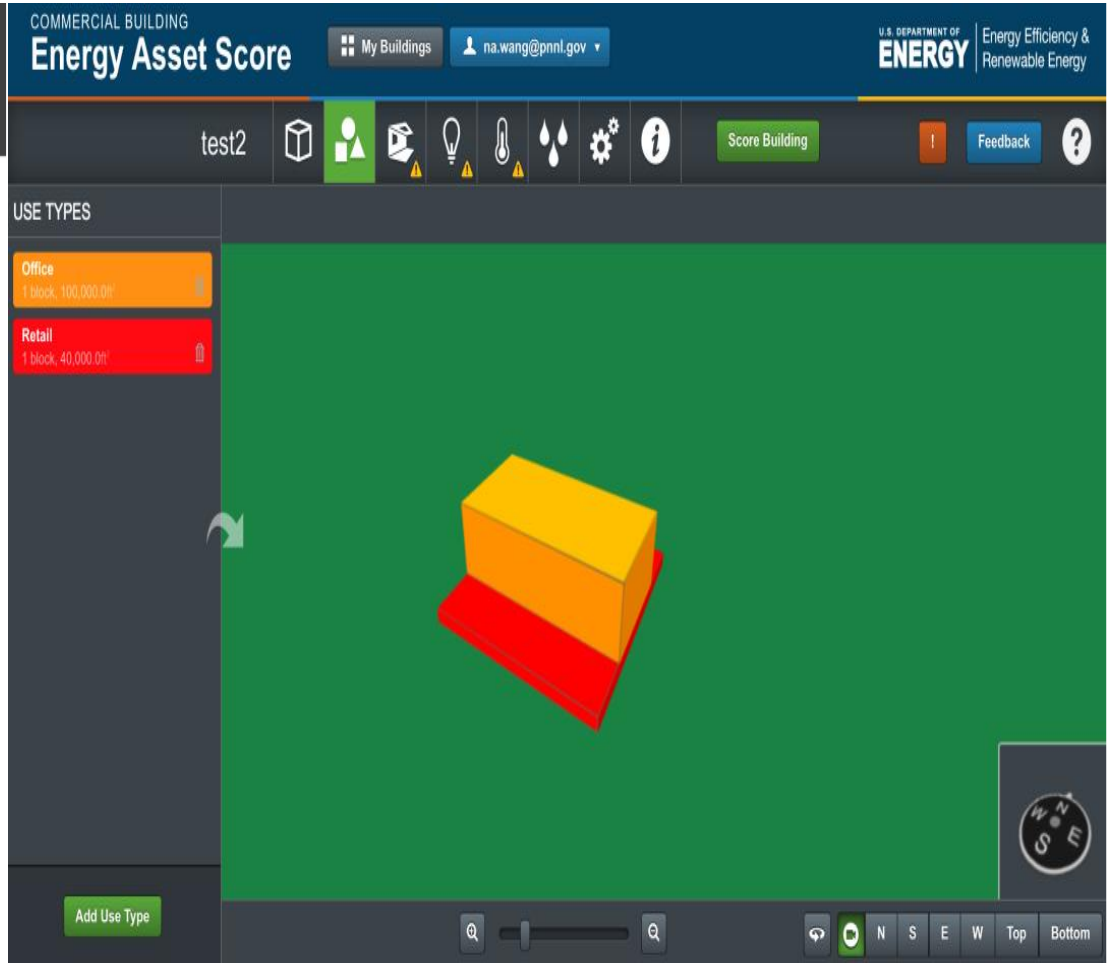
Building Energy Asset Score

2016 Building Technologies Office Peer Review



U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Nora Wang, Nora.Wang@pnnl.gov
Pacific Northwest National Laboratory

Project Summary

Timeline:

Start date: 04/01/2011

Planned end date: Ongoing program

Key Milestones

Asset Score 2.0 with Preview (01/27/2016)

Building Data Reporting Platform Beta (06/30/2016)

Key Partners:

None

Budget:

Total Project $ to Date:

- DOE: $7.263M
- Cost Share: $0

Total Project $:

- DOE: $TBD
- Cost Share: $0

Project Outcome:

- A credible scoring system for commercial and multi-family buildings that can be used to inform retrofits and real estate transactions.
- A streamlined process and tool to collect, manage, and report building asset data.

Purpose and Objectives

Problem Statement: There was no low-cost, standardized tool for consistently evaluating a building's structure and energy-related systems independent of operations/tenant behavior. A national energy Asset Score for commercial and multifamily buildings is essential to encourage effective valuation of energy efficiency in real estate transactions and spur investment in capital improvements.

Target Market and Audience:

Market: Commercial and Multi-family Buildings. Commercial sector accounts for 19% of total energy consumption in the U.S., totaling 18,021 TBtu*.

Audience: Building owners/operators, state & local governments, federal agencies, service providers, utilities.

Impact of Project:

- Provide a standard, free evaluation tool to help commercial building owners and operators gain insight into the efficiency of building systems and their potentials, motivate investment in improvements, and improve valuation of efficiency.
- By 2020, use Asset Score to evaluate 1% of total commercial space** (870 million ft^2) and identify 36 TBtu primary energy use savings (assuming 20% on average) and $356 million cost savings*.
- In the long term, use Asset Score to inform real estate transactions.

*According to EIA Annual Energy Review 2011. The total energy consumption in the commercial sector estimates fro18,021 TBtu in 2011 (p.40). The total consumer expenditure estimates for energy in the commercial sector is $178,128 million in 2010 (p.79).

**According to CBECS 2012, the total commercial floor space is 87,043 million sq.ft.

Approach

Approach:

- Create a free Asset Scoring Tool application with simplified data requirements using the EnergyPlus building modeling engine (via OpenStudio).
- Develop a quick and easy way help unsophisticated users to initiate an energy efficiency analysis.
- Provide a standardized report documenting the building's Asset Score to inform owners, operators and others who have limited knowledge of building energy efficiency.
- Help building owners and managers disaggregate building energy information and include a mechanism for identifying energy improvement opportunities.

Key Issues:

- Determine the appropriate level of data inputs for an accurate assessment while minimizing data collection burden.
- Provide useful information and actionable strategies to help building owners make informed decision on building upgrades.
- Create a streamlined process for building screening, energy audit, data management and report, and building valuation.

