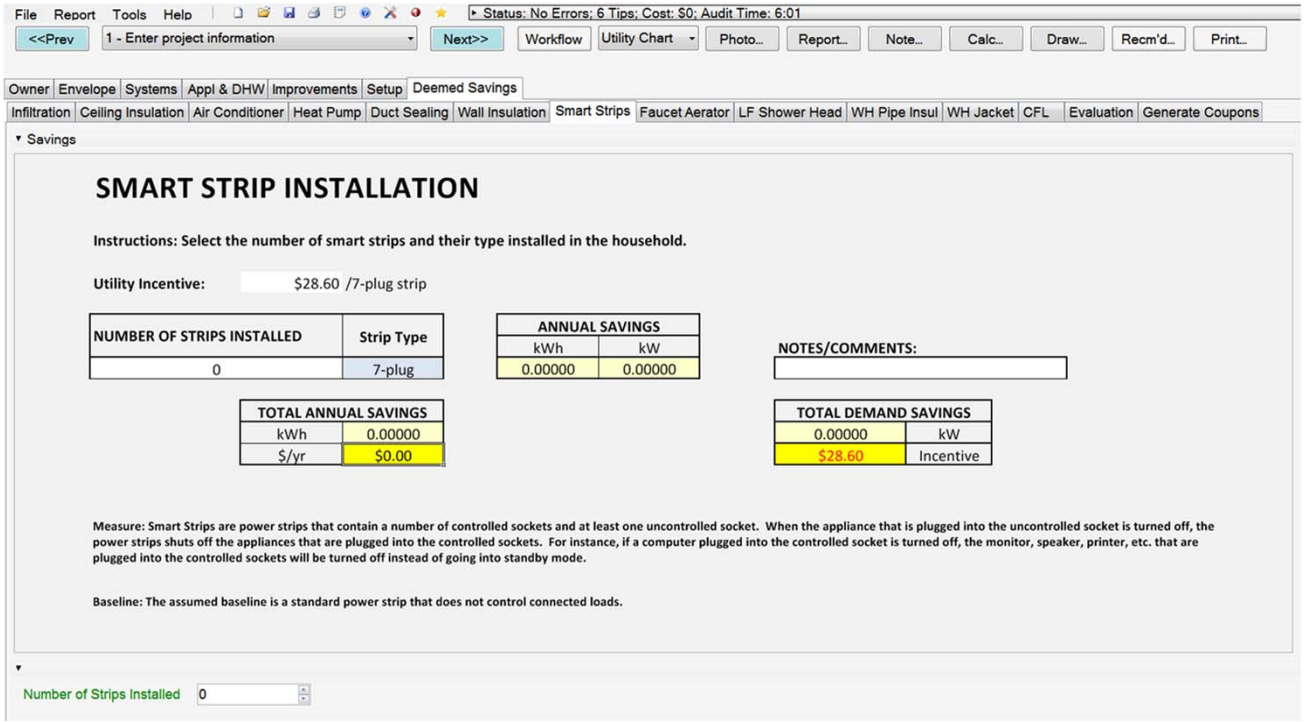
Custom analyses and data collection



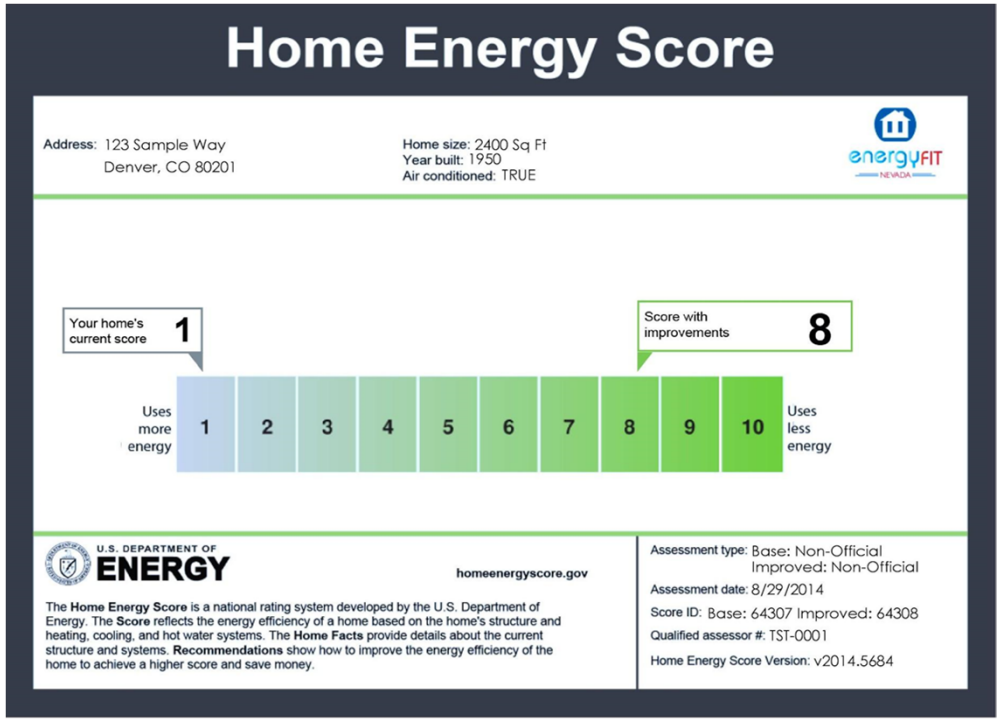
- Instantly incorporate calculators, lists, forms
- Built-in Excel-compatible spreadsheet emulator
- Quickly spec and build additional data collection screens – completely integrated with OptiMiser

OPTIMISER®
power | simplicity | accuracy

www.optimiserenergy.com

Home Energy Score

- HES reports with YOUR recommendations, not HES defaults!
- HEScores without any additional data inputs
- In *your* report
- Add *your* logo



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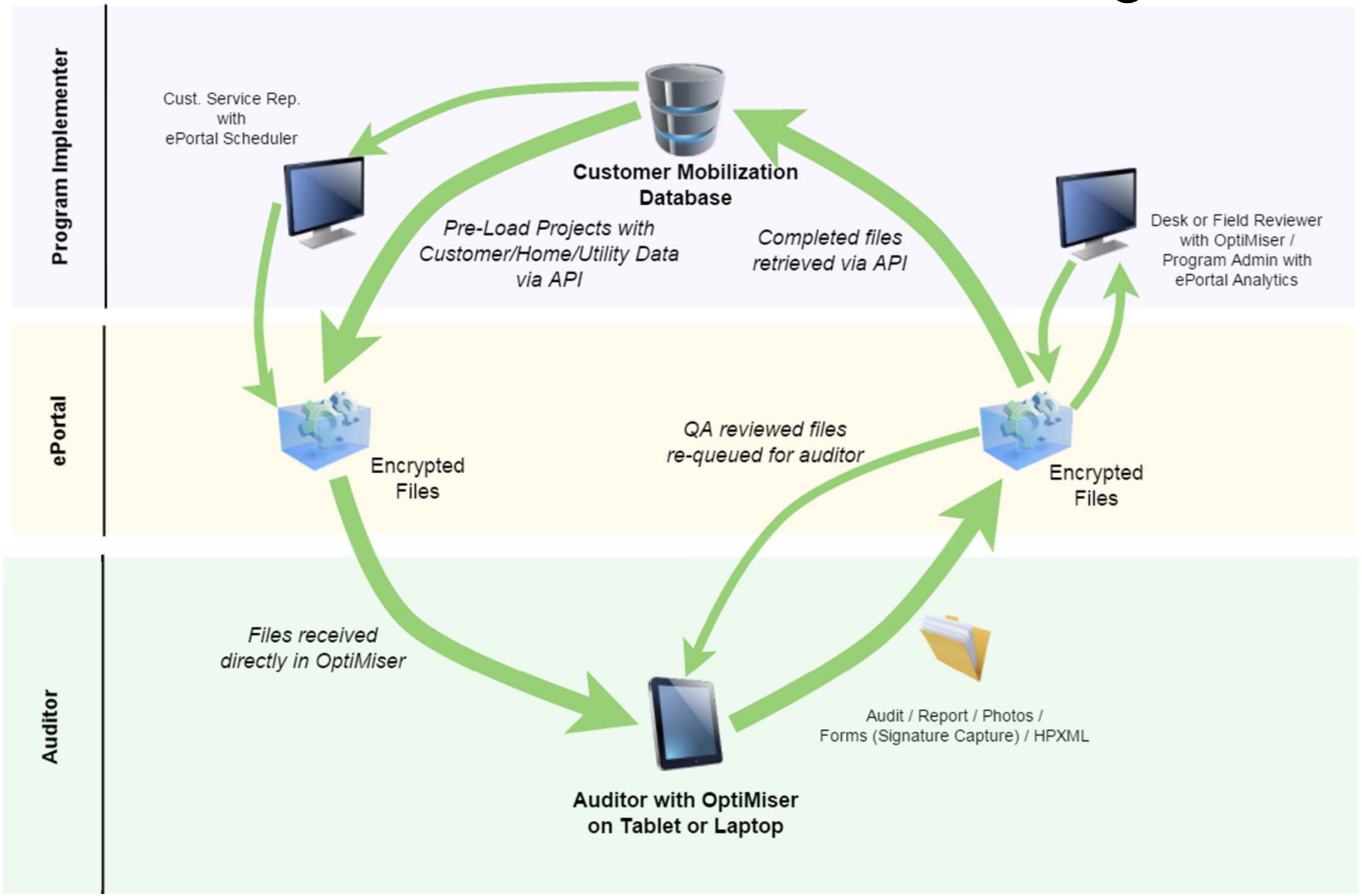
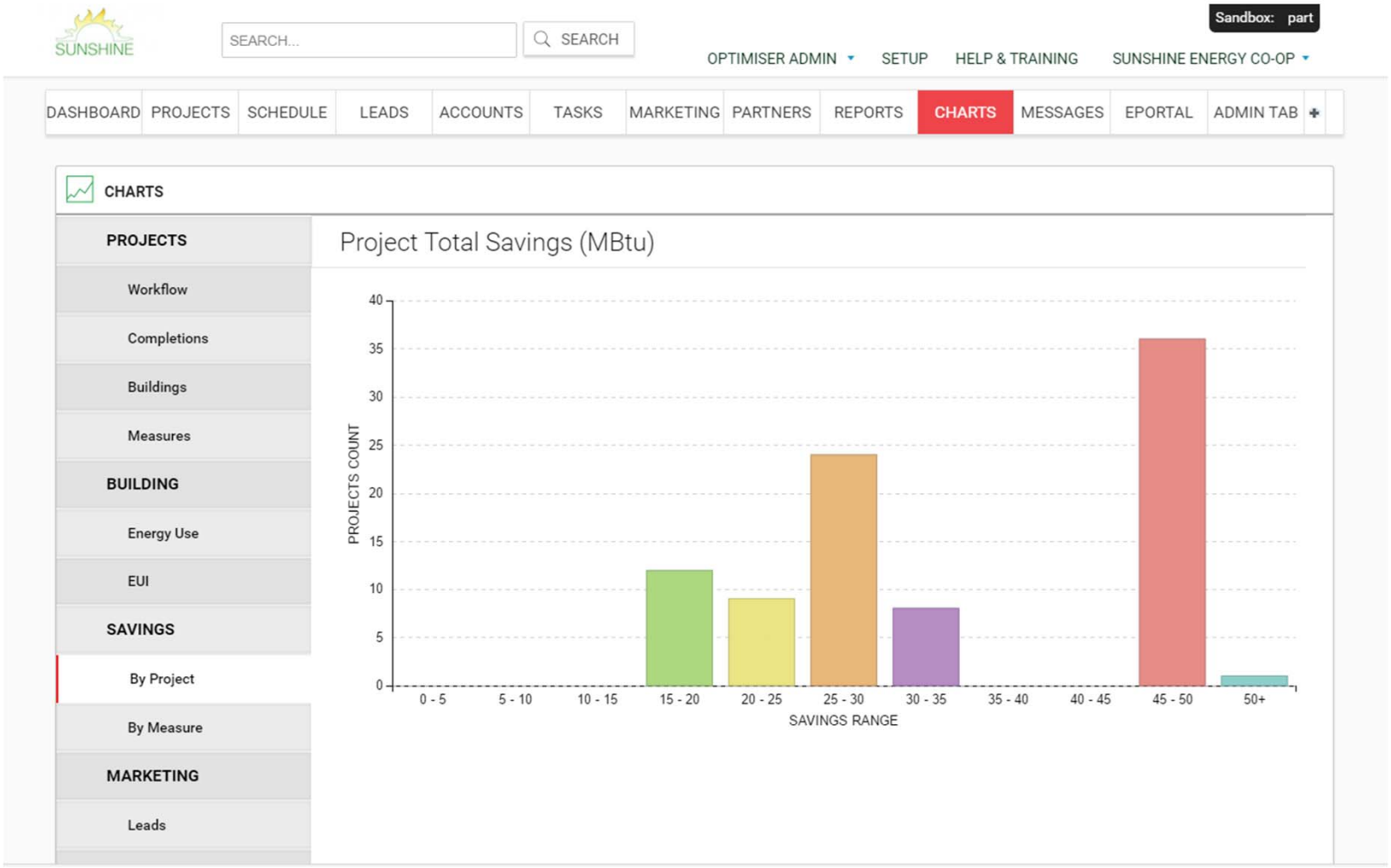
Field-to-backend data handling