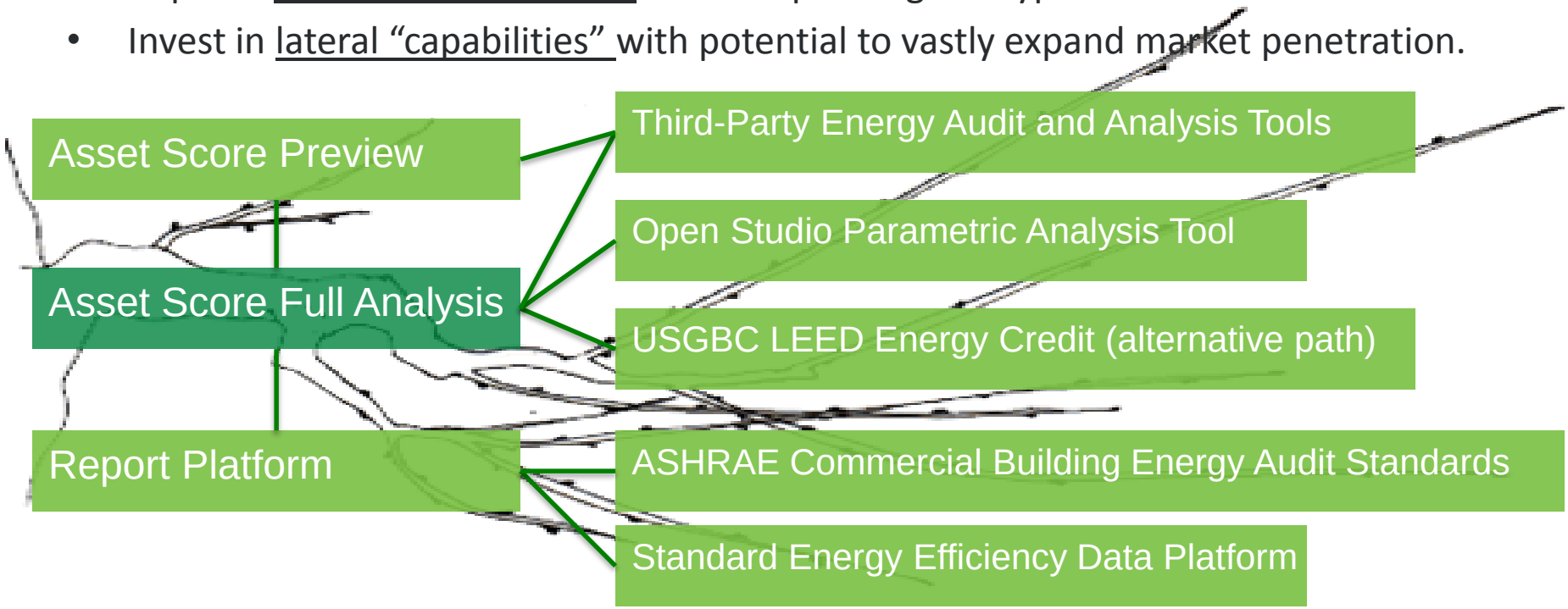
Approach

Distinctive Characteristics:

Position the tool upstream the real estate owners by working with architects, professional service providers.

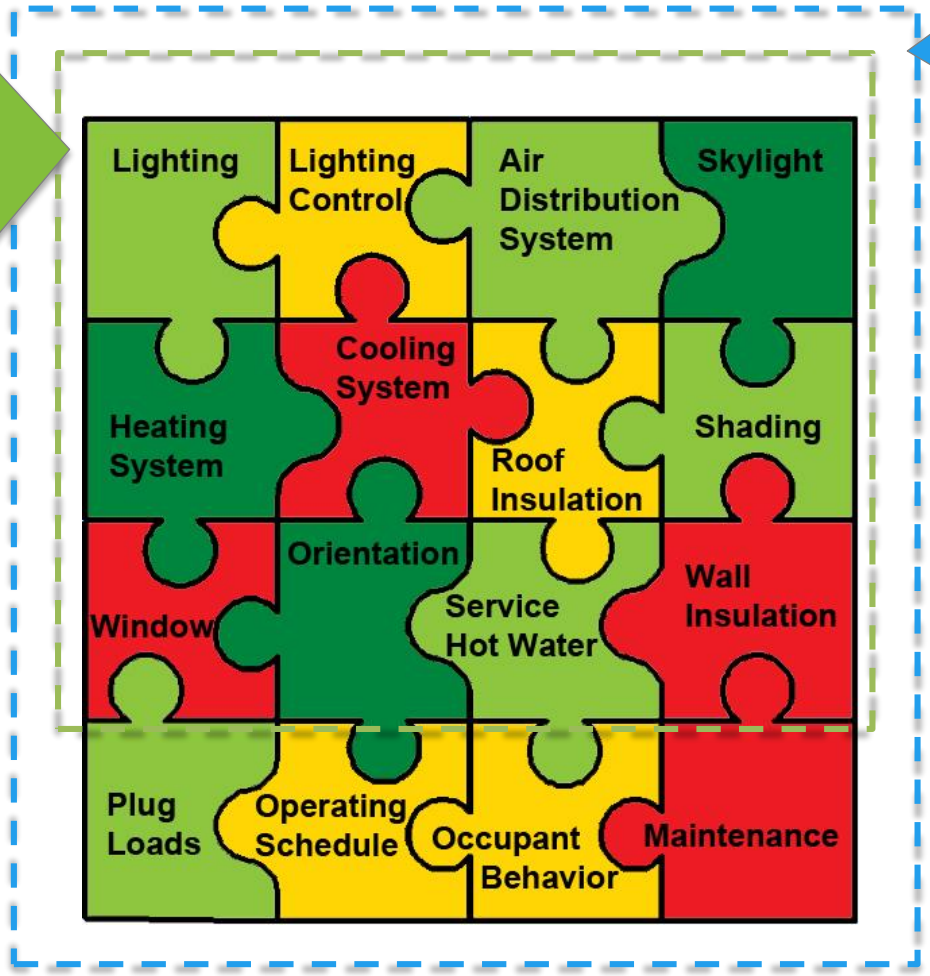
Strategic Objectives:

- Create self-sustaining deployment channels by building user base in EE services, engineering, design, and program administration sectors.
- Improve core technical quality before expanding use types.
- Invest in lateral "capabilities" with potential to vastly expand market penetration.



How Asset Score Works

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.

Asset Score runs an *energy simulation* using EnergyPlus.

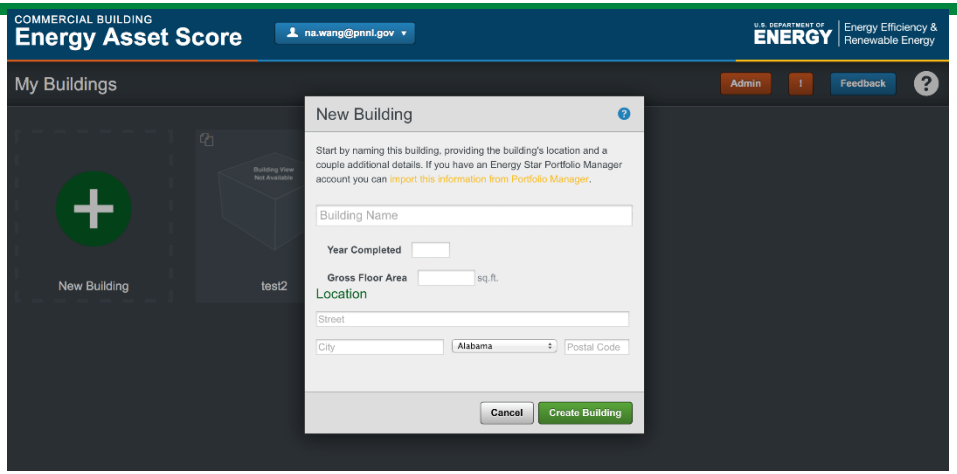
The simulation normalizes for building operations, occupancy and tenant behavior.

Types of Buildings

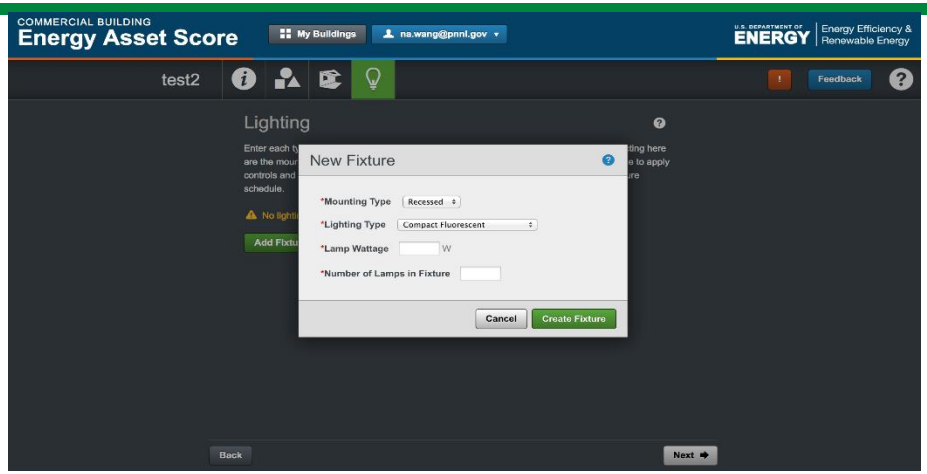
Asset Score assesses the following *new and existing* building types:

- Multifamily (low/high-rise, 3+ units)
- Office
- Retail
- Assisted living
- City hall
- Community center
- Courthouse
- Educational (including K-12 schools)
- House of Worship
- Library
- Lodging
- Medical office
- Parking garage
- Police station
- Post office
- Senior center
- Warehouse (unrefrigerated)
- Mixed-Use (of the above types)

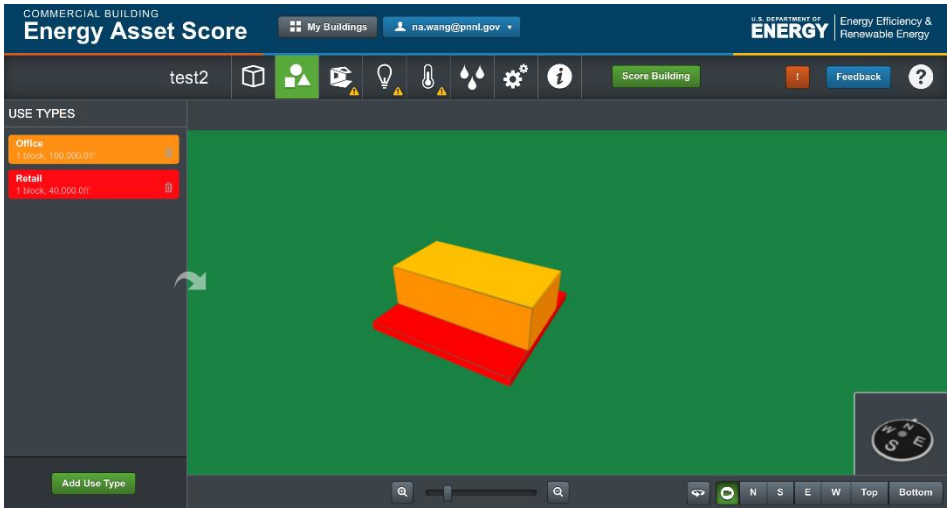
Asset Scoring Tool



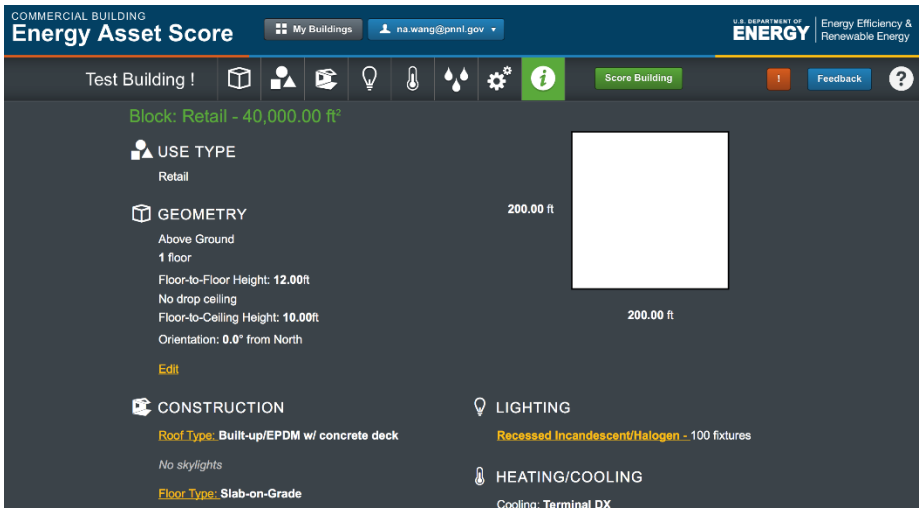
1. Create a new building and enter basic building information