Nexus

Building performance program management

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ASHRAE 1-3 Commercial Audits

- ASHRAE Level 1, 2 and 3 audits in the field
- Data collection, measure analysis, and reporting
- Eliminates hours of spreadsheet manipulation and report preparation.
- Targets a wide range of buildings, including:
  - office
  - retail
  - education
  - food sales/service
  - health care (In/outpatient)
  - lodging
  - multi-family
  - public assembly
  - public order and safety
  - religious
  - warehouse and storage
  - government
- Models a broad variety of ECMs:
  - operation and maintenance (O&M, or retro-commissioning)
  - low cost retrofit
  - investment grade retrofit and demand response measures.

Integrated Quality Management

Originally piloted with implementation partner GoodCents in Energizing Indiana program.

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The Challenge

Program requirements and “black box” file submission results in rejected files
- added auditor or desk reviewer time

Insufficient feedback to auditors to correct rejection
- added auditor time

Poor quality control necessitates more field reviews
- added field reviewer time

Incomplete or incorrect data inputs results in compromised program data
- added data handling time (or bad results)

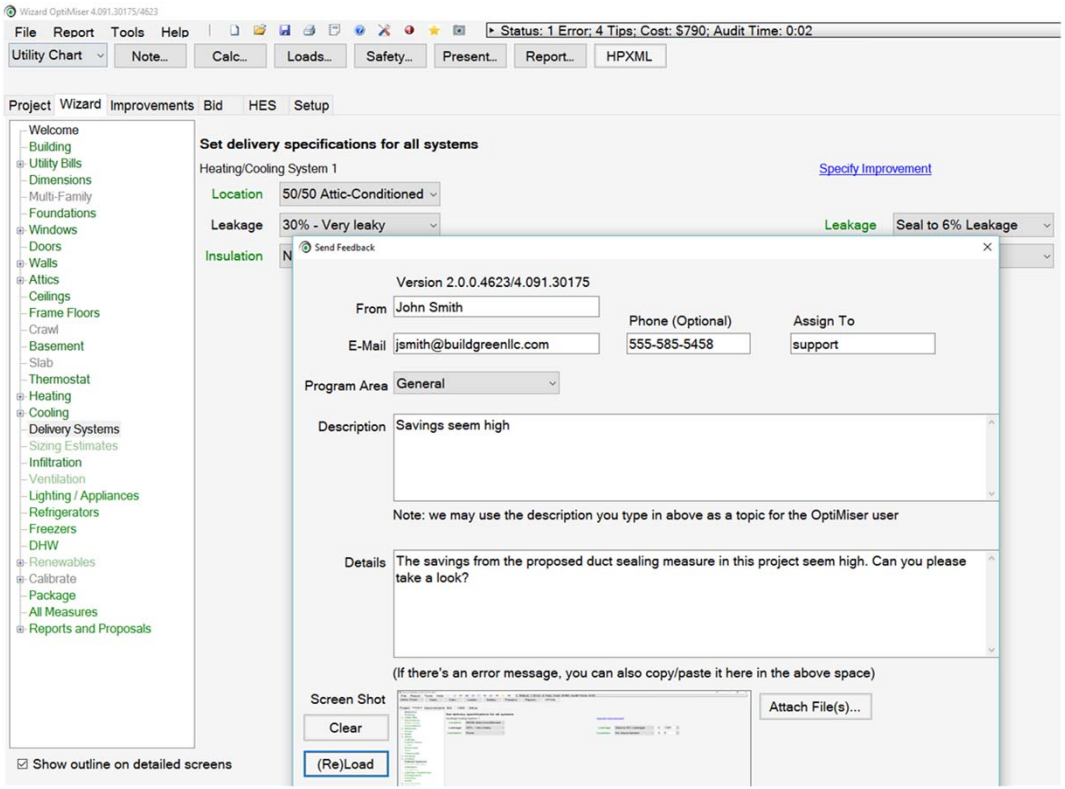
Compromised program data leads to lost energy and demand savings during EM&V reviews
- added time and expense and lost confidence

The Solution

- Software automation to speed and verify data
  - Required Fields
  - Data Types
  - Allowable Entry Ranges
- Default values when practical and needed
- On-entry page notifications
- Post audit completion review
- Assurance of more accurate report generation
- Assurance of successful file submission
- Detailed, specific guidance on measure implementation
- Integration with legacy data

Better Communication

- Sends complete status report to speed diagnosis
- Communicates directly to engineering and development team
- Encourages continuous learning and software improvements