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



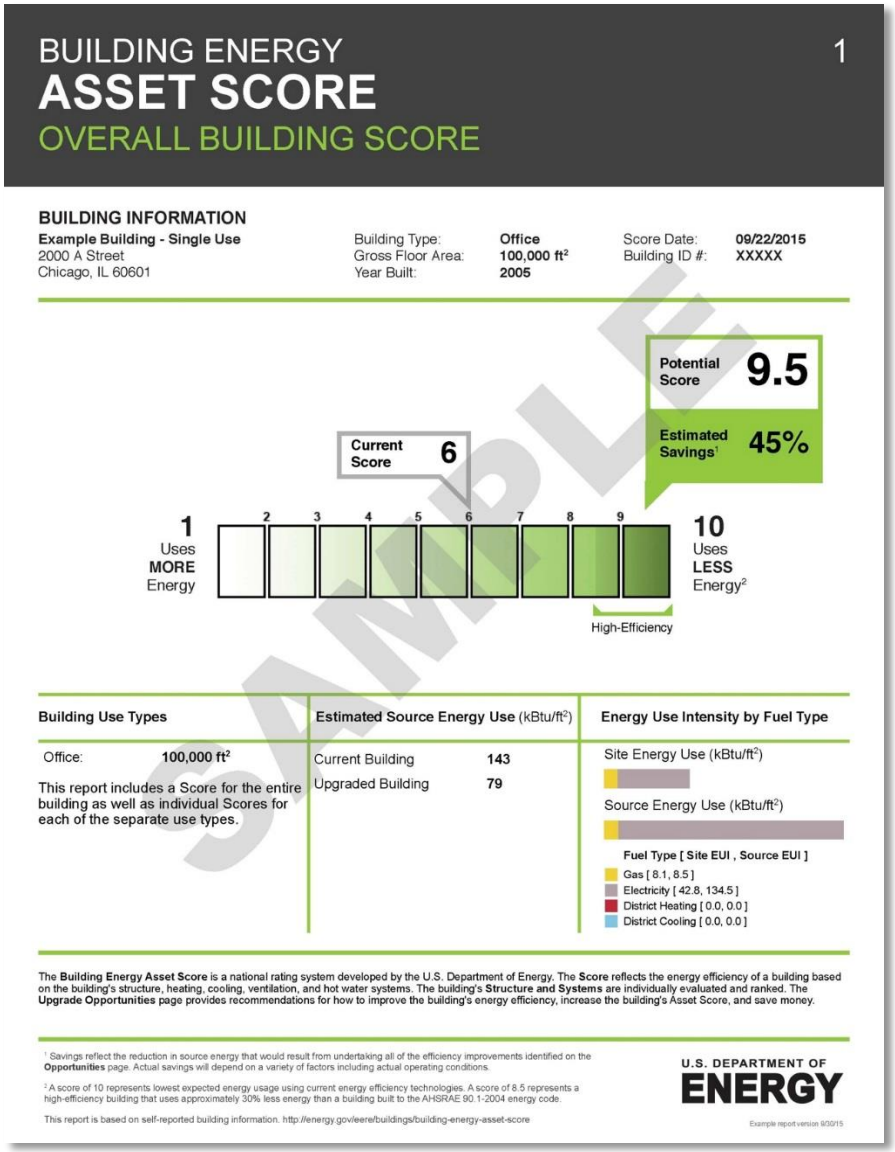
3. Create 3-D block(s) of your building and apply use type(s) and features to your building block(s)



4. Score your building and receive your Asset Score Report

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Asset Score Report


BUILDING ENERGY
ASSET SCORE 1
OVERALL BUILDING SCORE

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

Potential Score 9.5
Estimated Savings[1] 45%
Current Score 6

1 Uses MORE Energy — 10 Uses LESS Energy[2]
High-Efficiency

Building Use Types
Office: 100,000 ft²
This report includes a Score for the entire building as well as individual Scores for each of the separate use types.

Estimated Source Energy Use (kBtu/ft²)
Current Building 143
Upgraded Building 79

Energy Use Intensity by Fuel Type
Site Energy Use (kBtu/ft²)
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

SAMPLE

Four sections

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


BUILDING ENERGY
ASSET SCORE 3
UPGRADE OPPORTUNITIES

Building Name: Example Building - Single Use
Gross Floor Area: 100,000 ft²

Cost Effective Upgrade Opportunities | Energy Savings[1] | Cost[2]

Building Envelope
- Add roof insulation in Office Block - Learn More — High — $ - $$
- Install high performance triple pane windows in Office Block - Learn More — High — $$ - $$$

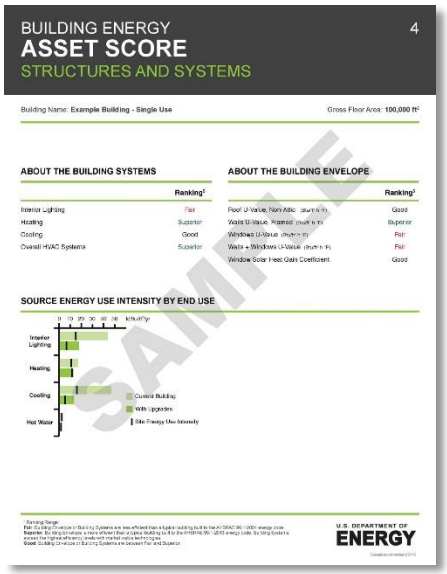
Interior Lighting
- Upgrade T8 fluorescent lighting in Office Block with LED lighting - Learn More — Medium — $$
- Add daylighting controls in Office Block - Learn More — Low — $$

HVAC Systems
- Add air-side economizer in Office Block - Learn More — Medium — $-$$
- Implement demand controlled ventilation (DCV) in Office Block - Learn More — Medium — $$
- Add variable frequency drive to supply fans in Office Block - Learn More — Medium — $$

Hot Water Systems
- Add low flow faucets in Office Block - Learn More — Low — $$

U.S. DEPARTMENT OF ENERGY

SAMPLE


BUILDING ENERGY
ASSET SCORE 4
STRUCTURES AND SYSTEMS

Building Name: Example Building - Single Use
Gross Floor Area: 100,000 ft²

ABOUT THE BUILDING SYSTEMS

	Ranking[1]
Interior Lighting	Fair
Heating	Superior
Cooling	Good
Overall HVAC Systems	Superior

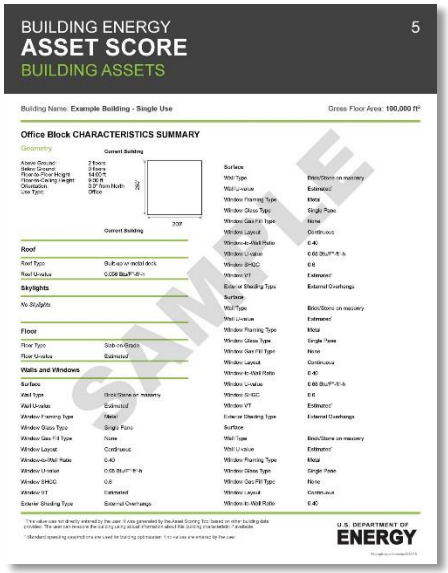
ABOUT THE BUILDING ENVELOPE

	Ranking[1]
Roof U-Value, Non-Attic	Good
Walls U-Value, Framed	Superior
Windows U-Value	Fair
Walls + Windows U-Value	Fair
Window Solar Heat Gain Coefficient	Good

SOURCE ENERGY USE INTENSITY BY END USE
Interior Lighting
Heating
Cooling
Hot Water
Current Building
With Upgrades
Site Energy Use Intensity

U.S. DEPARTMENT OF ENERGY

SAMPLE


BUILDING ENERGY
ASSET SCORE 5
BUILDING ASSETS

Building Name: Example Building - Single Use
Gross Floor Area: 100,000 ft²

Office Block CHARACTERISTICS SUMMARY

Geometry — Current Building
Above Ground: 2 floors
Below Ground: 0 floors
Floor-to-Floor Height: 14.00 ft
Floor-to-Ceiling Height: 9.00 ft
Orientation: 0.0° from North
Use Type: Office
200'
200'
Current Building

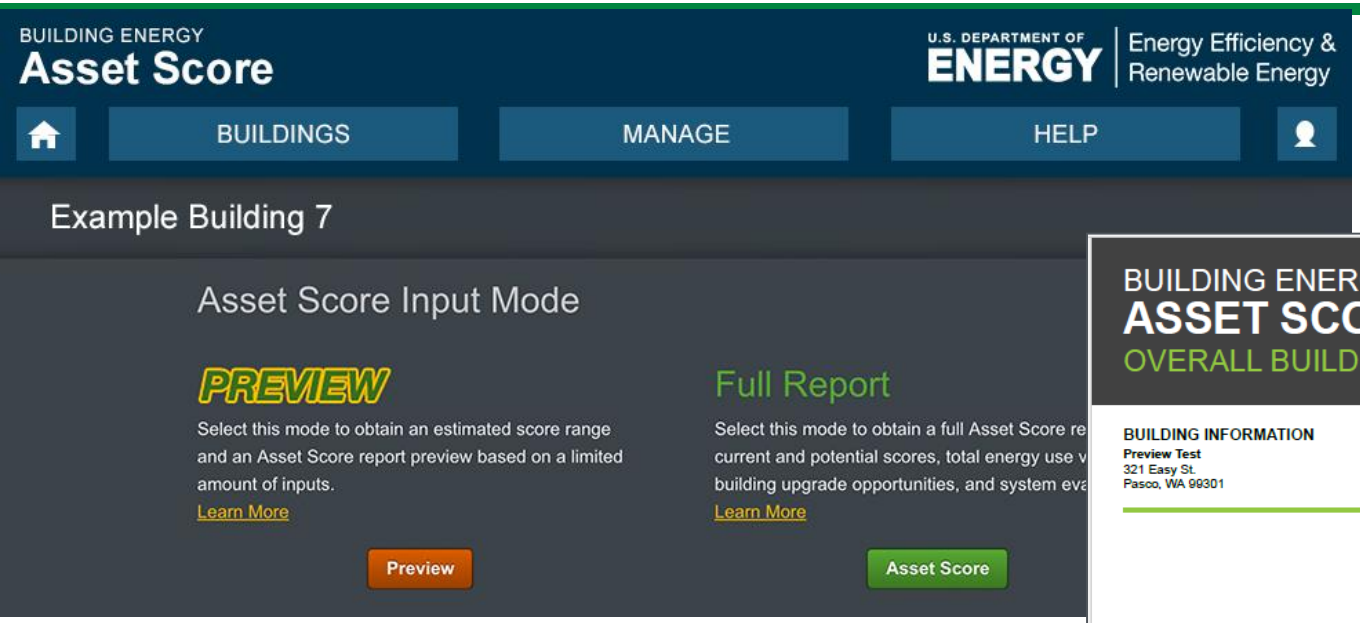
Roof	
Roof Type	Built-up w/ metal deck
Roof U-value	0.056 Btu/ft²-h-R
Skylights	
No Skylights	
Floor	
Floor Type	Slab on Grade
Floor U-value	Estimated
Walls and Windows	
Surface	
Wall Type	Brick/Stone on masonry
Wall U-value	Estimated
Window Framing Type	Metal
Window Glass Type	Single Pane
Window Gas Fill Type	None
Window Layout	Continuous
Window-to-Wall Ratio	0.40
Window U-value	0.65 Btu/ft²-h-R
Window SHGC	0.6
Window VT	Estimated
Exterior Shading Type	External Overhangs
Surface	
Wall Type	Brick/Stone on masonry
Wall U-value	Estimated
Window Framing Type	Metal
Window Glass Type	Single Pane
Window Gas Fill Type	None
Window Layout	Continuous
Window-to-Wall Ratio	0.40
Window U-value	0.65 Btu/ft²-h-R
Window SHGC	0.6
Window VT	Estimated
Exterior Shading Type	External Overhangs
Surface	
Wall Type	Brick/Stone on masonry
Wall U-value	Estimated
Window Framing Type	Metal
Window Glass Type	Single Pane
Window Gas Fill Type	None
Window Layout	Continuous
Window-to-Wall Ratio	0.40