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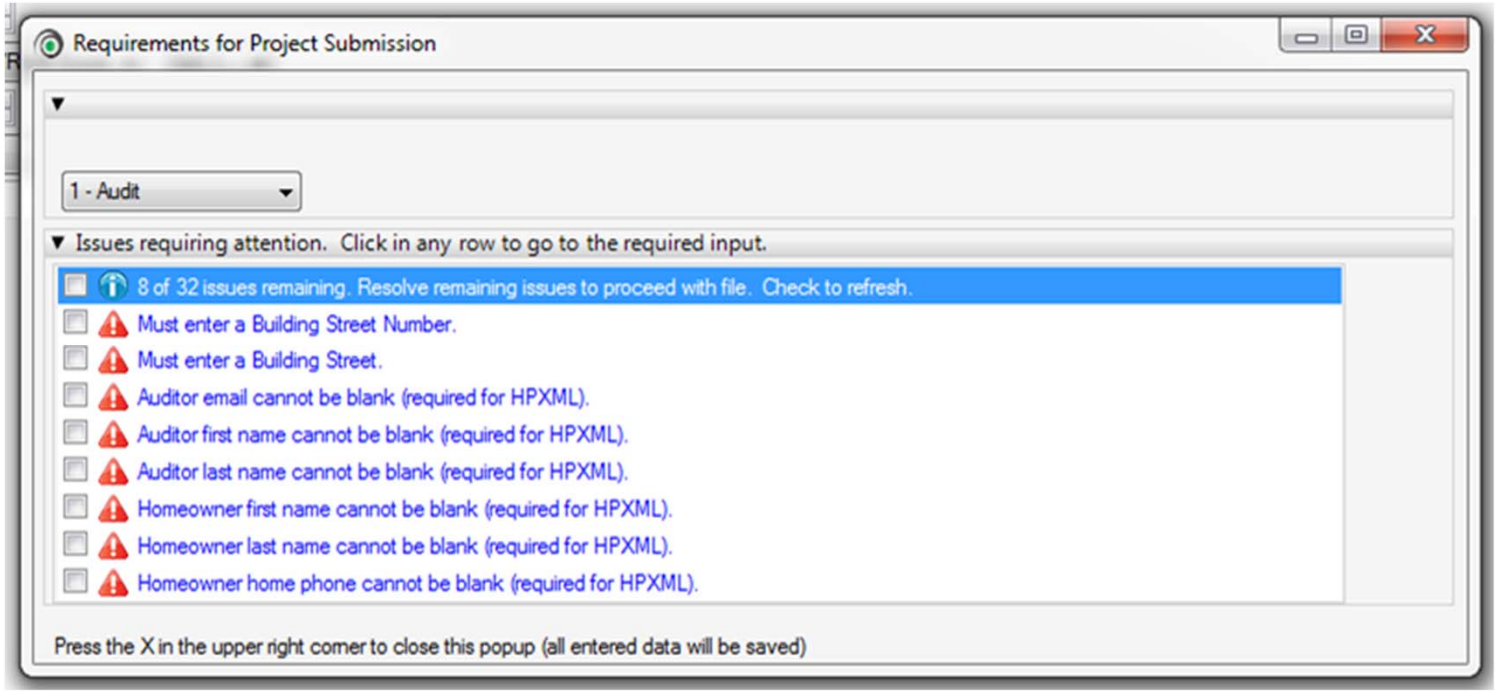
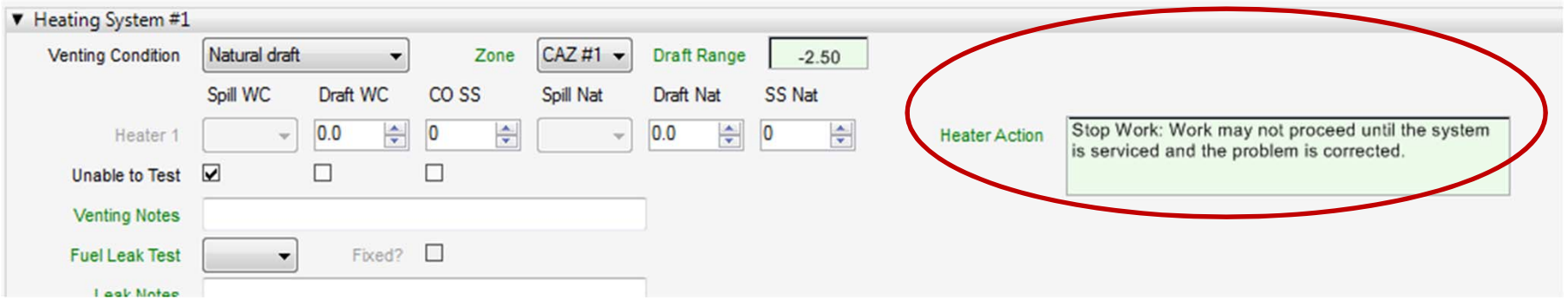
QC Messagelist

- Detailed real-time feedback
- Fix potential issues before you leave the site
- Incorporate reliable incentive and financing calculations