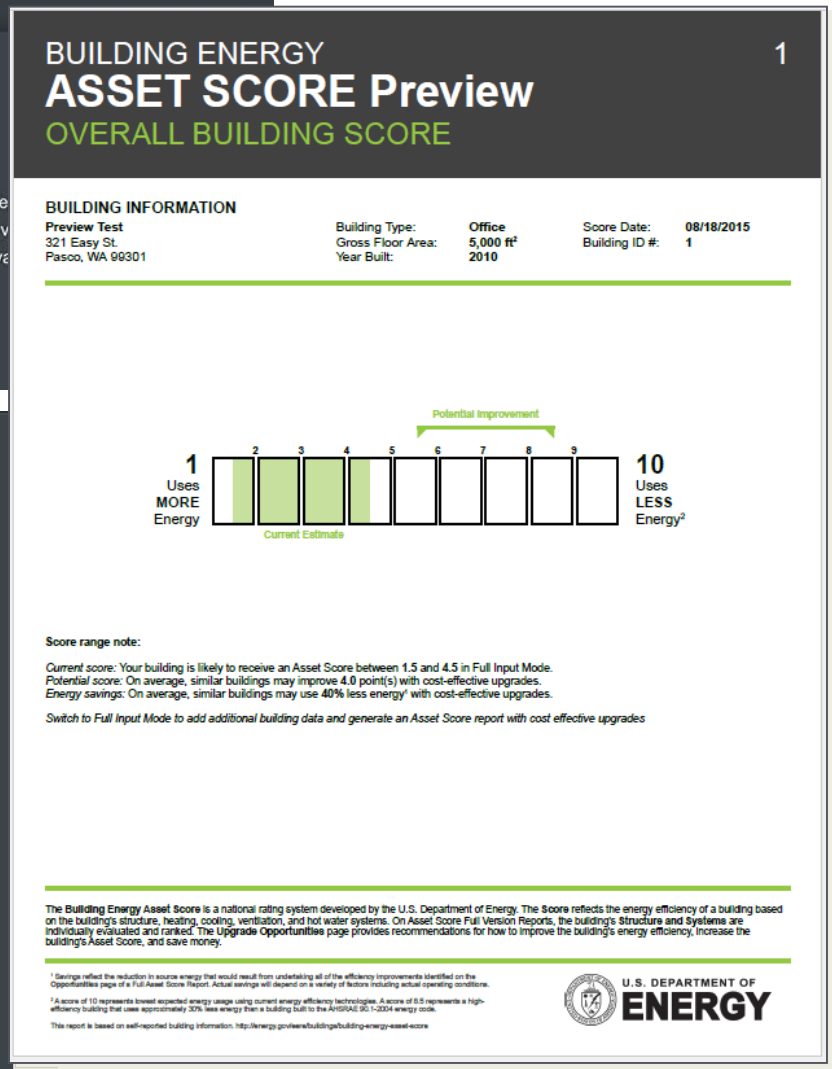
U.S. DEPARTMENT OF ENERGY

SAMPLE

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Asset Score Preview

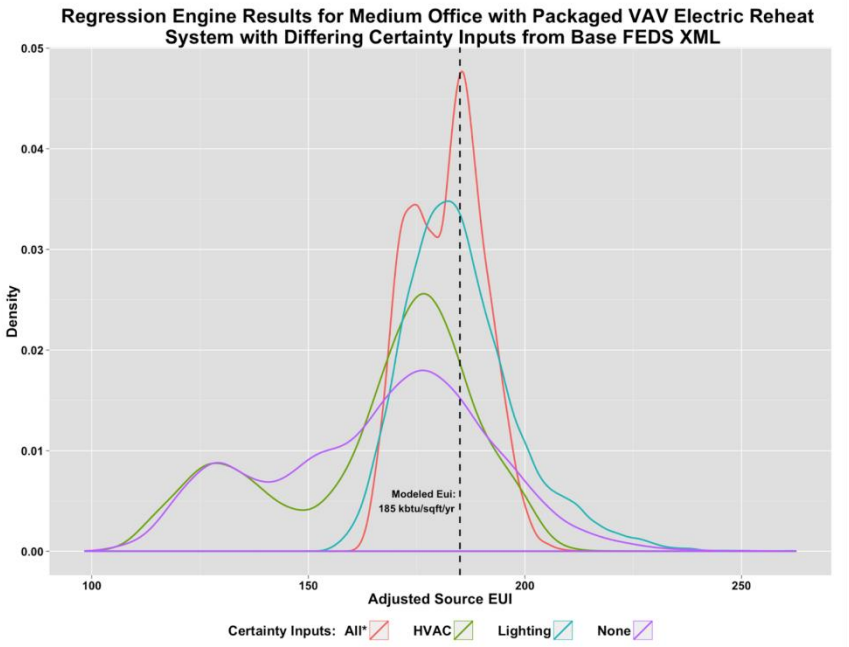




How Preview Works

Only 7 data points are required from users:

- Building Address,
- Year of Construction,
- Use Type,
- Gross Floor Area,
- No of Floors,
- Orientation,
- Retrofit Years (if applicable)



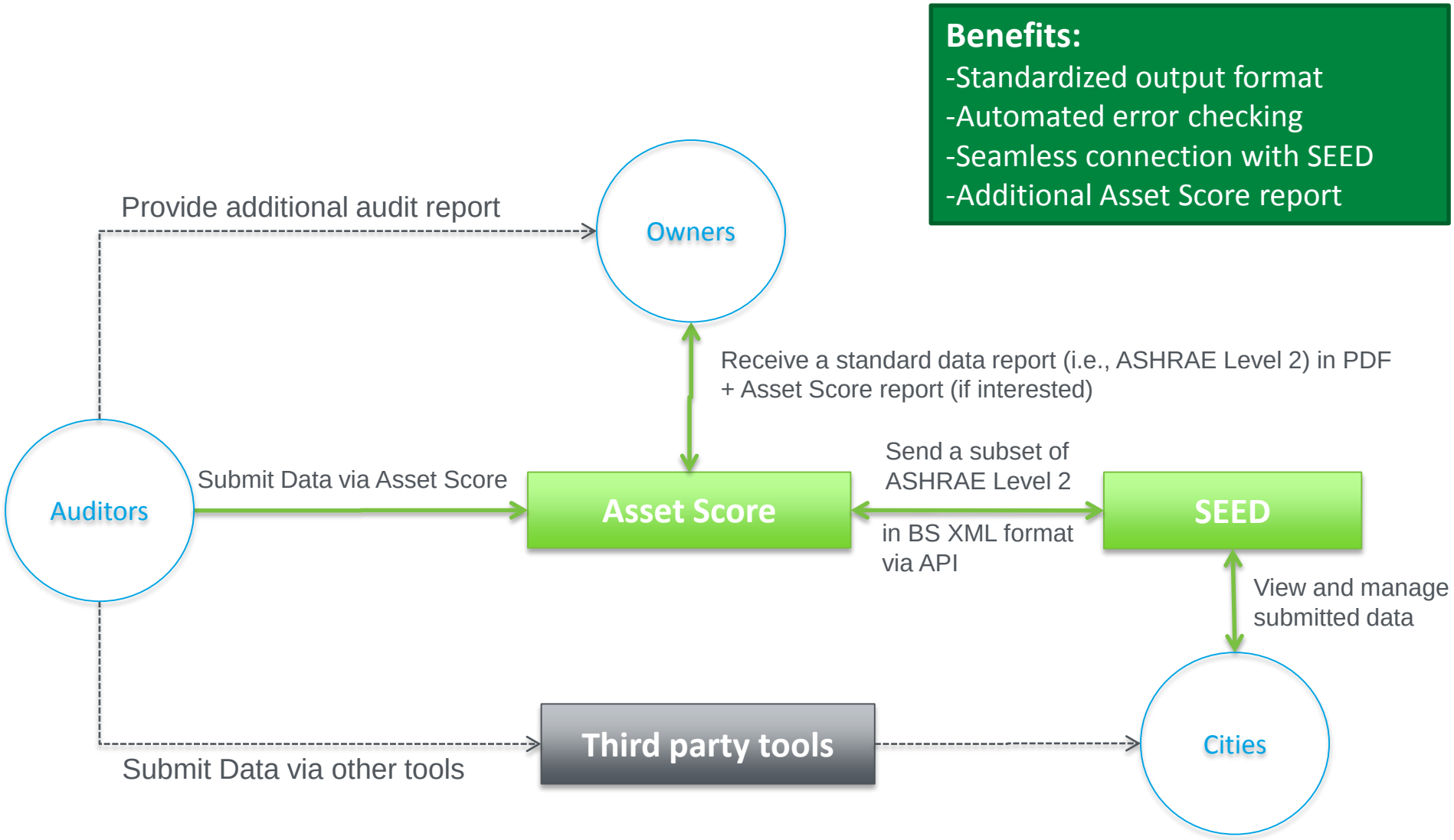
Match the user inputs to the corresponding prototype buildings and display defaults.