Safety Assurance

Appliance testing to ensure safety of customer and auditor



Ambient condition testing and required plan of action

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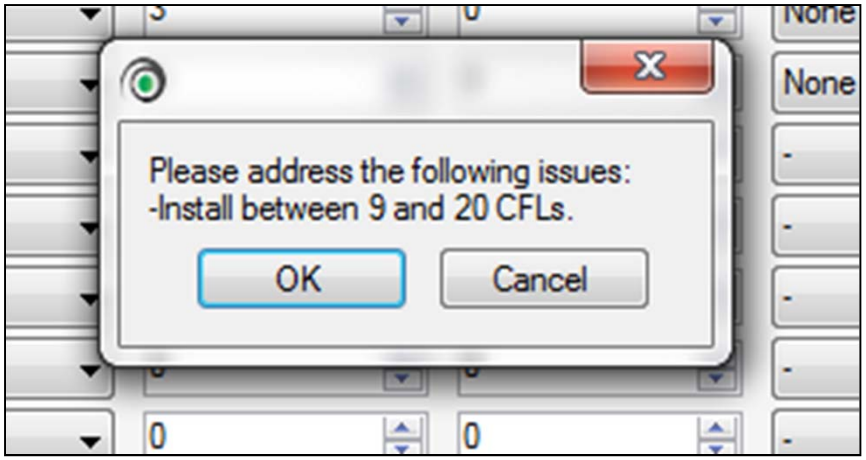
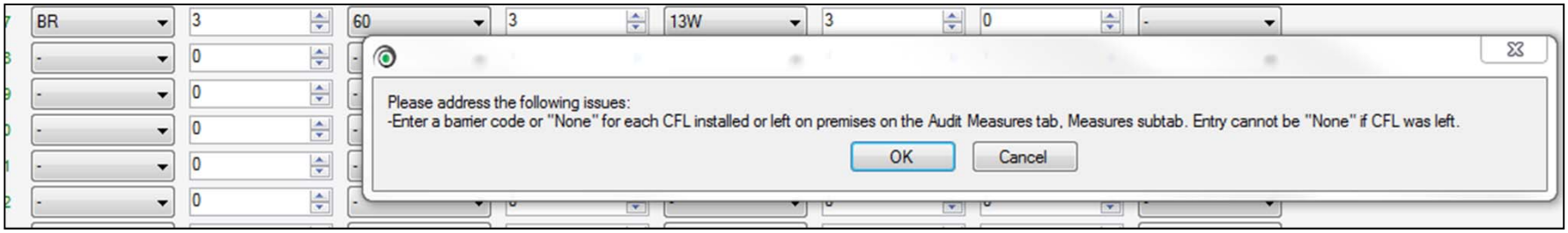
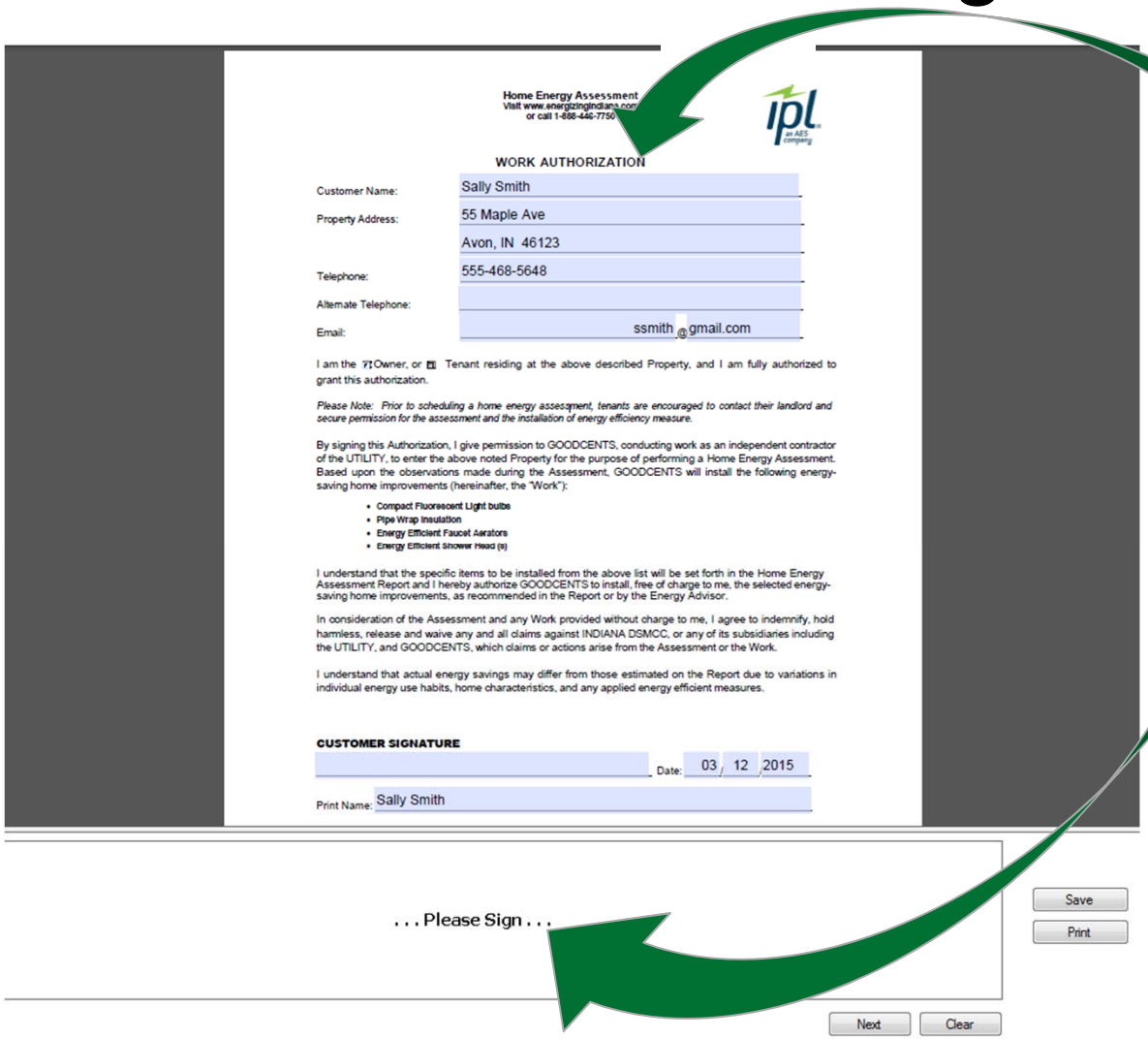
Data Integrity