Allow users to modify the defaults if more information is known.

Run the data model (regression analysis) and calculate the mean, minimum, and maximum EUIs.

Post-process and Display the score range.

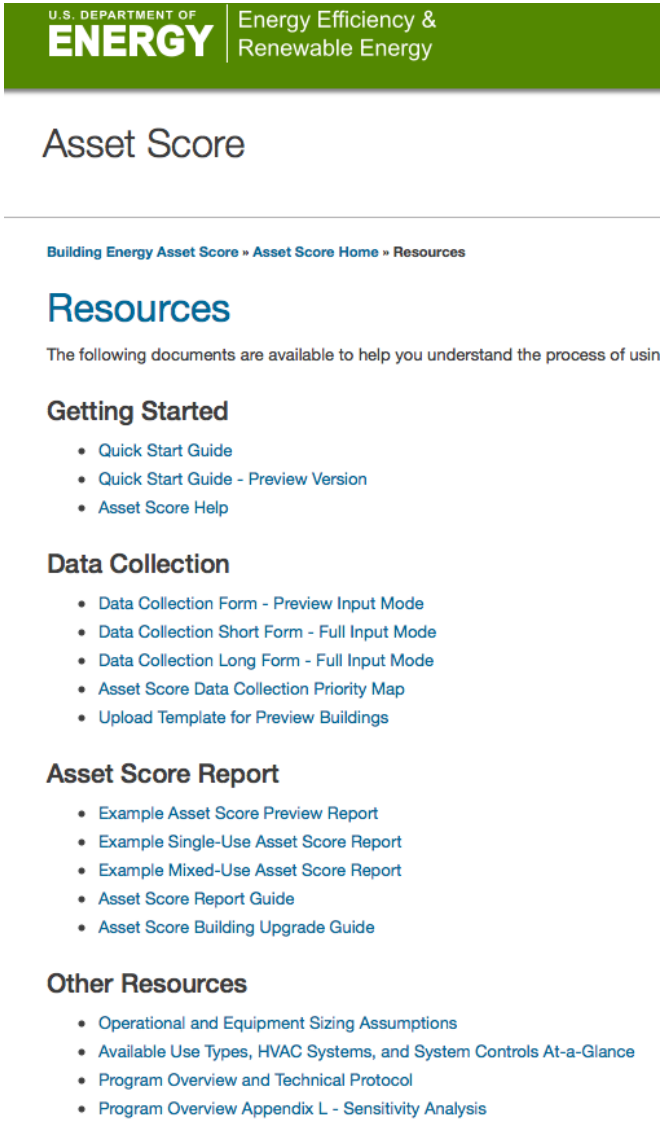
Reporting Platform



Progress and Accomplishments

Accomplishments:

- Developed Asset Score Preview including batch analysis capability.
- Allow Open Studio (.osm) model download.
- Added new capability to model plenums, parking garage, skylights, cool roofs, energy recovery ventilation (ERV), dedicated outdoor air system (DOAS), minimum air flow fraction, elevators, variable frequency drive for constant volume supply fan, and multiple fuel type for reheat.
- Added new energy efficiency measures of cool roofs, occupancy sensors, top-lighting controls, ERV, fan control and minimum air flow fraction for multiple zone distribution air handling units.
- Revised to 10-point scales and fine-tuned the scales.
- Updated baseline ranges for envelope, heating, and cooling systems in the 'Structures and Systems' section.
- Added input data validations in API.
- Updated user support materials, including Asset Score Building Upgrade Guide, Help page, and Technical Protocol, Data Collection Forms, and Asset Score report.



Progress and Accomplishments

Market Impact and Recognition:
21 organizations committed to use the Asset Score on 10 buildings in 2016 and work with DOE to produce a case studies to highlight best practices and lessons learned:

- AECOM
- Arup
- Association of Energy Engineers
- CH2M Hill
- City of Milwaukee, WI
- DNV GL
- FS Energy
- Ingersoll Rand
- JBG Companies
- Liberty Property Trust
- Marriott International
- Marx Okubo
- National Oceanic and Atmospheric Administration
- Performance Systems Development
- Skidmore, Owings & Merrill
- State of Missouri
- State of Rhode Island
- Steven Winter Associates
- Transwestern
- U.S. General Services Administration
- YR&G

825 Buildings scored

83M Square feet

30 States

155M Square feet in process

Asset Score was recognized in the White House event on Jan 28, 2016.
https://www.whitehouse.gov/the-press-office/2016/01/29/fact-sheet-cities-utilities-and-businesses-commit-unlocking-access

Project Integration and Collaboration

Project Integration:

- Reached out to 200+ entities
- Maintain communications with 50+ key stakeholders
- A national network of DOE, leading companies, federal agencies, and state and local governments has been formed to expand the tool's use and guide its future development

Subcontractors and Collaborators:

- NREL provide Open Studio technical support
- PSD provide Help Desk user support
- CBEI provide regional user outreach and develop training curriculum

Communications:

- GreenBuild 2015
- ACEEE Summer Study 2016
- Public webinar to release Preview
- Numerous 1:1 webinars with interested stakeholder groups
- Invited presentations and trainings

Next Steps and Future Plans

Next Steps and Future Plans:

- Develop mobile-friendly user interface to support onsite data collection.
- Expand building use types to include food service, food sales, hospitals, data centers, laboratories.
- Integrate onsite renewables.
- Enhance API and link to DOE's Standard Energy Efficiency Data (SEED) Platform, Buildings Performance Database (BPD), and other third-party tools.
- Support more advanced heating and cooling systems and controls.
- Pilot test Reporting Platform with cities.
- Develop assessor qualifications and associated quality assurance protocols.
- Develop sustainable user support and training model.

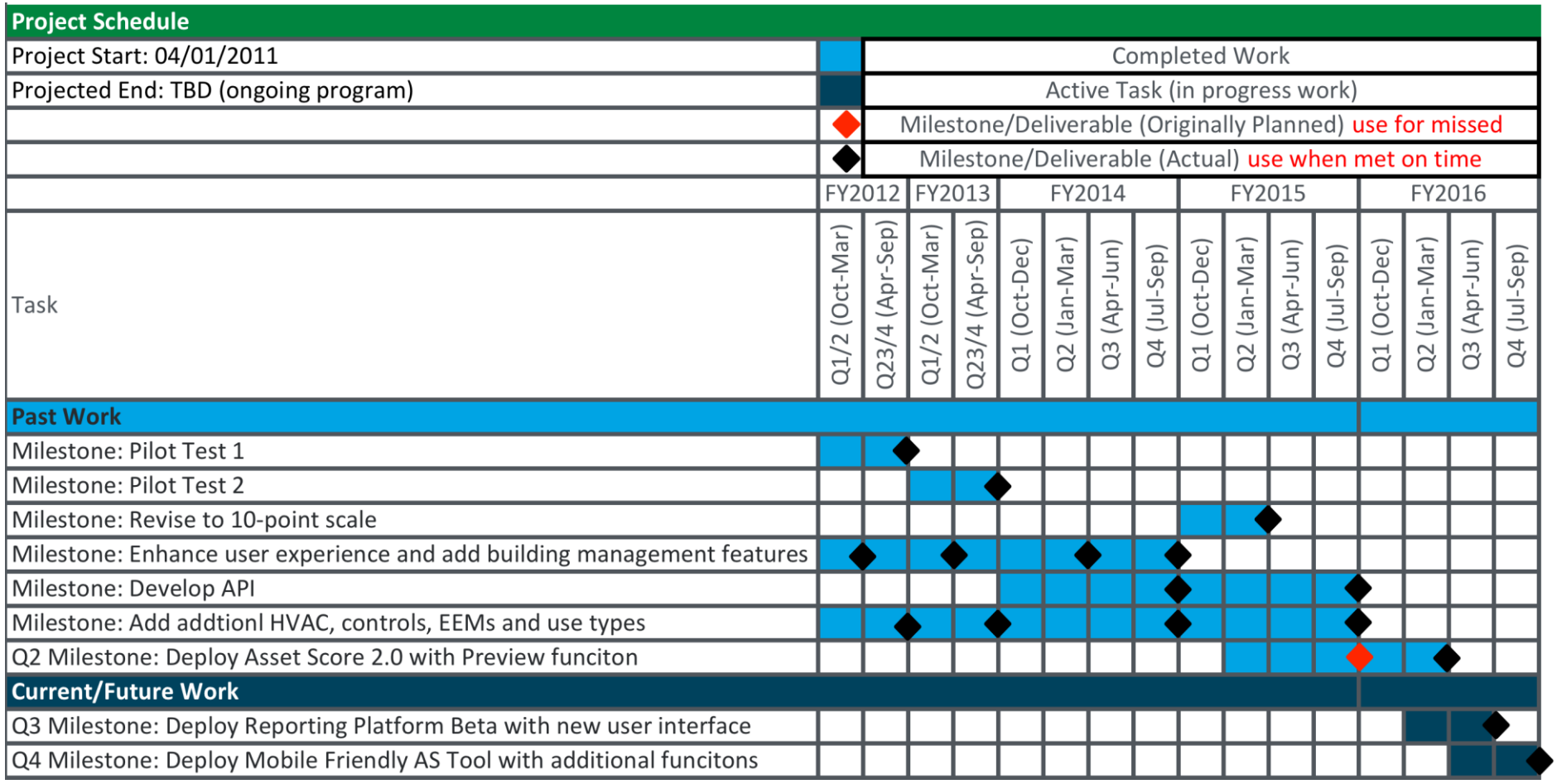
REFERENCE SLIDES

Project Budget

Cost to Date: $7,263,000
Additional Funding: none

Budget History					
April 2011 – FY 2015 (past)		FY 2016 (current)		FY 2017 – TBD (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
$5,263,000	$0	$2,000,000	$0	TBD	$0

Project Plan and Schedule



Value Propositions

Building owners:
- Communicate the underlying energy efficiency of your buildings to tenants and investors
- Demonstrate national sustainability leadership and corporate social responsibility
- Ensure the market recognizes your energy efficiency investments
- Guide energy-related investments and reduce operating expenses in a building or across a building portfolio

Real estate managers:
- Strengthen your sustainability service offerings for building ownership clients
- Provide added value to clients by understanding their asset portfolios and opportunities for energy efficiency improvement
- Support building owners in communicating their sustainability leadership to the marketplace
- Demonstrate national sustainability leadership and corporate social responsibility

Architects
- Guide energy-efficient design considerations with a no-cost, standardized tool
- Strengthen your sustainability-related platform for clients
- Demonstrate national sustainability leadership and corporate social responsibility
- Collect energy-related metrics across projects and report metrics to national programs

Energy services companies, engineers and consultants:
- Strengthen your energy/sustainability service offerings for clients
- Enhance business development activities and create opportunities
- Help building owners communicate their sustainability leadership to the marketplace
- Integrate your data seamlessly with the Asset Score through our API

State and local governments:
- Strengthen government transparency by reporting building energy information to citizens
- Collect building energy-related metrics that inform the creation of local energy goals and milestones
- Demonstrate local clean energy and sustainability leadership and communicate progress
- Guide energy-related investments and reduce operating expenses across your building portfolio

Utilities and utility program administrators:
- Quickly and cost-effectively identify new customers for rebate and incentive programs
- Enhance customer service by providing Asset Score evaluations for customers
- Demonstrate commitment to clean energy and corporate social responsibility
- Quantify energy efficiency results to regulators and other parties