- Validation of proper and allowable data entry
- Exception handling to explain variances





Efficient Data Handling: Form Filling



Automated form generation & signature capture

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Pre-Implementation

More effort + poor result

- add desk review time
- add auditor time
- add field review time
- add data handling time and poor results
- add EM&V time, expense and lost confidence

Post-implementation

Less effort + better result

- nearly eliminated
- cut in half
- nearly eliminated
- flexible, automated and reliable
- no surprises, less effort, more confidence

Presentation Highlights: OptiMiser

- OptiMiser leverages **energy bills** as the largest and most reliable source of information helping to **eliminate guess work** and minimize the impact of unknown data.
- OptiMiser runs on its own software engine and can be used every day **for very quick initial assessments to very detailed comprehensive projects**.
- Through the automated **utility bill calibration,** users can enter **data ranges when the exact information is unknown** and the tool will build an optimal model.
- By using **software automation**, OptiMiser has addressed the most common challenges with energy modeling, such as **accuracy or time use**.

Related Resources in the Residential Program Solution Center

Explore resources related to energy modeling tools and best practices:

- Review your standards for the diagnostic and software tools used by contractors with help from the Contractor Engagement & Workforce Development –Make Design Decisions handbook.
- Explore the benefits and limitations of energy estimating methods at the individual upgrade level in the Home Performance with ENERGY STAR Sponsor Guide.
- See examples of programs that offer participants multiple types of home energy assessments, including home energy modeling and diagnostic testing.
- Consider how to improve project level realization rates with insights from this recent ACEEE report.

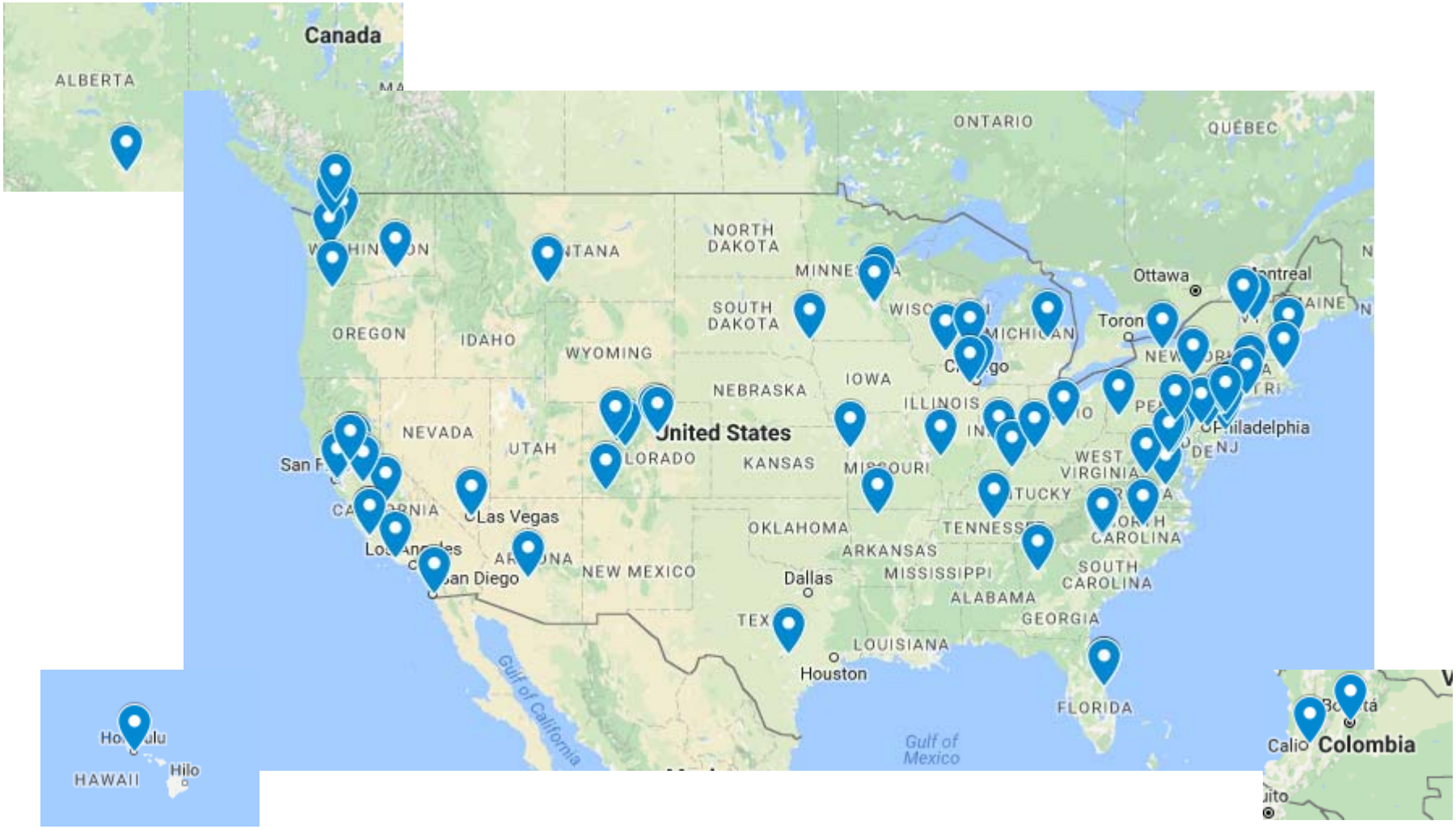
https://rpsc.energy.gov

- While you're there, see the latest Proven Practices post on Incentivizing Home Upgrade Actions.
- **Send us your ideas!** The Solution Center is continually updated to support residential energy efficiency programs.

Addenda: Attendee Information and Poll Results

U.S. DEPARTMENT OF ENERGY

Call Attendee Locations



Better Buildings

U.S. DEPARTMENT OF ENERGY

Call Attendees: Network Members

- American Council for an Energy-Efficient Economy (ACEEE)
- CLEAResult
- Center for Sustainable Energy
- Davis Energy Group
- District of Columbia Sustainable Energy Utility
- Efficient Windows Collaborative
- Energy Efficiency Specialists
- FSL Home Improvement
- Group14 Engineering Inc.
- International Center for Appropriate and Sustainable Technology (ICAST)
- Johnson Environmental
- Lifestyle Homes, Inc.
- Midwest Energy Efficiency Alliance (MEEA)
- North Carolina Building Performance Association
- Richmond Region Energy Alliance
- Southface
- The Insulation Man, LLC
- University of Central Florida
- Vermont Energy Investment Corporation (VEIC)

Call Attendees: Non-Members (1 of 3)

- ACTION-Housing
- Association for Energy Affordability (AEA)
- Bay City Electric Light and Power
- BlocPower
- Bridging The Gap
- BSHM Architects, Inc.
- California Association of Building Energy Consultants (CABEC)
- Carolina Smart Homes
- City of Bloomington (IN)
- City of Highland (CA)
- CivicSpark
- Community Office for Resource Efficiency (CO)
- County of San Diego (CA)
- Craft3
- Commonwealth of Pennsylvania (CWOPA)
- Dow Corning
- DSB Energy Services LLC
- Energetics Incorporated
- Energy Analytics
- Energy Efficiency Solutions, LLC
- Energy Smart Colorado
- Fairfax County (VA)
- Franklin Energy Services
- Facility Strategies Group, LLC (FSG)
- Green Button Alliance

Call Attendees: Non-Members (2 of 3)

- Green Compass Sustainability Consulting
- Greenergy Chicago, Inc
- Housing Authority of the County of San Bernardino (HACSB)
- HansenRE Marketing Services
- Hawaii Energy
- HDR CONSULTING LLC
- Healthy Building Research & ROCIS Initiative (Reducing Outdoor Contaminants in Indoor Spaces)
- Holy Cross Energy
- Home Office Training & Technology
- US Department of Housing and Urban Development
- Home Ventilating Institute (HVI)
- Johns Manville
- La Plata Electric Association (LPEA)
- Madison Lakeview LLC.
- Massachusetts Department of Energy Resources
- Mercy Housing
- MKthink
- North Arkansas Regional Medical Center (NARMC)
- National Housing Law Project

Call Attendees: Non-Members (3 of 3)

- New Jersey Natural Gas
- National Renewable Energy Laboratory (NREL)
- Opportunity Council
- OptiMiser
- Pacific Northwest National Laboratory
- Parsec Energy Consulting
- People's Self Help Housing
- Pacific Gas and Electric Company (PG&E)
- POCH Colombia
- Pratt Center for Community Development
- Rethinking Power Management
- Schreiner Design
- SIM2
- Sustainable South Bronx
- Technician Community Development LLC
- Texas State University
- Therma-Stor LLC
- Universidad Autónoma de Occidente (Colombia)
- UIL Holdings Corporation
- University of Minnesota
- University of Pennsylvania
- Utility Cost Management LLC
- Washington State Department of Commerce

Opening Poll #1

- Which of the following best describes your organization's experience with energy modeling tools and best practices?
  - Some experience/familiarity – ***45%***
  - Limited experience/familiarity – ***22%***
  - Very experienced/familiar – ***20%***
  - No experience/familiarity – ***11%***
  - Not applicable – ***2%***

Closing Poll

- After today's call, what will you do?
  - Seek out additional information on one or more of the ideas – ***82%***
  - Make no changes to your current approach – ***12%***
  - Consider implementing one or more of the ideas discussed – ***3%***
  - Other (please explain) ***-3%***